Seventh Netherlands National Communication under the United Nations Framework Convention on Climate Change

Ministry of Economic Affairs and Climate Policy

CONTENTS

1 EXECUTIVE SUMMARY

Introduction

This report presents the Seventh National Communication from the Netherlands, as required under the Climate Change Convention as well as under the Kyoto Protocol. It describes the information required by the guidelines, including the supplementary information under Article 7.2 of the Kyoto Protocol. The report gives an overview of all required elements, but focuses in more detail on the developments since the Sixth National Communication. The National Communication has been written parallel to the Biennial Report which is also required under the Climate Change Convention. Both reports provide a full coverage of all required information and therefore can be read independently of one another.

National Circumstances

The Netherlands is a constitutional monarchy. The legislative process is realised in a combined effort by the government and Parliament. The Ministry of Infrastructure and Water Management (IenW; previously: Ministry of Infrastructure and the Environment (I&M)) is responsible for the environmental legislation and policy development. With the arrival of a new coalition government in October 2017 the responsibility for climate policy shifted to the Ministry of Economic Affairs and Climate Policy (EZK; previously: Ministry of Economic Affairs (EZ)). Other Ministries keep their responsibility for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g. the Ministry of Infrastructure and Watermanagement is responsible for climate adaptation).

The Netherlands is a densely populated country. In 2017, the population amounted to 17.1 million people, with approximately 507 persons per km^2. A further important demographic factor influencing the pressure on the environment is a decrease in the number of persons per household to 2.2 in 2017.

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 highest point is 321 metres above sea level, at the border with Belgium and Germany, and the lowest point is 7 metres below sea level. The surface area of the land, plus inland and coastal waters, amounts to 41,543 km^2. The land surface covers 33,680 km^2, of which 54% is used as agricultural land. While the use of land for agricultural is decreasing, land use for settlements and infrastructure is increasing, on the other hand. Forests make up roughly 10% of the land use.

The Netherlands is located in the so-called ’temperate zone’. The 30-year annual average temperature in the centre of the country is 10°C, while the mean annual average at 52^oN is close to 4°C. An increase of around one degree has been measured in the Netherlands over the last 100 years, with the three warmest summers of the last 300 years in 2006, 2007 and 2014.

The Gross Domestic Product (GDP) of the Netherlands, in 2016, was € 672 billion (using 2010 prices). The Netherlands ranks relatively high on the list of agricultural exporters. Transportation has traditionally been an important activity due to the country’s favourable location for transporting goods from the harbours to the EU inland destinations. Rotterdam's ports are among the largest in the world. The ports function as a 'mainport' (hub) for transporting all kind of goods to many countries throughout Europe.

Agriculture in the Netherlands focuses on cattle breeding, crop production and horticulture; of which greenhouse horticulture is the most important subsector. The amount of horticulture in total agricultural production is increasing over time. The amount of fuel consumed by the greenhouse

horticultural sector is comparable to fuel consumption in the commercial and public service sector (taking cogeneration into account).

Another characteristic of the Netherlands is the availability of large domestic reserves of natural gas; this is one of the factors contributing to a relatively large chemical industry (using natural gas as chemical feedstock). The production of natural gas was reduced in recent years as a result of earthquakes in the Groningen area (in the north of the Netherlands), where the – by far- largest gas field in the Netherlands is located. The percentage of natural gas in the total end-use for energy decreased since the early 90s from 50% to about 40% in 2015, which is still relatively high.
The share of renewable energy in total Dutch energy consumption has increased from 1.1 % in 2001 to 6.0 percent in 2016.

Greenhouse gas (GHG) emissions and trends

In 2015, the total GHG emissions (including indirect CO_2 emissions, but excluding emissions from land use, land-use change and forestry (LULUCF)) in the Netherlands amounted to 195.2 Tg CO_2 eq. This figure is approximately 12.5% below the emissions in the base year of 1990 (223.1 Tg CO_2 eq).

Figure 1.1 shows the trends and contributions of the different gases in relation to the aggregated national emissions of greenhouse gases. In the period 1990–2015, emissions of carbon dioxide (CO_2) increased by 1.5% (excluding LULUCF). Emissions of non-CO_2 GHGs, i.e. methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (F-gases), decreased by 41%, 53% and 74% respectively. Emissions of LULUCF-related sources increased by about 10% in the period 1990–2015. The total amount of GHG emissions in the Netherlands for the year 2015 (including LULUCF) was 202.0 Tg CO_2 eq.

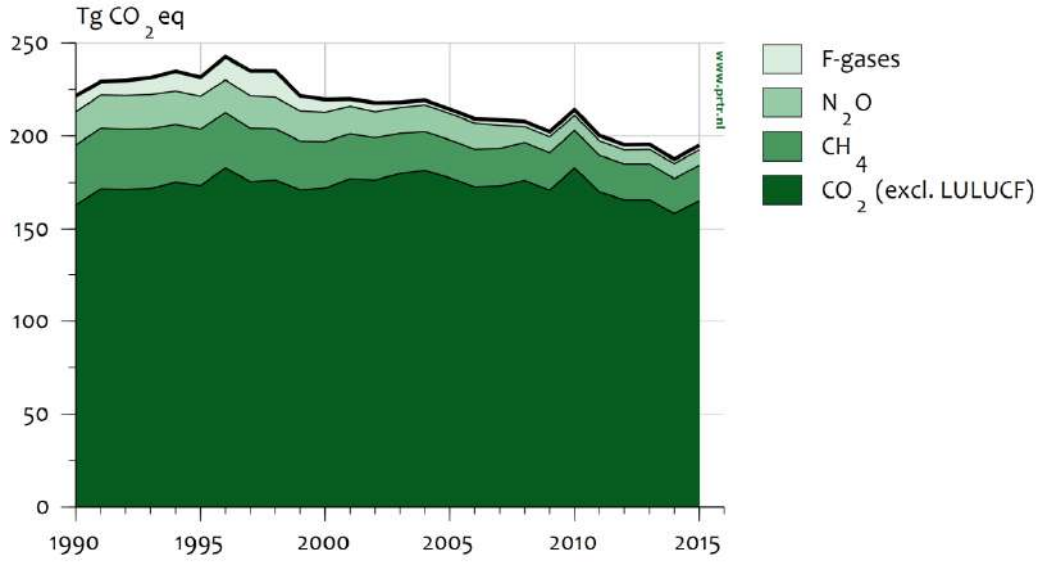


Figure 1.1 Greenhouse gases: trends and emission levels (excl. LULUCF), 1990–2015.

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, the Netherlands has in place a National System for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. The Netherlands established its National System in 2005. During the initial review, it was

found to comply with all the necessary requirements. Since then the system as such has remained unchanged, with the exception of an organisational change that came into effect as of January 1st 2010.

The Ministry of Economic Affairs and Climate Policy is the coordinating Ministry in the Netherlands for Climate Change Policy. The Netherlands Enterprise Agency (RVO.nl) coordinated the establishment of the National System and was subsequently also assigned the role of 'single national entity' (NIE).

The Netherlands maintains its National Registry in a consolidated manner in the Central European Emissions Trading Registry (EU Registry) with all the Parties that are also members of the European Union. The Registry is maintained by the Dutch Emissions Authority (NEa).

Policies and Measures (PAMs)

The scope of the policies and measures (PAMs) is limited to domestic and EU policies and measures implemented since 1990 or planned in the Netherlands and includes PAMs that have had, or are expected to have, a significant impact on greenhouse gas emissions in the Netherlands, even if the primary objective of the policy is (or was) not directly related to climate change. The policies and measures are described by sector and by greenhouse gas, in addition to cross-sectoral policies and measures.
The most important PAMs are mentioned below:

Agreement on Energy for Sustainable Growth (Energy agreement)
In 2013, the Dutch national government concluded a cross-sectoral agreement with more than 40 stakeholders, including energy companies, NGOs and regional and local governments. This Agreement on Energy for Sustainable Growth marks a significant step in the transition towards a sustainable energy system in the Netherlands. Signatories to the Agreement share responsibility and commitment to achieve the following overarching objectives:

- An average energy efficiency improvement of 1.5% per year (adding up to a reduction of 100 PJ by 2020)
- A 14% share of renewable energy in the Netherlands' total consumption of energy by 2020 and 16% by 2023
- Creation of at least 15,000 additional jobs by 2020.

This agreement includes some 160 economy-wide actions for the participating parties to implement this commitment, including actions by the national government. During its implementation, additional actions were agreed in 2015 and 2016 in order to attain the 2020 targets for energy efficiency and renewable energy.

SDE+ (Stimulation of Sustainable Energy Production)
Renewable energy production is stimulated with the SDE+ incentive scheme. Producers receive financial compensation for the renewable energy they generate. Production of renewable energy is not always profitable because the cost price of renewable energy is in most cases still higher than that of energy derived from fossil fuels. SDE+ compensates producers for the unprofitable part of the cost price for a fixed number of years. Separate regulations and subsidy programmes have been implemented to develop large-scale offshore windfarms.

Long-Term Agreements on Energy Efficiency (LTA3 and LEE)
The Long-Term Agreements LTA3 and LEE are voluntary agreements that incentivise energy savings in industry. They are concluded between the national government, the trade associations and the participating companies. These Long-Term Agreements are enforced using environmental permits: companies which do not participate are required (in their permits) to implement all energy-saving measures with a pay-back period of less than five years. Participants in the LTA are required to draw

up an Energy Efficiency Plan (EEP) every four years for the next four years. They also have to submit annual monitoring reports on projects that have actually been implemented and their results.

Agrocovenant

The Agro covenantis a Public-Private Partnership signed in 2008 dealing with greenhouse gas emissions, biomass and wind power. With respect to the first, the aim is to reduce CO_2 emissions in 2020 by at least 3.5 Mton and those of non-CO_2 greenhouse gases like methane and nitrous oxide by 4.0 to 6.0 Mton (in CO_2-equivalents) compared to 1990. The targets for the year 2020 are production of 200 PJ per year of renewable energy from biomass and a total amount of wind energy on land of 3.5 billion kWh per year, equivalent to approximately 12 PJ.

EU Emissions Trading System (ETS)

As prescribed by Directive 2003/87/EC, a trading system for CO_2 emissions started in the EU on 1 January 2005, focusing on CO_2 emissions from large industrial emitters. It is a cap-and-trade system, where participants are assigned a set amount of allowances up front and are required to surrender annual allowances equal to their actual emissions. In 2013, the EU ETS entered its third phase, running up to 2020. The ETS now also includes more sectors (i.e. domestic and intra-EU aviation) and gases (nitrous oxide, PFCs). Its allowances will be reduced by 21% between 2005 and 2020 in order to reduce the total emissions.

European directives related to energy efficiency

Several EU directives are important to improve energy efficiency: the Energy Performance of Buildings Directive (EPBD), which sets minimum energy performance standards for new buildings; the§ Energy Efficiency Directive (EED), which sets, among other things, binding targets for final energy consumption and improves market conditions for energy efficiency; the CO_2 emission performance standards, which improves the fuel efficiency of passenger cars and light-duty vehicles; and finally, the Ecodesign Directive. The Ecodesign Directive provides consistent EU-wide rules for improving the environmental performance of energy-using or energy-related products, such as household appliances. The Directive sets out minimum mandatory requirements for the energy efficiency of these products.

Biofuels

European Directive 2009/28/EC on renewable energy has been implemented into Dutch legislation. This Directive states that Member States should ensure that a minimum of 10% of all energy consumption in transport must come from renewable sources in 2020. In practice, this target is mainly fulfilled with biofuels.

Developments in long-term policy planning

In January 2016, the Ministry of Economic Affairs and Climate Policy published its Energy Report, which sets out the long-term ambition of the Dutch government to make the transition towards a low-carbon energy system by 2050. The incumbent government, which took office in October 2017, intends to continue this transition and has set an ambitious target to reduce the Netherlands' domestic greenhouse gas emissions by 49 per cent by 2030. In order to realise that ambition, a new Climate and Energy Agreement will be concluded, as a follow-up of the 2013 Energy Agreement that will end in 2020 (2023 for renewable energy).

Projections and the total effects of policies and measures

The projections are based on the National Energy Outlook 2017 (NEV 2017), which describes the most likely developments based on the available information about energy prices, markets, technology and policies. Compared with the National Energy Outlook 2015, which was used in the previous Biennial Report, the NEV 2017 has incorporated new insights into economic and demographic developments, sectoral developments, fossil fuel prices and CO_2 prices and policies. New insights into

exogenous modelling assumptions up to May 2017 have been taken into account, using official national statistics from Statistics Netherlands (CBS) and the Pollutant Release and Transfer Register of the National Institute for Public Health and the Environment (RIVM) where available. This approach means that the base year for most modelling parameters is 2015, or 2016 where possible.

The modelling distinguishes two different policy variants, which are based on the underlying principles of Dutch and European policy: the variant 'With Existing Measures' (WEM) and the variant 'With Additional Measures' (WAM). Both variants contain measures made binding by market participants, public organisations and other government bodies on or before that date. A variant 'Without Measures' is not included in the modelling.

Although CO_2 emissions increased between 2015 and 2016, the structural trend for the future is expected to be a decrease of CO_2 emissions. This is the result of increasing efforts towards the decarbonisation of the energy system. In the policy variants with existing measures and with additional measures, greenhouse gas emissions are expected to fall to 171 and 170 Mton of CO_2 equivalents by 2020, respectively. This figure represents a decrease of almost 23% compared to 1990 levels.

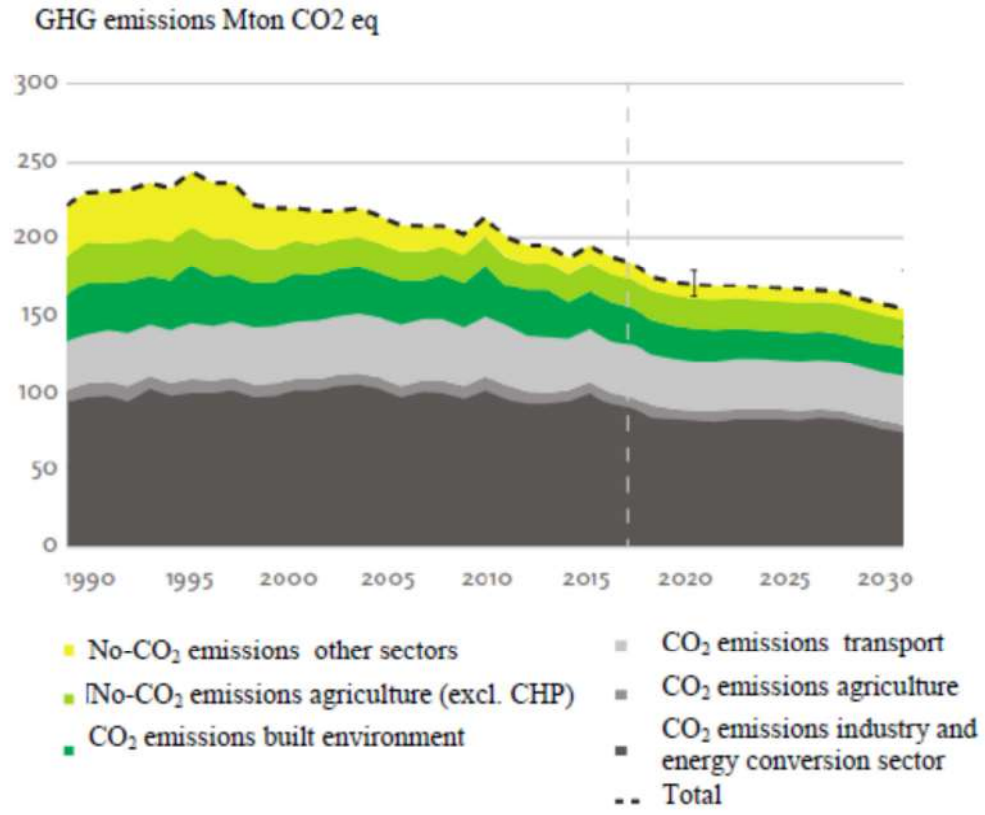


Figure 1.2 Historic and projected emissions of greenhouse gases by sector,1990–2030.

Vulnerability assessment, climate change impact and adaptation measures

The climate in the Netherlands is expected to undergo significant changes over the coming decades. The most pressing consequences are increasing heat stress, increasing flood risks due to both more extreme river discharge and sea level rise, more frequent failure of vital infrastructure like electricity and IT, more frequent damage to crops or production resources, increased health burden and productivity loss, and changes in biodiversity. At the same time, the Netherlands is subsiding. These conditions, in a country such as the Netherlands –situated in a low-lying delta area, with four large rivers and with a high population density– give rise to climate change impacts which require risk assessments, and decisions on timely and smart interventions.

The Dutch Delta Programme, that started in 2010, has been a recent vehicle for climate change adaptation planning in the Netherlands, focussing on flood protection, fresh water availability and spatial adaptation.. The Netherlands Court of Audit in 2012 advised to broaden the scope beyond the water domain, which resulted in the National Climate Adaptation Strategy 'Adapting with ambition' (2016). The strategy broadened the scope of adaptation planning to include the effects of climate change within nine sectors: water and spatial management; nature; agriculture, horticulture and fisheries; health and welfare; recreation and tourism; infrastructure (road, rail, water and aviation); energy; IT and telecommunications; public safety and security.

The Netherlands Environmental Assessment Agency has developed a methodology to define the urgency of adaptation measures by looking at the degree of uncertainty, the probability and impact of climate effects, and the adaptive capacity of the system at hand and the lifetime of the necessary investments. The resulting assessment has led to identification of six urgent climate effects as the focus in the National Climate Adaptation Strategy; problems associated with heat stress, failure of vital systems, crop failures and other problems in the agricultural sector, shifting climate zones influencing flora and fauna, increase in infectious diseases and allergic (respiratory) conditions, and cumulative effects of system failure.

The National Climate Adaptation Strategy is the precursor to a Climate Adaptation Implementation Programme which is currently being developed. Its goal is mainstreaming climate adaptation in all policies, in all policy implementation and in all – hereto relevant – activities of civil society, citizens and companies, targeting the abovementioned nine sectors. Stakeholders are gathered around the issues, to discuss and analyse the relevant elements, to define which is the role and responsibility of each of the stakeholders and to formulate an action plan, in which each stakeholder assumes certain responsibilities.

Provision of financial, technological and capacity-building support to developing countries

Dutch support for climate action in developing countries is an integral part of its development cooperation and is financed from its budget for foreign trade and development cooperation. The Netherlands is committed to scaling up its support for mitigation and adaptation activities in developing countries and has continued to realise a year-on-year increase in its climate finance after having delivered on its commitment of Fast-Start Finance during 2010–2012. While public climate finance amounted to €286 million in 2013 and €395 million in 2014, it increased to €420 million in 2015 and €472 million in 2016. In addition, public finance from the Netherlands in 2015 mobilised €73 million of private finance for climate-relevant activities in developing countries. In 2016, the mobilised private finance amounted to €171 million.

Adaptation expenditure amounted to €116 million in 2015 and represented 28% of Dutch public climate finance. In 2016, adaptation expenditure rose to €156 million, which amounted to 33% of the total sum. This increase was due to a better integration of climate change adaptation in development activities. The share of mitigation expenditure was stable in absolute terms at €31 million, which amounted to 7% of the total amount in 2015 and 2016. Most public climate finance supported cross-cutting activities (65% in 2015, 60% in 2016), due to substantial contributions to activities through multilateral and other channels that support both adaptation and mitigation.

As Dutch support for climate action is part of its development cooperation, both our bilateral and our multilateral climate finance are characterised by a strong focus on poverty. Poorer people and communities are typically affected the most by climate change, not only because they are often the most exposed, but also because they have the fewest resources to cope and adapt. To support mitigation, we focus on providing access to renewable energy and on halting deforestation; to support adaptation, we focus on climate-smart agriculture, integrated water resource management and the provision of climate-resilient water, sanitation and hygiene (WASH) services. Disaster risk reduction is an integral part of our programmes for integrated water resource management, while it also receives support through the Partners for Resilience alliance. Gender is an important cross-cutting issue, as climate action is most effective when it builds on the capacities of both genders and addresses the needs as well as the vulnerabilities of both.

The information on activities, actions and programmes undertaken to meet commitments under Article 10 is described in various parts of this National Communication.

Research and systematic observation

Research activities in the Netherlands cover the themes climate system, impact and policy support, and implementation studies. It is characterised by: intensive participation in international and European programmes while the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW) coordinate Dutch contributions to the international research arena.

The Netherlands' research on climate change is well embedded in, acknowledged by and co-steered within three large international scientific programmes in the field of global change research: the International Geosphere Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), and the International Human Dimensions Project (IHDP). The Royal Netherlands Meteorological Institute (KNMI) participates in IGBP and (through its WMO membership) in WCRP.
Extensive support is also given to the work of the Intergovernmental Panel on Climate Change (IPCC). Many of the leading Dutch institutions participate in research projects under the EU's Horizon 2020 Research and Innovation programme and the Copernicus Climate Change Service (C3S). The synergy and cooperation between European projects and the national research programmes reinforce the crucial international dimension to Dutch research activities

National research programmes add to, and support, international research programmes. The national research activities in the Netherlands include a number of research programmes through NWO, research programmes supported by various ministries as well as knowledge networks and programmes. Research within the NWO theme Water and Climate generates knowledge that is important for the top sector Water. This top sector includes the three clusters of Water Technology, Delta Technology, and Maritime Technology / Research. R&D related to energy transition is to a large extent also implemented through the top sector in the top sector energy, an interdepartmental programme.

Results from the international, European and national research programmes are made available to the international community through reports, publications and the Internet. These results can often be obtained free of charge or at low cost.

With regard to systematic observation, the Netherlands actively participates in the various fields of climate-related monitoring, both nationally and within European and global programmes, including atmospheric climate observation systems, including those measuring atmospheric constituents; ocean climate observation systems; and terrestrial climate observation systems.
Systematic observations of many climate parameters are carried out in a network of over 40 observation stations and are enhanced by special observational programmes carried out at the Cesar Observatory site. Three universities and five major research institutes collaborate in Cesar, and on this site a number of activities are ongoing, including training of young scientists. It is also one of the selected certified stations for the GCOS Reference Upper-Air Network (GRUAN).
Additional projects are in place dealing with ground-based observation, ocean-base observation as well as satellite-based observation.

Education, training and public awareness

There is a high-level mandate for education, training and public awareness. The Dutch climate envoy is responsible for following up on this matter and works closely with the Ministries of Education, Infrastructure and Water Management and Foreign Affairs, as well as with NGOs and in particular youths. In summary, the general policy to promote education, training and public awareness is aimed at: integrating sustainability in the curricula of primary and secondary education; fostering the network of initiatives, organisations and educational institutions that work on education for sustainable development; funding organisations which contribute to increasing awareness of climate; organising events to build momentum and create partnerships; and increase awareness of adaptation.

In 2014, youth organisations joined forces and urged for an increase in education for sustainable development . Together with multinational corporations, teacher unions and research institutes, the youth organisations managed to sign an agreement with a majority of Parliament to take the next step in education for sustainable development. As a follow-up a broad-based collaboration project, "Learning for Tomorrow" was launched in 2016 by a number of existing youth networks together with existing education networks, which will arrange financial, knowledge and resource support through the programme "Learning for Tomorrow".

The intergovernmental programme "Duurzaam Door" (Continue Sustainably, established in 2004) stimulates learning processes for sustainable development. The target group comprises both youths and adults. This programme, funded by Netherlands Enterprise Agency (RVO.nl), finances different organisations that are active in education, training and public awareness. Together, these organisations form a platform to facilitate policy advice, knowledge and contacts between local governments, entrepreneurs, and education, research and civil organisations. Themes that play a central role are energy, water, biodiversity, natural resources and food. The programme also promotes and enhances the inclusion of climate change issues in school curricula and teacher training programmes.

Since 2011 the former Ministry of Infrastructure and the Environment coordinated a joint initiative bringing together representatives of local authorities and central in the *Local Climate Agenda* , together with nine climate ambassadors (representing the municipal, provincial and water authorities) and their working groups. Over 135 local and regional governments signed up for the agenda. In 2014 a number of points on the Local Climate Agenda have been improved and continued as the adaptive Local Climate Action Programme 2014–2020 with as key action increasing the involvement of community partners, developing a knowledge bank, and appointing a new team of Local Climate Ambassadors. An addition import them is stimulating the climate-neutral and climate-robust city/region.

In 2016 the first National Climate Change Summit "bring Paris home" was organised. About 1,700 participants from NGOs, businesses, local authorities and the government participated in this event. The target for this Summit was initiating, accelerating or linking as much climate action as possible. And resulted in 14 climate deals in various sectors with an estimated impact of approximately 17 Mt in reductions by 2030.

Additional to the governmental organisation NGOs play an important role in education, training and public awareness. In a large campaign known as HIER, 40 organisations (mostly NGOs) work together to counter the negative effects of climate change through activities such as coordinated consumer campaigns, raising awareness, joint communication efforts and political lobbying..

A number of actions are dealing with adaptation topic, of which several are related to water. The first campaign 'The Netherlands lives with Water' started already in 2003. The most recent one is The programme 'Our Water', launched in 2014 as also a tool was made available to provide people with information about the flood risk of their neighbourhood and their home.

With the activities and efforts in the field of education, training and public awareness, the Netherlands also implements the (amended) New Delhi work programme. The activities also include special activities for young people, as well as regional cooperation actions and activities aimed at international education, training and capacity building.

2 NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1 Government structure

The Kingdom of the Netherlands compromises four countries (see Figure 2.1): the Netherlands, Aruba, Curaçao, and Saint Maarten. Since 10 October 2010 the islands of Bonaire, Saba and Saint Eustatius have been special municipalities of the Netherlands. They are called the Caribbean Netherlands. Together with the countries Aruba, Curacao, and Saint Maarten they form the Caribbean part of the Kingdom. Reporting under the UNFCCC (Convention and KP) is restricted to the European part of the Kingdom, hereafter referred to as the Netherlands.

Figure 2.1 Kingdom of the Netherlands

The Netherlands is a constitutional monarchy. The legislative powers are vested in the national government, the 12 provinces and (as of 1 January 2018) the 380 municipalities (VNG, 2017). The Dutch Parliament, officially referred to as the States General of the Netherlands, comprises the Senate (*Eerste Kamer*; 75 members, elected by the provinces) and the House of Representatives (*Tweede Kamer*; 150 members, elected directly by the citizens).

The legislative process is realised in a combined effort by the Dutch 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, such as a Decree or Order in Council, or other binding agreements such as Long-Term Agreements. The regional governments, for example, are responsible for granting environmental licences and permits.

With the arrival of a new coalition government in 2017 a reorganisation of the Dutch government structure has been implemented:

After the merger of the Ministry of Agriculture, Nature and Food Quality and the Ministry of Economic Affairs under the name Ministry of Economic Affairs in 2010, once again there has been a separate Ministry of Agriculture, Nature and Food Quality from October 2017 onwards. In addition, the responsibility for climate policy shifted from the Ministry of Infrastructure and the Environment to the Ministry of Economic Affairs. The latter has been renamed the Ministry of Economic Affairs and Climate Policy (EZK). Other Ministries keep their responsibility for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g. the Ministry of Infrastructure and Watermanagement is responsible for climate adaptation).

Many parties are involved in the policymaking process, such as the 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, for example through participation in advisory councils.

2.2 Population profile

The 1990–2017 period saw a population increase in the Netherlands from 14.9 million to around 17.1 million inhabitants (Table 2.1). Annual growth fluctuates, but since 2000 it has been falling rapidly: growth was 0.8% in 1980, 1990 and 2000 but, since then, it has reduced to 0.5%, with the lowest value of 0.15% in 2006. For the coming years, a decrease in growth is expected; population growth could even drop to close to zero by 2045 (Figure 2.2).

			1950	1960	1970	1980	1990	2000	2015	2016	2017
Population	Total population	number	10,026,773	11,417,254	12,957,621	14,091,014	14,892,574	15,863,950	16,900,726	16,979,120	17,081,507
Private households	Total private households	x 1,000	2,535	3,171	3,986	5,006	6,061	6,801	7,665	7,721	7,794
	One-person households		245	387	679	1,085	1,813	2,272	2,868	2,906	2,961
	Multi-person households		2,290	2,784	3,307	3,921	4,249	4,529	4,797	4,814	4,833
	Average household size	number	4	4	3	3	2	2	2	2	2
Population growth	Total population growth	number	173,507	138,754	161,809	117,572	117,871	123,125	78,394	102,387	.
	Total population growth, rate	o/oo	17	12	13	8	8	8	5	6	.
Population density	Population density	number	309	352	384	415	439	468	502	504	507

Table 2.1 Key population figures (CBS, 2017a)[1]

[1] CBS, 2017a http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=37296eng&D1=0,52-55,57-58,68&D2=40-67&LA=EN&HDR=G1&STB=T&VW=T

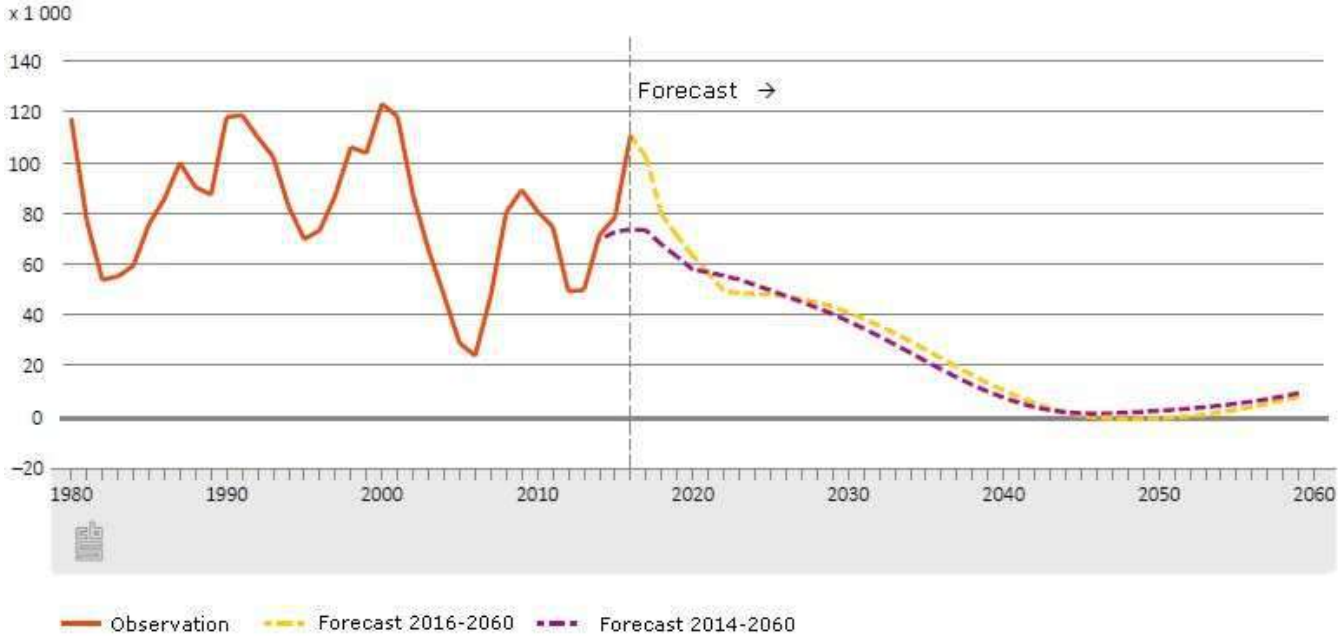


Figure 2.2 Population growth and forecast 1980–2060 (Source: Statistics Netherlands (CBS, 2016)

The Netherlands is a densely populated country. The population density increased between 1990 and 2017 from 439 to 507 persons per km^2. A further important demographic factor influencing the pressure on the environment is a decrease in the number of persons per household (from 2.5 in 1990, via 2.3 in 2000, to 2.2 in 2017). The number of households increased from 6.2 million in 1990 to 7.8 million in 2017, while the percentage of single-person households increased from 30% to 38% (CBS, 2017a). The strong increase in single-person households is illustrated in Figure 2.3. A consequence of this development is the need for more housing, and an increasing claim on land for new dwellings and infrastructure.

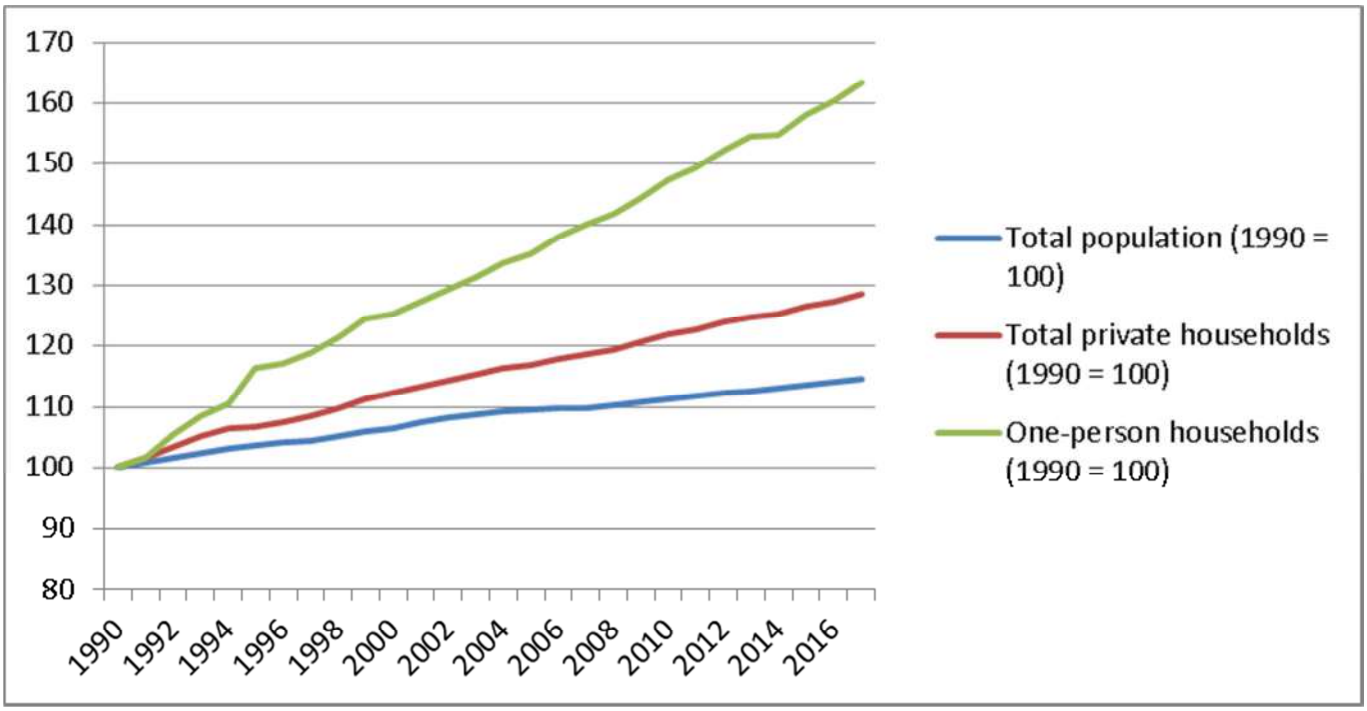


Figure 2.3 Development of population and number of households between 1990 and 2017 (Source: CBS, 2017a)

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 being below sea level (see Figure 2.4). 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 have been created with controlled water levels. The eastern part of the Netherlands includes Pleistocene ice-pushed ridges covered with wind-borne sand deposits. The southern part consists mainly of Meuse terraces with loess deposits or wind-borne sand deposits. The highest point is 321 metres above sea level, at the border with Belgium and Germany, while the lowest point is 7 metres below sea level. The surface area of the land, plus inland and coastal waters, amounted to 41,543 km^2 in 2017. The land surface covers 33,680 km^2 in total (CBS, 2017b[2])

Although agricultural land is decreasing, it is still the main land use; agricultural land comprises about 54% (2.3 million hectares (ha)) of the total land area. Forest land is 0.4 million ha and wetland around 0.8 million ha. The land use settlement increases over time: in 1990 settlement was 0.4 million ha and in 2012 0.6 million ha. The population density is highest in the "Randstad" (a cluster of cities in the western part of the country comprising Amsterdam, Rotterdam, The Hague and Utrecht, as well as the interspersed villages, towns and smaller cities).

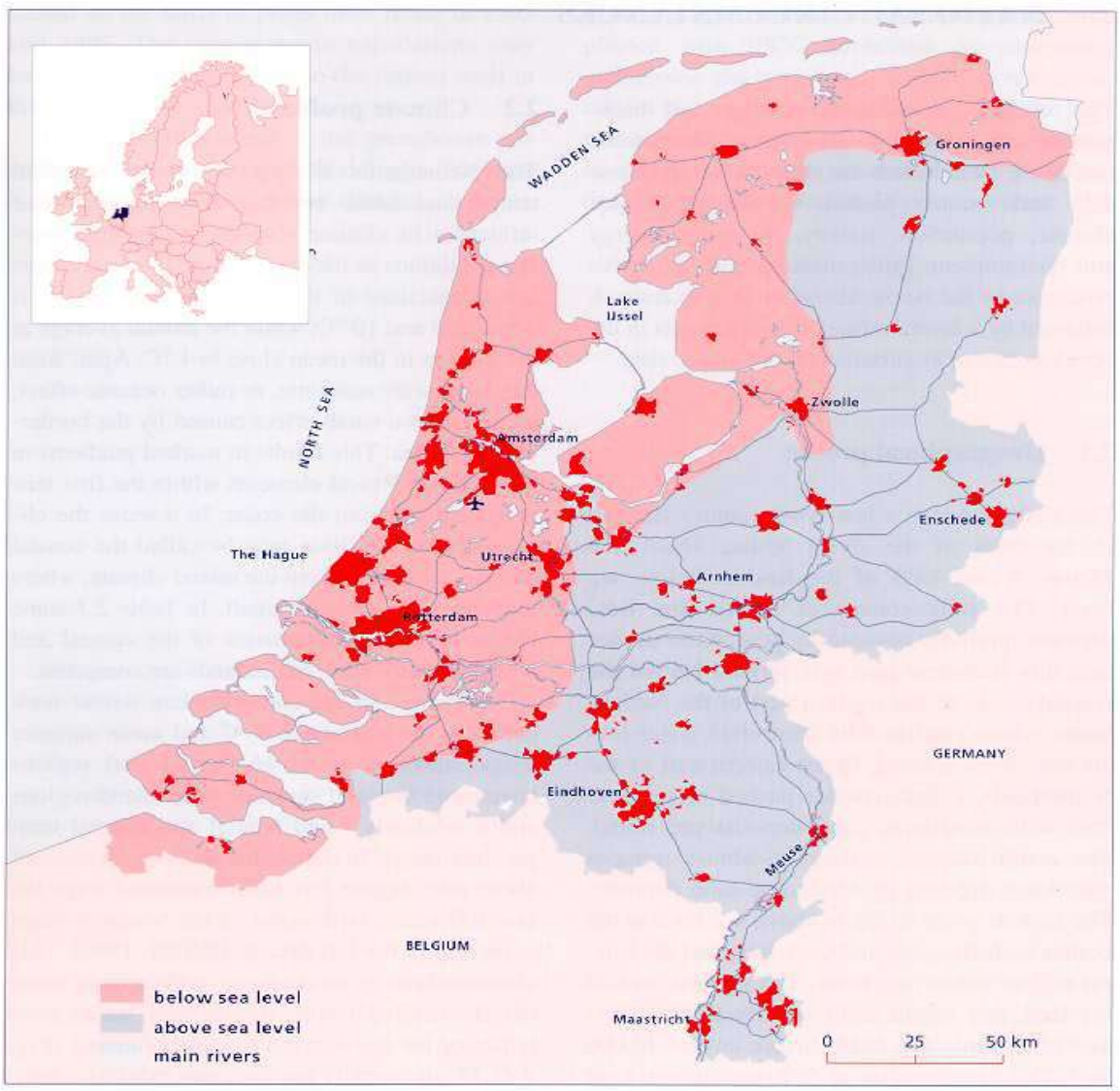


Figure 2.4 Key elements of the Netherlands' geographic profile

[2] CBS, 2017b Total surface of the Netherlands http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=37296eng&D1=0,52-55,57-58,68&D2=40-67&LA=EN&HDR=G1&STB=T&VW=T

2.4 Climate profile

The Netherlands is located in a so-called “temperate zone”. Due to strong maritime influences the climate is much milder than average conditions at the same latitude. The 30-year annual average temperature in the centre of the country is 10.0°C, while the mean annual average at 52°N is close to 4°C. Besides this larger scale maritime – or rather oceanic – effect, there is also a minor effect caused by the bordering North Sea. This results in marked gradients in most climatological elements within the first few dozen kilometres from the coast. Inland gradients are generally small. Table 2.2 compares some climatological characteristics of the coastal and inland climate of the Netherlands.

	De Kooy (coastal station)	Twente Airbase (inland)
Mean temperature (°C)		
- January / July	3.5 / 17.4	2.3 / 17.6
Mean daily temperature amplitude (°C)		
- January / July	4.3 / 6.5	5.3 / 10.8
Mean relative humidity (%)		
- January / July	88 / 80	88 / 76
Mean annual duration of sunshine (hr)	1,751	1,547
Mean annual wind speed at 10m h (m/s)	6	4
Mean precipitation (mm)		
- Annual	771	785
- Driest/wettest month	34 / 96	45 / 75

Table 2.2 Some climatological characteristics for De Kooy (coastal station) and Twente Air Base (around 150 km from the coast), based on observations for the period 1981–2010 (Source: Royal Netherlands Meteorological Institute (KNMI: *Koninklijk Nederlands Meteorologisch Instituut*))

Throughout the country, mean winter temperatures are about 3°C and mean summer temperatures are around 17°C. Coastal regions have more hours of sunshine than inland regions and a relatively small annual and diurnal temperature range. An increase of around 1°C has been measured in the Netherlands over the last 100 years, levelling off in the most recent decade (KNMI, 2011). The years 2006, 2007, and 2014 were the top three warmest years of the last 300 years,[3] with an average of 11.4°C; the 1981–2010 average being 10.1°C. This also translates into a drop in the annual number of so-called “heating degree-days” (HDD), which is an indicator of the demand for spatial heating (Figure 2.5). Mean monthly precipitation exhibits a rather strong annual cycle; the driest months are February, April and May; the wettest are October and November. The variation in mean annual precipitation deviates locally by no more than 16% from the national mean of 847 mm (KNMI, 2011).

[3] KNMI 2017, https://www.knmi.nl/kennis-en-datacentrum/uitleg/warmste-jaren

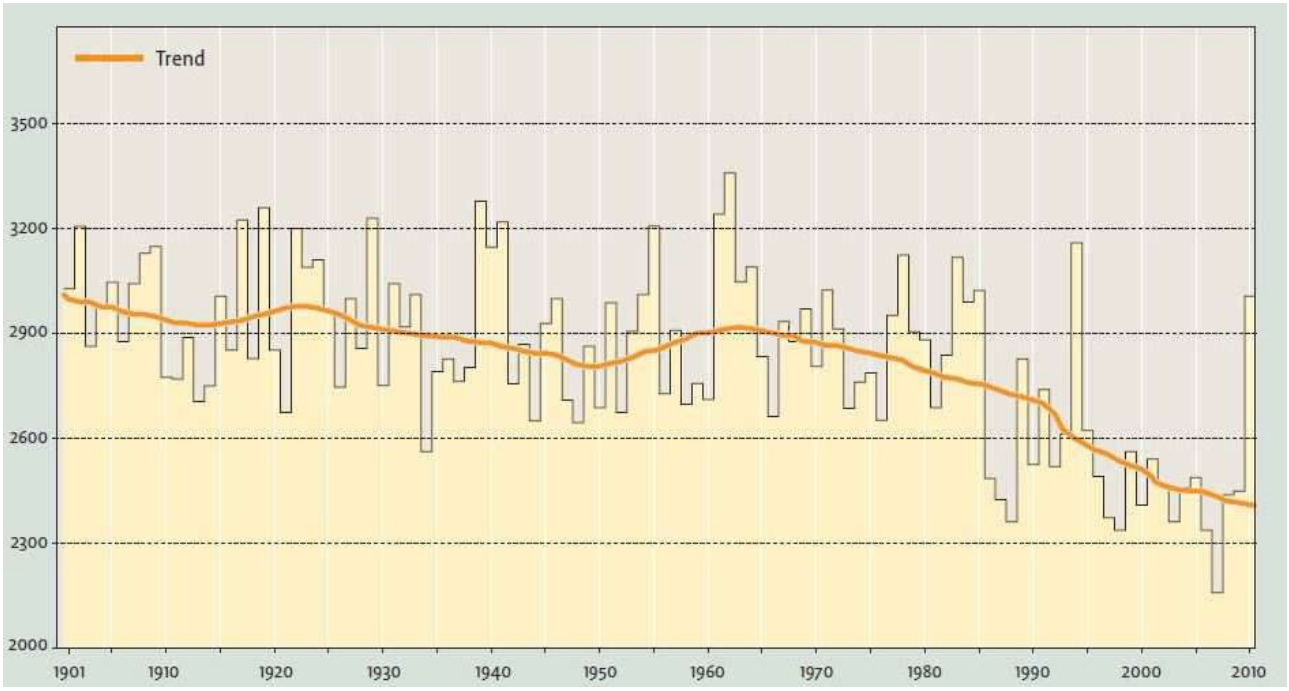


Figure 2.5 Development of the average surface temperature and the number of heating degree days (HDD in °C) in the Netherlands during the period 1901–2010 (Source: KNMI, 2011)

2.5 Economic profile

Development of GDP

The Gross Domestic Product (GDP) of the Netherlands was €400 billion in 1990 and €672 billion in 2016 (value at 2010 prices). Figure 2.6 shows a decline in the GDP in 2009, 2012 and 2013 as a result of the financial and economic crisis, followed by economic recovery in the past few years. The same trend can be seen in Figure 2.7, which shows the annual change of GDP compared to the previous year (2010 prices).

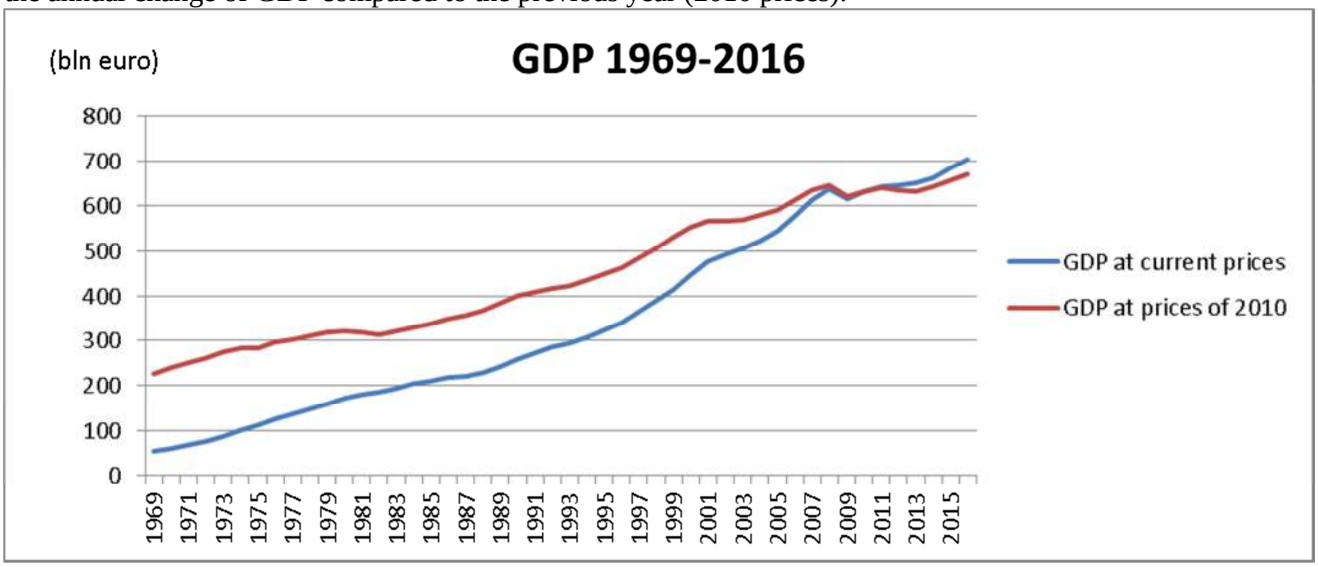


Figure 2.6 Gross Domestic Product 1969–2016 (CBS, 2017c [4])

[4] CBS, 2017c Approaches of domestic product (GDP); National Accounts
http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=82262eng&D1=21,43,65,87,97,107,117,127,142,157,172,187&D2=a&LA=EN&HDR=G1&STB=T&VW=T

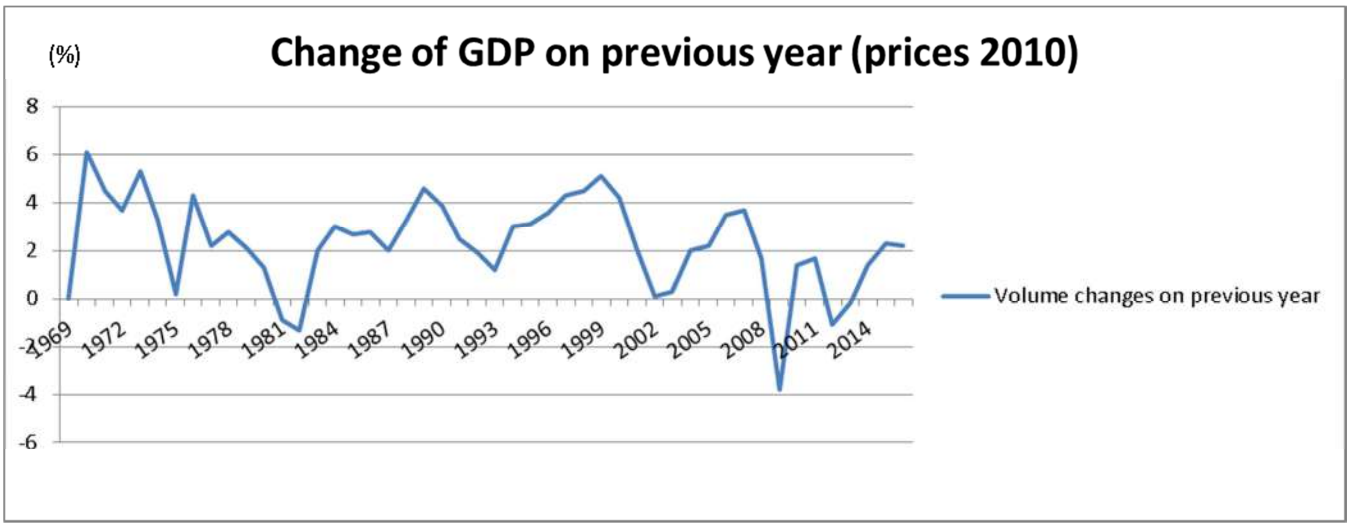


Figure 2.7 Change in GDP 1969–2016 (CBS, 2017c)

Import and export

The Netherlands has an extremely open economy. Many goods and services are imported and exported. This is due to the geographic location of the Netherlands, with its accessible ports and an extensive, highly developed and easily accessible hinterland. On balance, the Netherlands has been a net exporter for many years. Sectors which sell relatively large amounts of their production abroad include agriculture and industry.

Due to the economic crisis that started in 2008, the import and export value of goods plummeted in 2009. International trade gradually recovered after that and the import and export value of goods surged again. As of 2012, the import value has fluctuated around €375 billion; the export value around €425 billion.

The Netherlands imported €381 billion worth of goods in 2016. Machinery and transport equipment accounted for one-third of this. Mineral fuels and chemical products had a share of 14% each. The Dutch export value of goods amounted to €432 billion in 2016, of which nearly 30% was on account of machines and transport equipment. Chemical products attributed 18% to the export value; food and live animals nearly 14%. Goods produced in the Netherlands made the largest relative contribution to the export of food and live animals. In machines and transport equipment, the re-export value was highest. In 2016, the bulk of Dutch goods imports (54%) originated from the European Union (EU). Goods from Germany represented by far the highest import value, followed by goods from Belgium, China and the United States, although lagging far behind Germany by €30–35 billion (see Figure 2.8).

The highest value in Dutch goods exports remains within the European Union: almost three-quarters in 2016. The single most important destination is Germany (nearly €100 billion). Other EU countries occupy second to fifth place among the top ten destinations. The value of exports to these individual countries is however significantly lower than of exports to Germany. In sixth place is the United States as the first non-EU destination (see Figure 2.9) (CBS, 2017d[5]).

[5] CBS, 2017d https://www.cbs.nl/en-gb/publication/2017/26/trends-in-the-netherlands-2017

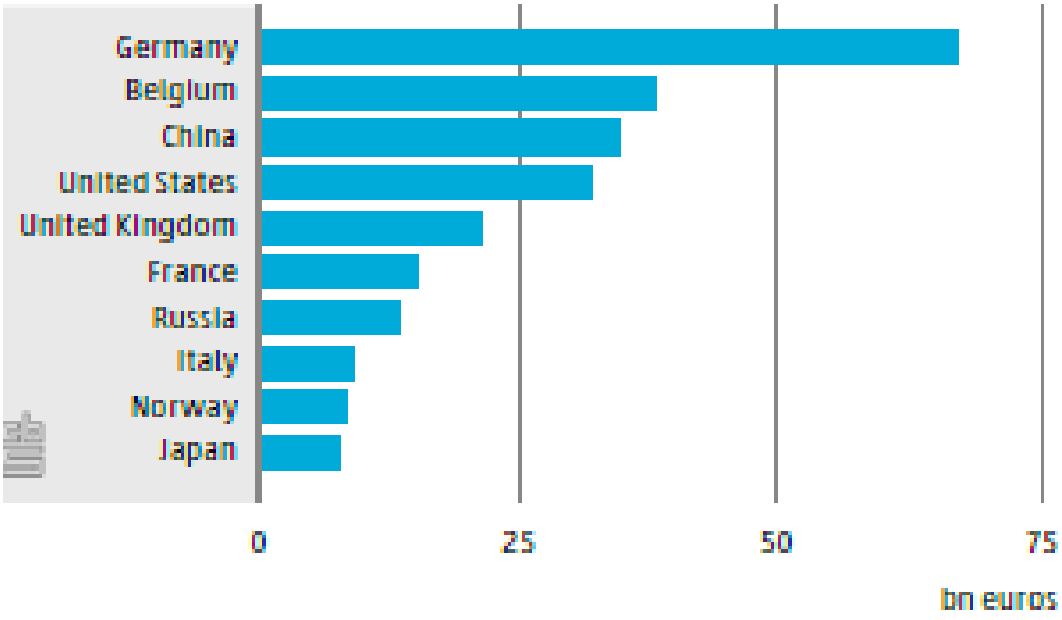


Figure 2.8 Top 10 countries importing goods, 2016 (CBS, 2017d)

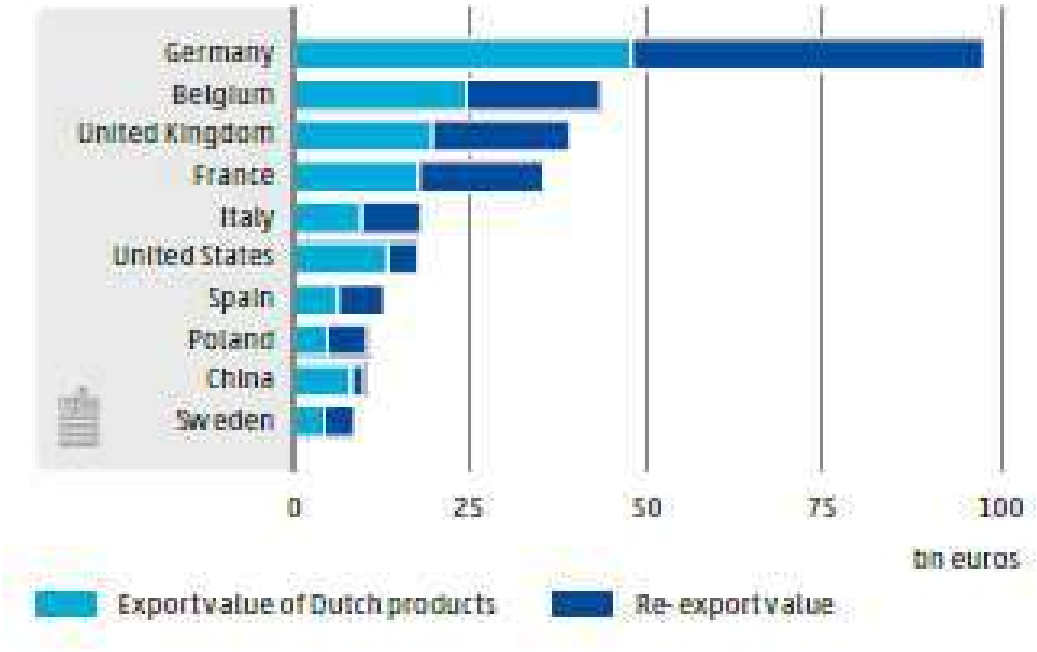


Figure 2.9 Top 10 countries exporting goods, 2016 (CBS, 2017d)

Important role for transport sector
The transport sector has traditionally been an important activity due to the country's favourable location for transporting goods from the coastal harbours to the EU inland destinations. The geographic situation also favours oil refineries in Rotterdam, from which large amounts of oil products are exported. Rotterdam is among the largest ports in the world. The port functions as a main port (hub) for transporting all kind of goods to many countries throughout Europe. Amsterdam Airport Schiphol is important as an air transit point for the rest of Europe. These main port functions explain the relatively high use of bunker fuels.

Consumption by households
Private consumption increased by 48% over the period 1990–2016 although (2010 prices), but since 2002 there has hardly been any growth in private consumption has stagnated, among other things due to the economic crisis (see Figure 2.10). Recently, household consumption has been slightly on the rise again.

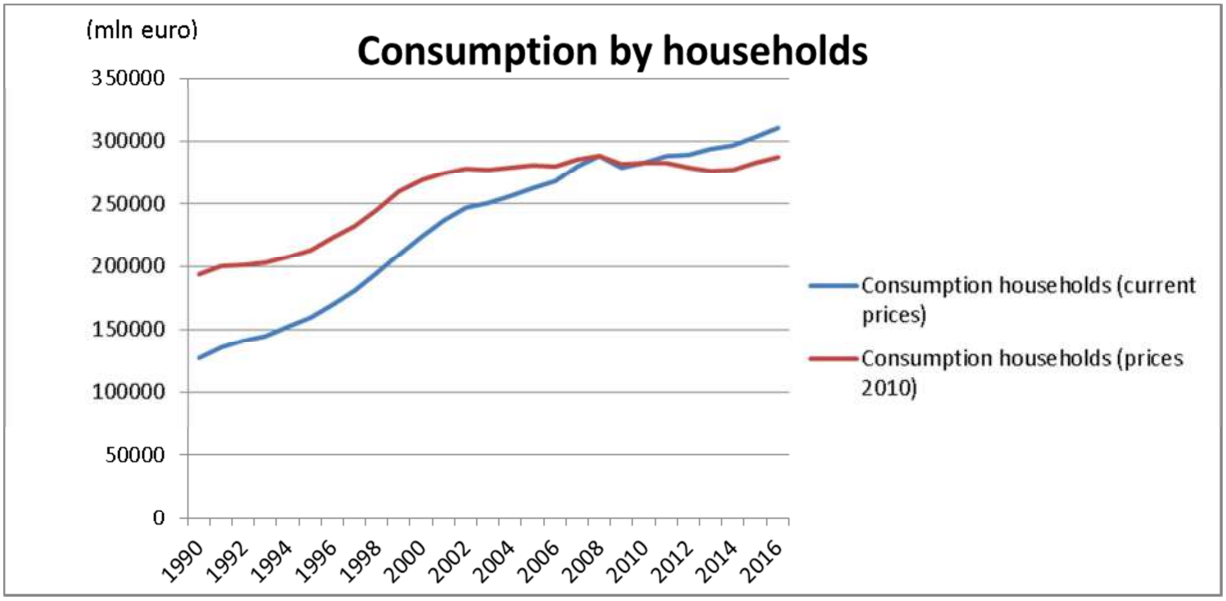


Figure 2.10 Private consumption 1990–2016 (CBS, 2017e[6])

2.6 Energy profile

2.6.1 Energy consumption

During the period 1990-2015 energy consumption in the Netherlands increased by 12%, reaching a maximum in 2010 of 3,485 PJ, while in 2016 the energy use was 3,155 PJ (CLO, 2017a[7]). As presented in Figure 2.11 this increase was concentrated in the period up to 2005–2006 and in the use of natural gas and in oil products. Coal is mainly used for the generation of electricity, while natural gas has a wide application as a raw material, for electricity production, heating, transport, etc. The peak in natural gas use in 1996 and 2010 is related to the additional gas use in cold winters (see also Figure 2.5, heating degree days).

Total energy consumption has fallen sharply since 2010, primarily as a result of a steep drop in natural gas consumption. This drop is to a large extent related to the drop in final consumption of natural gas for heating, as a consequence of milder winters. The contribution of natural gas to electricity production has also declined. With the commissioning of three new coal-fired power plants between 2013 and 2015 the use of coal has increased by more than a third. Finally, oil consumption in the period since 2010 has decreased to late-1990s levels.

[6] CBS, 2017e Consumption expenditure by purpose; National Accounts http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83071eng&D1=a&D2=21-47&LA=EN&HDR=T&STB=G1&VW=T

[7] CLO, 2017a, Energy use by energy carrier http://www.clo.nl/indicatoren/nl0054-energieverbruik-per-energiedrager-?ond=20881

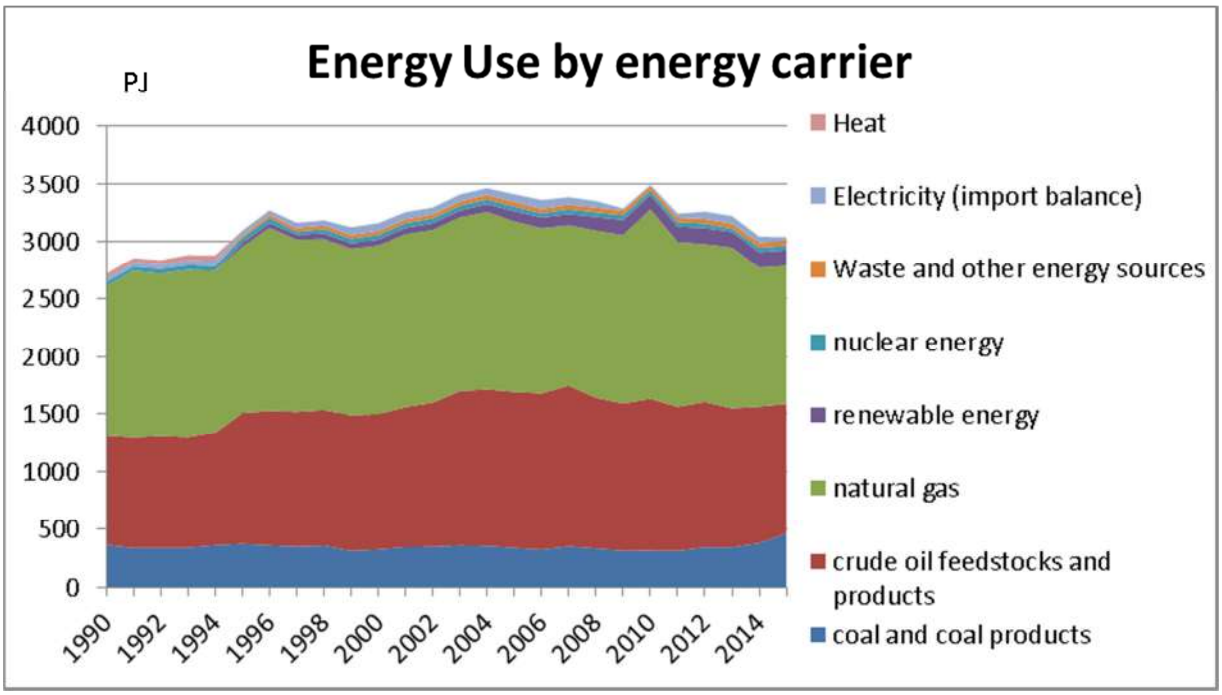


Figure 2.11 Energy use by energy carrier 1990–2015 (CLO, 2017a)

Renewable energy

The use of renewable energy increased in the 1990s on a limited basis: in 1990 1.1% of the energy used was from renewable energy sources and in 2000 this was 1.6% (see Figure 2.12, CLO, 2017b[8]). Since 2000, the share of renewable energy has gradually risen from 1.6% to 6.0% in 2016 (125 PJ), which is an average increase of 0.3% per year. This growth is clearly a result of the Dutch government's stimulation programme, which subsidises the extra production costs of renewable electricity (where these are higher than the costs of conventional electricity production) and the introduction of the obligatory use of bio-fuels in transport.

Almost three quarters of renewable energy originates from biomass, which concerns the production of electricity and heat in waste incineration plants, use of biomass in electricity production and bio-fuels in transport.

Wind energy is the second highest source of renewable energy. In 2016 a sharp increase occurred, primarily due to the opening of the 600-megawatt Gemini offshore wind farm north of the Wadden Islands. Installed capacity of onshore wind energy increased by around 250 megawatts (MW) in 2016 to almost 3,300 MW.

Installed capacity of solar power increased by 500 MW, a record increase, primarily due to an increase in major projects subsidised through the SDE+ (Stimulation of Sustainable Energy Production) in 2014. The total installed capacity of solar power is now 2 gigawatts.

[8] CLO, 2017b End use renewable energy per source
http://www.clo.nl/indicatoren/nl0385-verbruik-van-hernieuwbare-energie?ond=20881

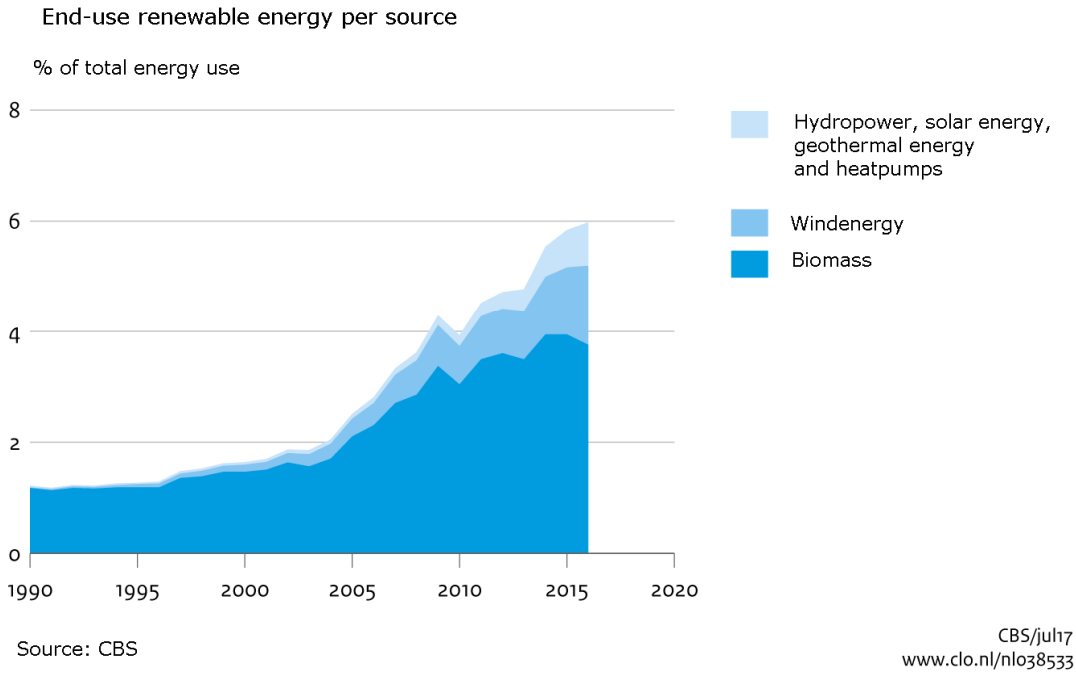


Figure 2.12 Contribution of renewable energy in the energy use 1990–2016 (Source: CLO, 2017b)

Energy use per sector

Figure 2.13 shows the energy consumption per sector.

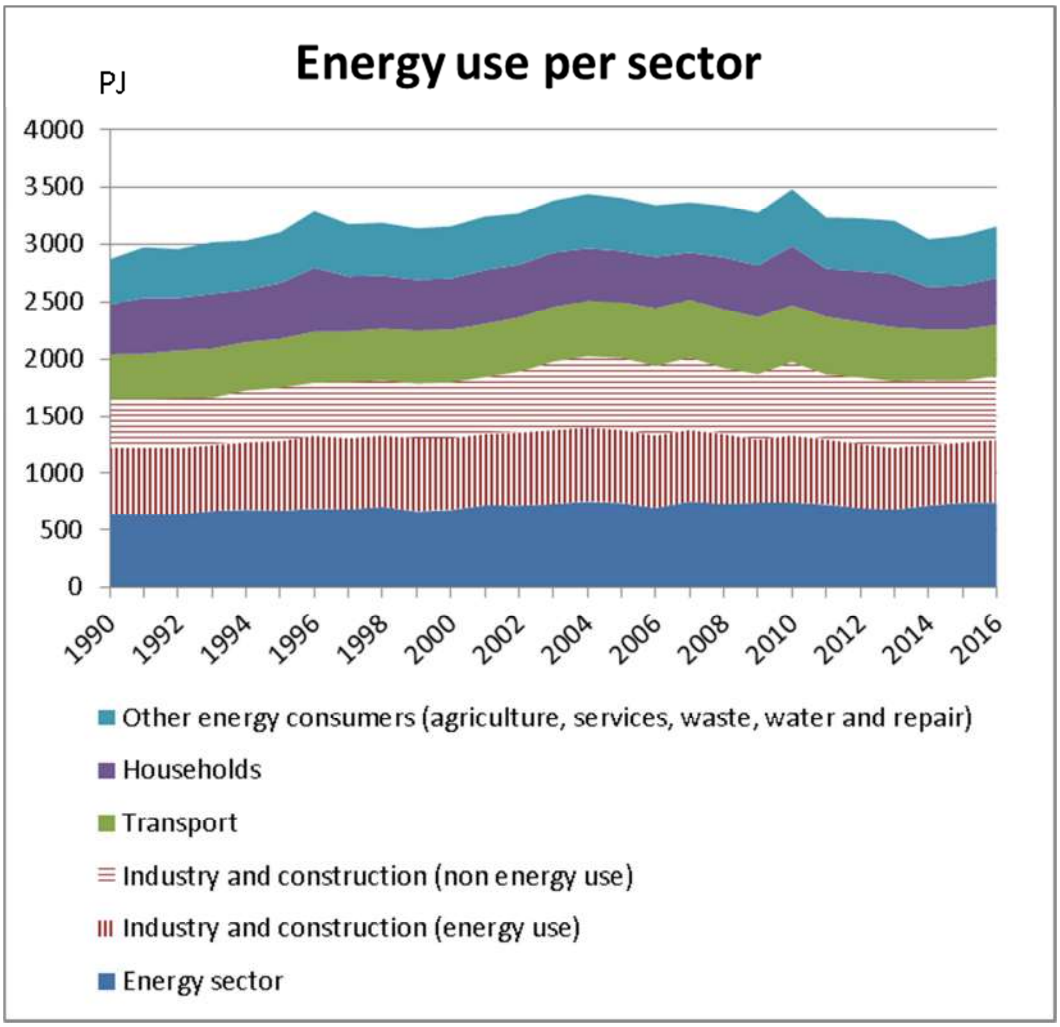


Figure 2.13 Energy use specified by energy users 1990–2012 (Source: CBS, 2017f)

Industry
Industry is the main user of energy in the Netherlands: about 35% of the national energy is used within industrial companies (see figure 2.13). The total energy use increased with almost 10% since 1990. The dominant industrial use is the chemical and pharmacy industry; in 2016 this was responsible for three quarters (75%) of industrial usage. Energy usage in this industrial sector has been increasing since 1990, while energy usage in other industrial sectors increased in the 90s with about 10%, but decreased since 2009 with 17% compared to 1990. Energy use in the chemical and pharmaceutical industries has increased by almost 22% since 1990. The increased importance of this industrial sector has also had a major impact on changes in the use of energy carriers. The use of natural gas in industry has decreased since 1990 by almost 20%, while the use of oil and oil products increased with almost 40%. The use of energy as a raw material (non-energy use) has also increased by almost 30% since 1990.
The share of some other sectors in the total energy use in 2016 are:

- food and tobacco 8%
- iron and steel 4%
- Paper, pulp and printing 2%

Detailed information on contributions by various industrial sectors to the greenhouse gas emissions, can be found in the National Inventory Report 2017 (Coenen et al, 2017) [9]

Households
In households, natural gas is currently the primary form of energy used to heat dwellings, to produce hot tap water and for cooking. Due to warmer winters and energy-saving measures, between 1990 and 2016 consumption fell from 350 to 297 petajoules (PJ). In Figure 2.14, the impact of the harsh winters in 1996 and 2010 can be clearly seen. Over the same period, the consumption of heat from district heating rose from 5 PJ to 12 PJ, which is a relatively small increase compared to natural gas. During the 1990s electricity consumption rose by approximately 2% per year, but the increase has since then levelled off at around 1% per year. This was caused by a rise in the number of electrical appliances in households, but the rise was not as steep as in previous decades. New appliances are also more energy-efficient than before. New lighting, white goods (major domestic appliances) and other appliances that fall under European Ecodesign requirements use less electricity.

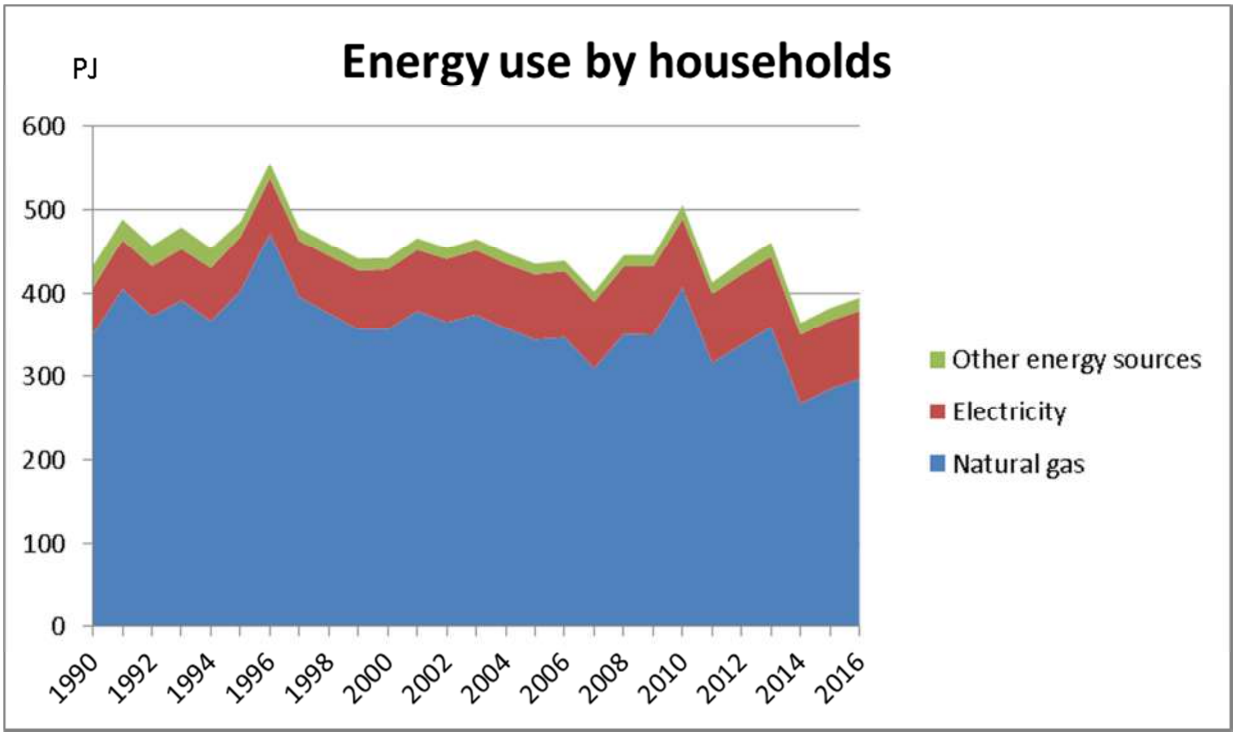


Figure 2.14 Energy use by households 1990–2016 (CBS, 2017g[10])

[9] Coenen et al, 2017 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/nld-2017-nir-14apr17.zip

Transport
Energy consumption by the transport sector, including mobile machinery, increased by nearly 23% in the period 1990–2016 (see Figure 2.15; CLO, 2017c[11]). In 2016, 45% of total engine fuel consumption was attributed to private cars; the percentage consumption by commercial vehicles was 25%. As a consequence of the economic crisis and the purchase of more fuel-efficient vehicles, consumption decreased between 2009 and 2014. Since 2015 energy consumption has begun to rise again, albeit slowly. LPG consumption continues to fall, and in 2016 it was around 80% lower than in 1990.

The energy used for shipping increased from 84 PJ to 110 PJ in the 1990–2016 period. Sea shipping is the main energy user and responsible for the increase: in 2016 sea shipping used 76 PJ; this was 47PJ in 1990. Inland shipping is rather stable with around 25–30 PJ, while fishing decreased from 12 to 4 PJ in the 1990–2016 period.

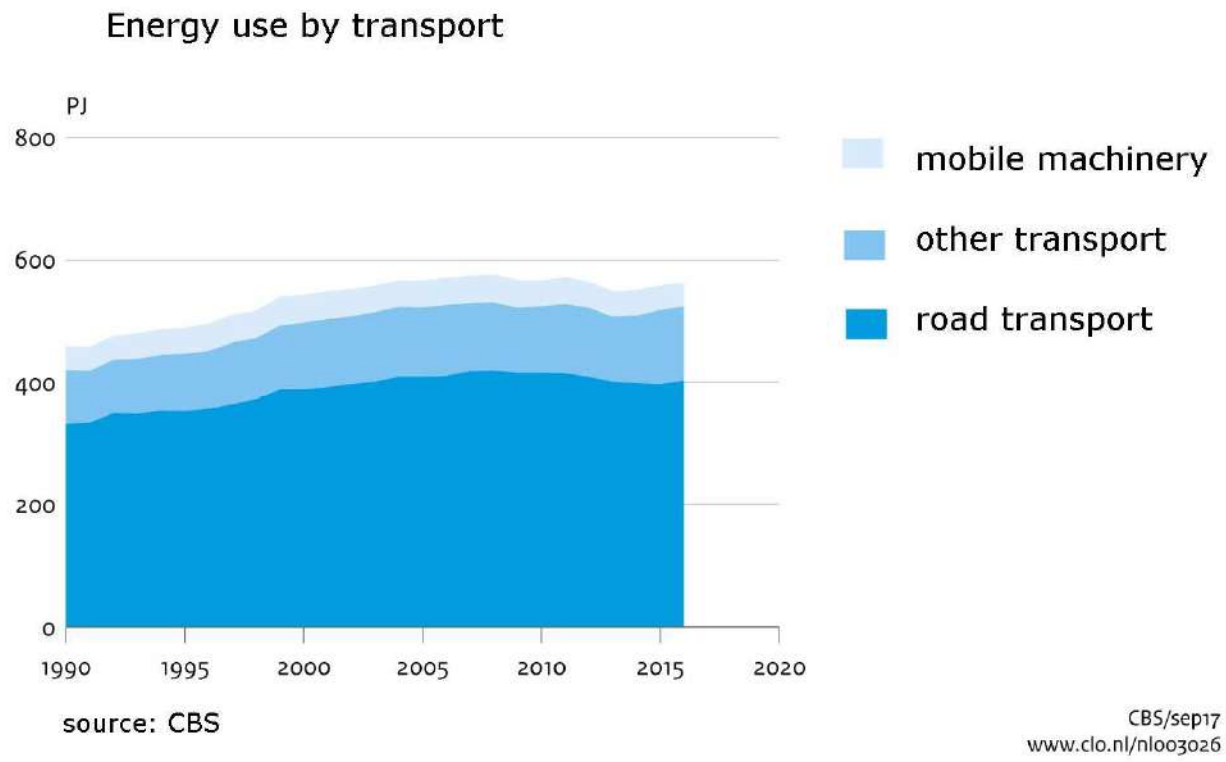


Figure 2.15 Energy use by transport (Source: CLO, 2017c)

Other energy consumers
The other energy uses encompass public and commercial buildings, services and agriculture. As in other sectors, energy use has increased since 1990, reaching 445 PJ in 2016. (see figure 2.13; CBS, 2017f).
The energy use for the service sector increased with 30% in 2016, compared to 1990.
In the agricultural sector the use of energy decreased with 5% compared to 1990. The energy use in horticulture is dominant and this mostly concerns the use of natural gas for heating. This natural gas use is related to the outside temperature so there are high usage rates in cold years, like 1996 and 2010, when gas use exceeded 150 PJ. Natural gas is not only used for heating glass houses, but also for electricity generation by combined heat and power (CHPs) and gas motors. In the period 2005-2009 in particular, the number of gas motors increased. This development resulted in a complete change of electricity use: after 2005 the sector became an net-exporter of electricity, although the amount of export reduced since 2010 with almost 50%, due to changed market conditions and the reduction of the total land area used by horticulture farms (LEI, 2017[12]).

[10] CBS, 2017g Energy use by households http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82375ned&D1=0&D2=a&D3=15-41&HDR=T,G1&STB=G2&VW=T
[11] CLO, 2017c Energy use by transport
http://www.clo.nl/indicatoren/nl0030-energieverbruik-door-verkeer-en-vervoer?ond=20881
[12] LEI, 2017 Energiemonitor van de Nederlandse glastuinbouw 2016
https://www.kasalsenergiebron.nl/content/research/Energiemonitor_Nederlandse_glastuinbouw_2016.pdf

2.6.2 Gas production

Another characteristic of the Netherlands is the availability of large domestic reserves of natural gas; this is 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. Since 1990 the production of natural gas was relatively stable around 2500 PJ (see Figure 2.16; CBS, 2017h[13]), but since 2014 there has been a sharp drop of the production of natural gas as a result of earthquakes in the Groningen area (in the north of the Netherlands). The strongest earthquakes until now has been 3.9 on the Richter Scale. Due to the earthquake issue, gas extraction at the Groningen gas field has been reduced by almost half between 2013 and 2017, in order to reduce the risk of more severe earthquakes and to improve the security of the inhabitants of the Groningen area. The further reduction in extraction that has been announced means that by about 2025 the Netherlands will no longer be a net exporter of gas. Without a reduction in gas consumption, this change will occur much sooner. Since the price of natural gas on the market has also declined considerably (in addition to the reduced extraction) and compensation for earthquake damage will be deducted from profit sharing, in three years' time natural gas revenues for the Dutch Treasury have dropped from a record high of €15 billion in 2013 to €2.8 billion in 2016.

"Green gas" generation has also started in recent years. This gas is generated from biomass. Since 2011, liquid natural gas (LNG) has also been imported, via the port of Rotterdam, from countries like Algeria, Qatar and Trinidad & Tobago.

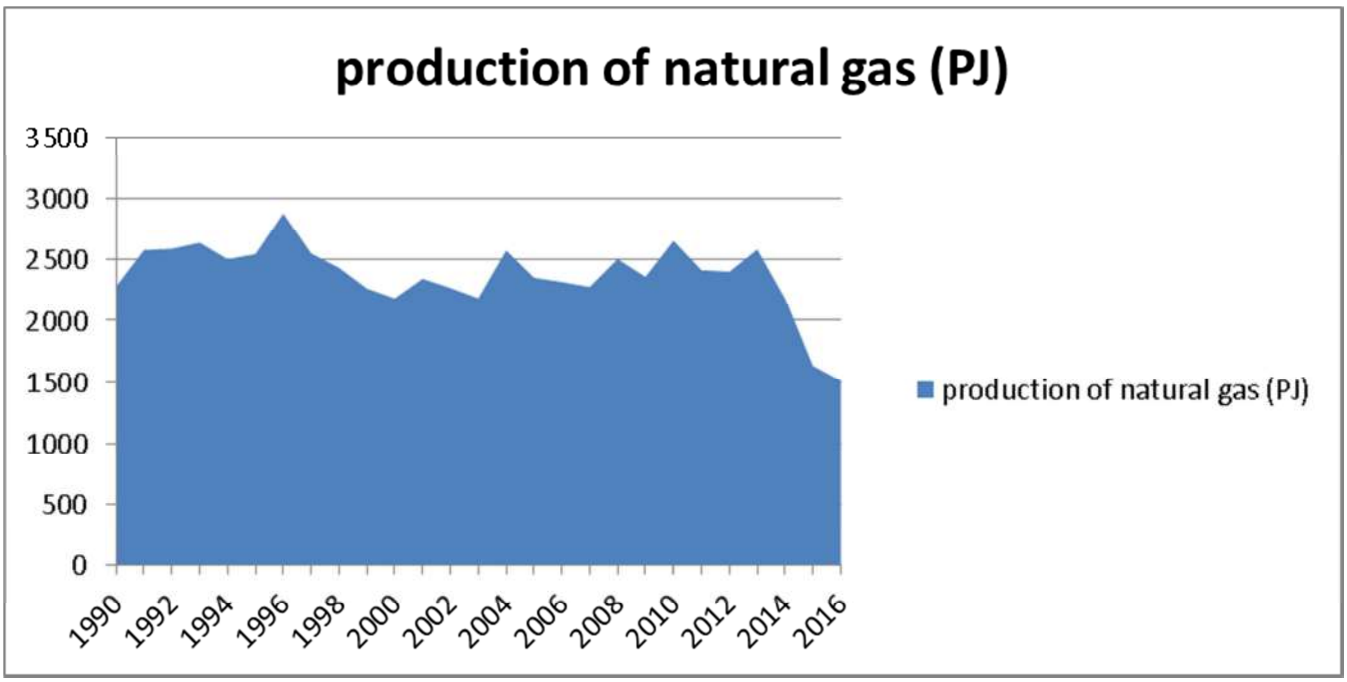


Figure 2.16 Production of natural gas in the Netherlands (CBS, 2017h)

2.6.3 Electricity production

Since 1990, the increase in electricity consumption was mainly "countered" by increased cogeneration and electricity imports. Boosted by a doubling of the installed capacity, the amount of combined heat and power (CHP) generation increased substantially from 1990 onwards, resulting in less fuel consumption for power generation compared to separated generation of electricity and heat.

[13] CBS, 2017h , natural gas production
http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83140eng&D1=1&D2=34&D3=a&LA=EN&HDR=G2,G1&STB=T&VW=T

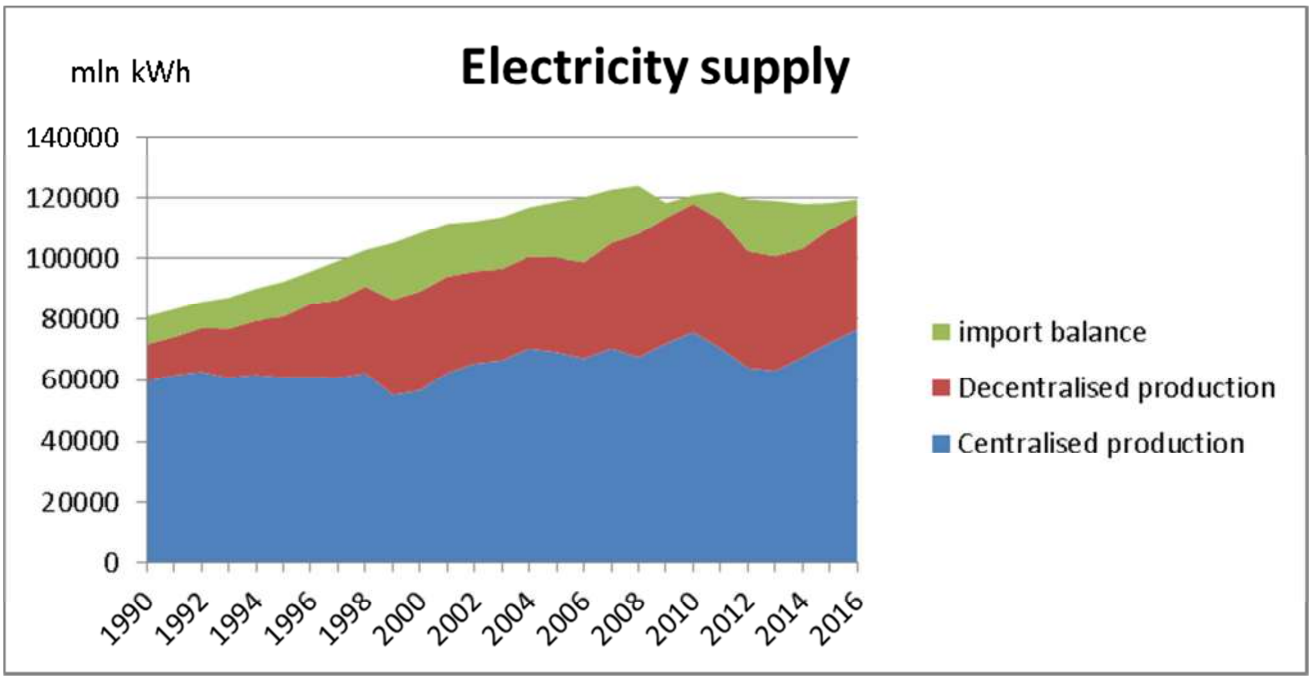


Figure 2.17 Supply of electricity (CLO, 2017d)

Figure 2.17 (CLO, 2017d[14]) gives an overview of electricity supply in the Netherlands for the period 1990–2016. The supply of electricity is calculated as the sum of all domestic production plus the balance between electricity imports and electricity exports.

Since about 1999, the liberalisation of the European electricity market has resulted in a higher net import of electricity. In 2013, electricity imports reached their highest ever level as it became cheaper to import electricity than to produce it in the Dutch gas-fired plants. The majority of this electricity was imported from Germany, where increased electricity was produced by coal-fired plants, due to the low prices of coal, and where at some points during the year the higher production of renewable electricity led to a higher rate of generation than could be used inside Germany. Imports also encompass electricity produced by hydro power in Norway.

In 2016, the electricity supply developed along similar lines to 2015. Production increased while imports declined. As a result, a relatively higher quantity of Netherlands-produced electricity was consumed, at the expense of electricity produced abroad. Domestic electricity production rose by 6% in 2015 and a further 5% in 2016. This growth was mainly driven by production in power plants, which reached record levels in 2016. The balance between electricity imports and exports (imports minus exports) fell by over 40% in both 2015 and 2016.

During the 1990–2016 period, the production of renewable electricity increased by a factor of 19, resulting in a share of almost 12.5% of total electricity consumption in 2016 (see Figure 2.18; CLO, 2017e[15]). By 2016, some 55% of this came from wind energy and 34% from biomass combustion. Wind turbines are mainly located on land, although they are beginning to find their way into the Dutch part of the North Sea too. By 2016, four wind farms were generating a total capacity of 957 megawatts (see Table 2.3) and this figure is set to increase over the coming years (up to more than 4000 megawatts in 2023).

[14] CLO, 2017d Electricity supply
http://www.clo.nl/indicatoren/nl0020-aanbod-en-verbruik-van-elektriciteit?ond=20881
[15] CLO, 2017e production of renewable electricity
http://www.clo.nl/indicatoren/nl0385-verbruik-van-hernieuwbare-energie?ond=20881

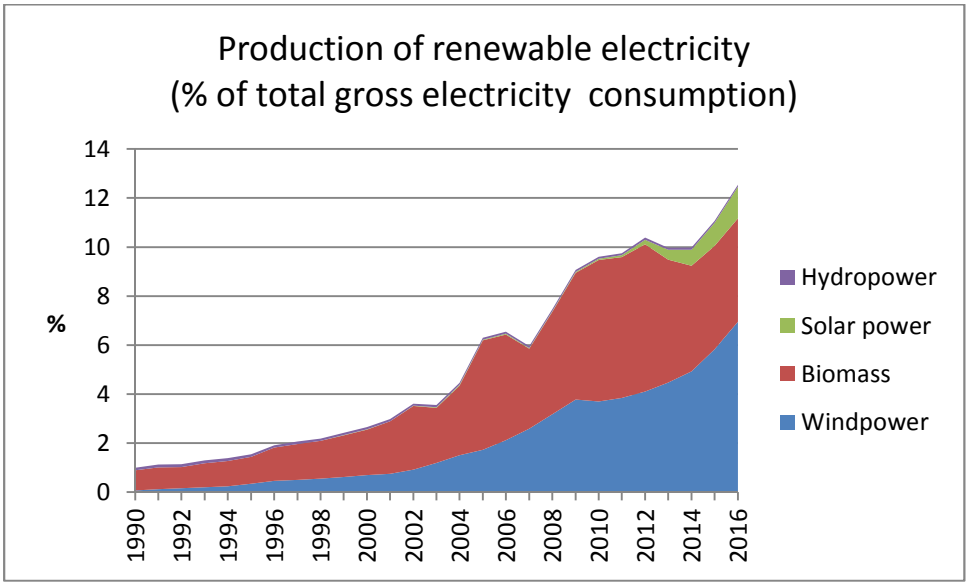


Figure 2.18 Contribution of renewable electricity in the electricity use 1990–2016 (CLO, 2017e)

Name windfarm	Number of wind turbines	Capacity (MW)	In operation since
Gemini Windpark	150	600	2017
Luchterduinen	43	129	2015
Prinses Amaliawindpark	60	120	2008
Egmond aan Zee OWEZ	36	108	2007
total	289	957	

Table 2.3 Wind farms in operation in the Netherlands (Source: Rijksoverheid.nl[16])

2.6.3 Refineries

The Netherlands has six large refineries, with five of them located in Rotterdam. These refineries have a total capacity of about 60 million tonnes of crude oil. The degree of utilisation is high, in some years 100%. This high production level is related to the high efficiency rate, the proximity of many petrochemical industries and the influence of German demand. This makes Rotterdam the world's largest supplier of bunker fuel oil and means that Amsterdam Airport Schiphol is amongst Western Europe's largest suppliers of jet fuel bunkers. The refineries in the Netherlands produce many relatively light oil products (LPG, naphtha, petroleum) from heavier crude oil with a sulphur content of 1.5%.

2.6.4 Energy prices

The Consumer Price Index (CPI) for energy reflects developments in prices for natural gas and electricity household consumption (see Figure 2.19; CBS, 2017i[17]). Since 2000, household energy bills have increased by an average of 4.5% per year, while inflation has been sitting at 1.8% per annum on average. The relatively large increase in energy prices for households is partly due to the steady increase in fuel prices on the world market. The energy CPI fell sharply during the crisis from late 2008 onwards, but returned to peak levels from early 2013. Since then it has again fallen sharply. With the increase in energy from raw materials, there was another slight rise in the consumer price in the second half of 2016.

[16] Rijksoverheid.nl Windenergie op zee (wind energy, off shore)
https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/windenergie-op-zee
[17] CBS, 2017i Consumer Price Index (CPI)
http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83131NED&D1=0&D2=125-126%2c130&D3=0-11%2c13-24%2c26-37%2c39-50%2c52-63%2c65-76%2c78-89%2c91-102%2c104-115%2c117-128%2c130-141%2c143-154%2c156-167%2c169-180%2c182-193%2c195-206%2c208-219%2c221-232%2c234-245%2c247-258%2c260-271%2c273-283&HDR=T&STB=G1%2cG2&VW=T

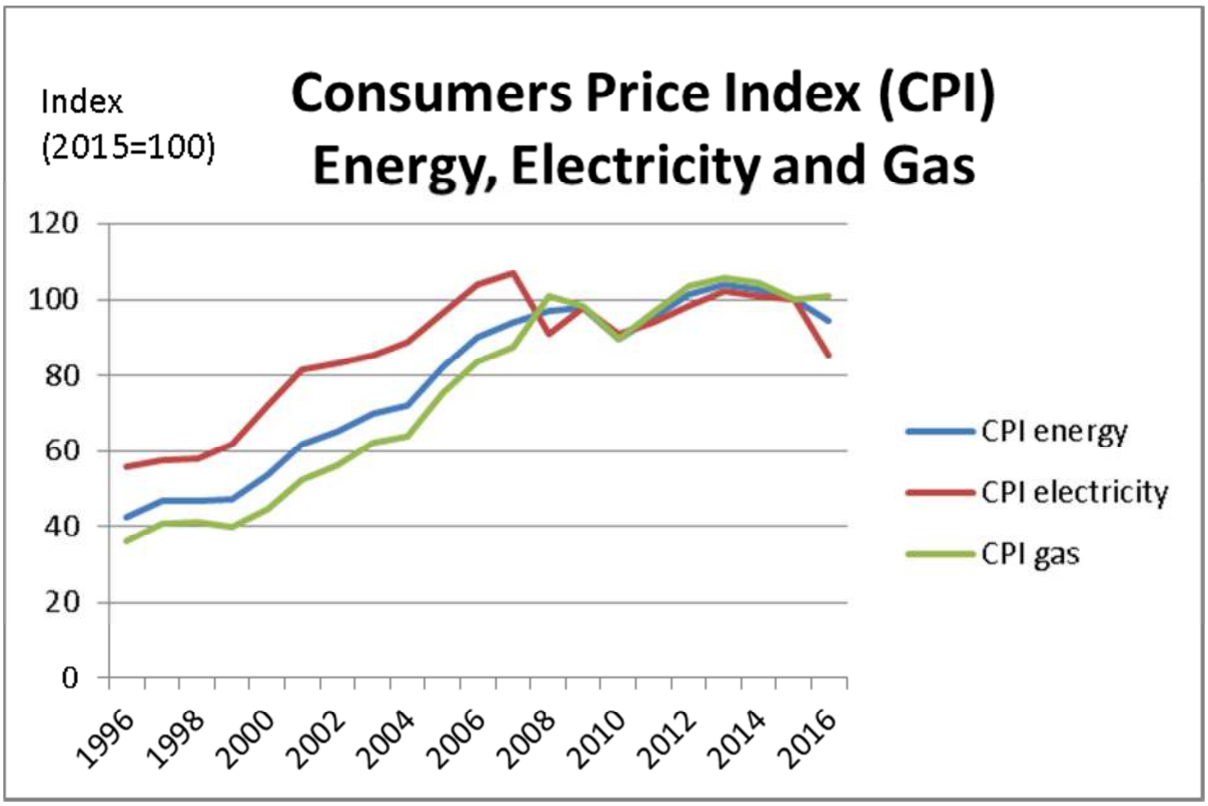


Figure 2.19 Consumers price index energy, 1995–2016 (Source: Environmental Data Compendium (CBS, 2017i)

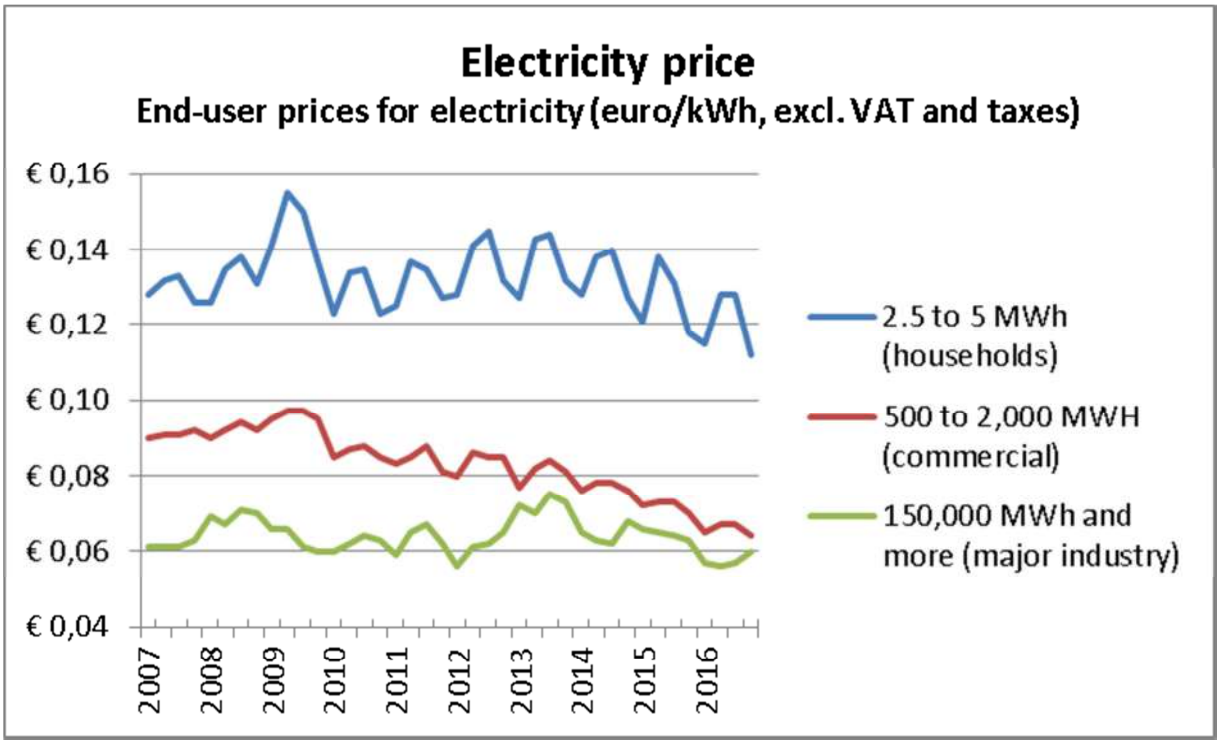


Figure 2.20 Consumer prices for Electricity, excluding taxes, 2007–2016 (Sources: CLO, 2017f)

Electricity price

Figure 2.20 shows the development of the electricity price since 2007 (CLO, 2017f[18]). The electricity price depends on the fuel prices for oil, coal and natural gas, among other factors. Another important component is the cost of deployment of the power plant and transport networks. This is why fuel prices alone do not necessarily have a strong

[18] CLO, 2017f End user prices for electricity
http://www.clo.nl/indicatoren/nl0554-energieprijzen-en-wereldolieprijs-?ond=20881

impact on the price of electricity. In the late 1990s, the natural gas and electricity prices for consumers increased as a result of Energy Tax, which replaced the Regulatory Energy Tax (REB: *regulerende energiebelasting*; ended in 2004) and the Environmental Quality Electricity Production Tax (MEP: *Ministeriële regeling milieukwaliteit elektriciteitsproductie*; the MEP was intended to stimulate renewable energy, and applied from 2001 to 2007). See also chapter 4 for a description of these measures.

Since 1 January 2009, transport costs for household users have depended on the connection type. This is referred to as the capacity rate. Before 1 January 2009, customers paid a fixed amount plus an amount for each unit of energy transported. In 2013 a new energy tax was introduced, the Sustainable Energy Surcharge. This surcharge was created to stimulate investment in sustainable energy.

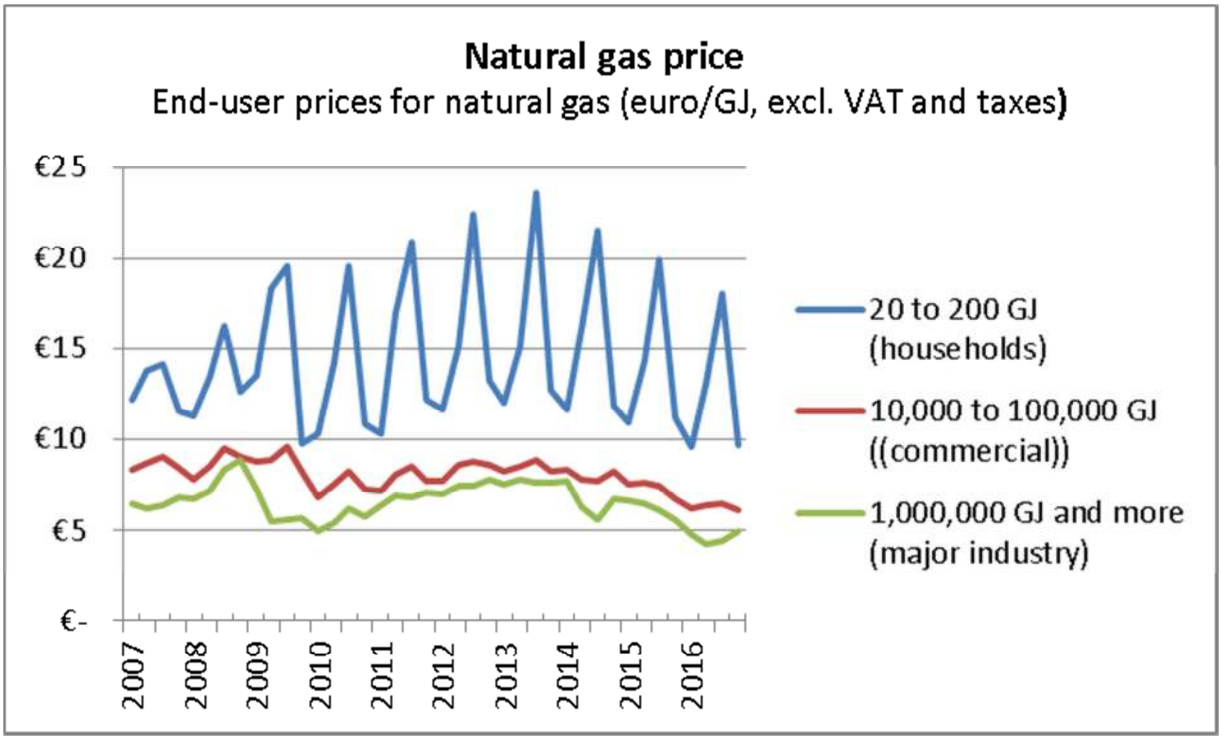


Figure 2.21 Consumer prices for natural gas, excluding taxes, 2007–2016 (CLO, 2017f)

Natural gas price
Figure 2.21 shows the development of the natural gas price since 2007 (CLO, 2017f[19]). In general, the natural gas price more or less follows the price of crude oil. Major world events also have an effect on natural gas prices.

2.7 Transportation

Transport volumes are influenced by demographic, economic, spatial and infrastructural factors.

Aviation
Aviation is highly concentrated at Amsterdam Airport Schiphol, by far the large airport in the Netherlands. Figure 2.22 shows some facts and figures concerning Schiphol in 2016. Schiphol handled 89% (CBS, 2017j) of all air passengers and 96% of all air freight (CBS, 2017j) within the Netherlands (see Table 2.4). The four small airports handle the rest of the passengers and freight.

Within Europe, Schiphol is one of the largest airports: with respect to the number of transport movements Schiphol has a number one position and with respect to the number of passengers and cargo volume Schiphol has a number three position in 2016 (source: Schiphol, 2017[20]).

[19] CLO, 2017f End user prices for natural gas
http://www.clo.nl/indicatoren/nl0554-energieprijzen-en-wereldolieprijs-?ond=20881
[20] Schiphol Group 2017, Facts and figures 2016 https://www.schiphol.nl/en/download/b2b/1493733786/4aVl6vZ9YcWwaIMAIoUGeY.pdf

Figure 2.22 2016 facts and figures concerning Amsterdam Airport Schiphol (Schiphol, 2017)

Airports	year	Flights	Passengers	Cargo
		(number)	(number)	(tonnes)
Amsterdam Airport Schiphol	**2016**	478,864	63,526,363	1,661,679
Rotterdam The Hague Airport	**2016**	19,055	1,643,993	77
Eindhoven Airport	**2016**	30,910	4,780,197	-
Maastricht Aachen Airport	**2016**	3,931	176,562	60,480
Groningen Airport Eelde	**2016**	2,482	152,451	-
Total	**2016**	535,242	70,279,566	1,722,236

Table 2.4 2016 aviation figures (Source: CBS, 2017j[21])

Goods transport to and from the Netherlands
Since 1998, goods transport has grown by over 20%. Maritime transport and rail transport have seen the biggest increases. Most goods are transported by road (CLO, 2017g[22]).

In 2015, nearly 40% of goods transport in Dutch territory took place by road (see Figure 2.23 and figure 2.24). Until 2007, the total quantity of goods transported by road rose each year. In 2008 it began to decline, partly due to the economic downturn. Since 2013 it has slowly begun to rise again. The same pattern can be seen in the other transport categories. Nearly two-thirds of all transported goods involved cross-border transport. Maritime transport and inland shipping accounted for 34% and 18% of goods transport respectively. The high percentage for maritime transport is largely due to the presence of the port of Rotterdam, one of the biggest ports in Europe.

[21] CBS, 2017j, 2016 aviation figures
http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37478hvv&D1=2,11,42,73&D2=a&D3=307&HDR=T&STB=G1,G2&VW=T
[22] CLO, 2017g, Goods transport to and from the Netherlands
http://www.clo.nl/indicatoren/nl0025-vervoersprestaties-goederenvervoer?ond=20897

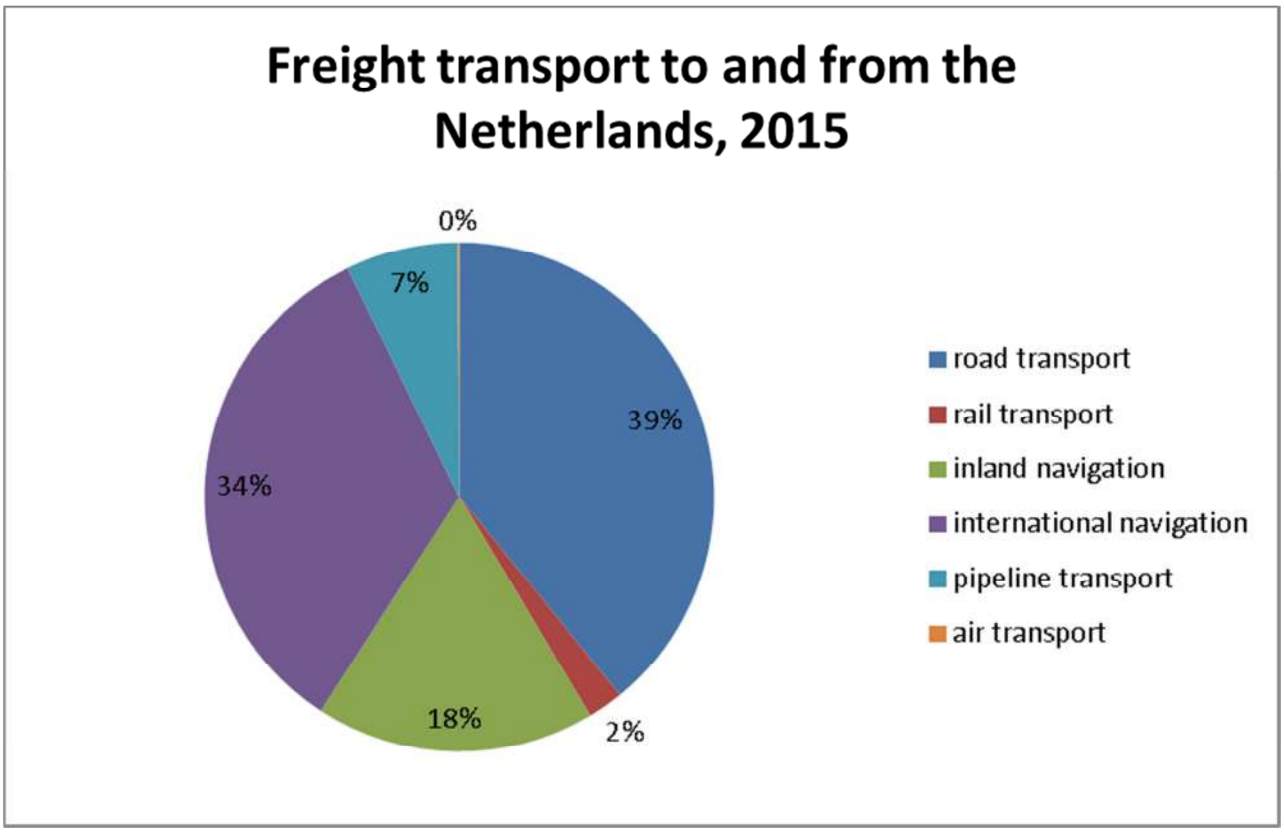


Figure 2.23 Freight transport to and from the Netherlands in 2015 (CLO, 2017g)

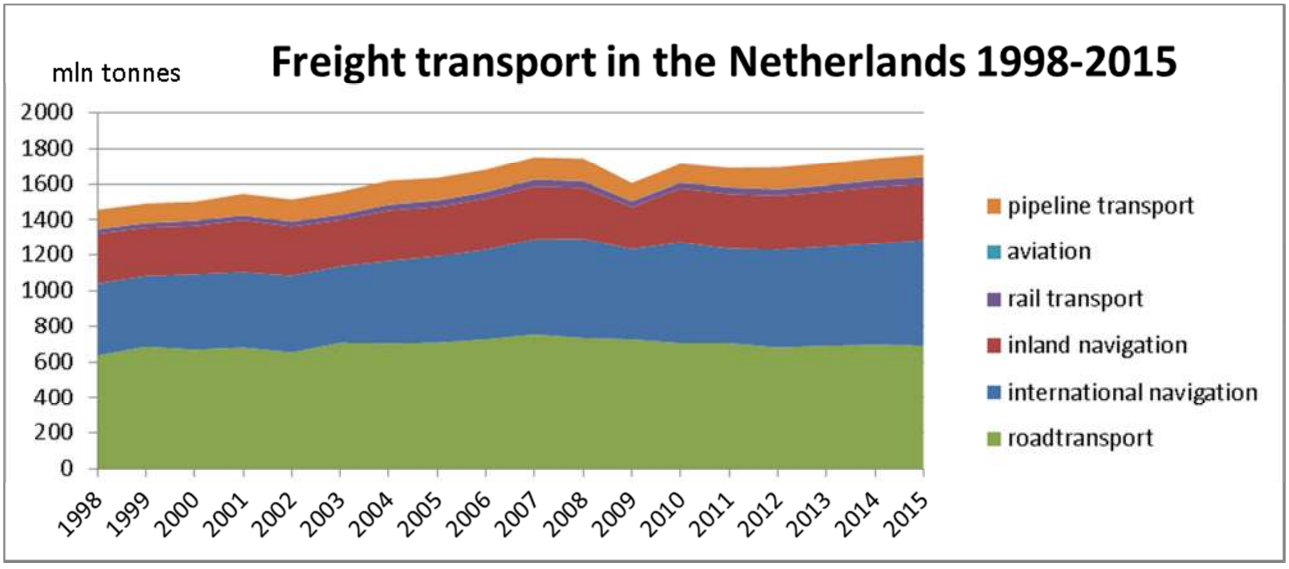


Figure 2.24 Development of freight transport in the Netherlands since 1998 (CLO, 2017g)

Table 2.5 shows some more details on developments in road transport (CBS, 2017k[23]). Due to the economic crisis the amount of freight transported fell from 2007 onwards with 10%, but in the past few year the amount of freight is increasing again.

[23] CBS, 2017k road transport key figures
http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83077ned&D1=0-2&D2=0&D3=0&D4=a&HDR=T&STB=G1,G2,G3&VW=T

year	transported freight (1 000 tonne)	freight-tonne kilometres (x mln)	vehicle kilometres (mln km)
1997	584,441	87,428	.
1998	598,510	89,517	.
1999	667,002	95,292	.
2000	640,579	90,462	.
2001	650,092	89,271	.
2002	624,668	87,560	.
2003	628,812	88,943	.
2004	672,318	98,874	9,213
2005	674,947	95,781	8,936
2006	680,409	94,946	9,011
2007	700,291	88,920	8,395
2008	682,134	88,737	8,770
2009	675,315	82,254	8,366
2010	657,702	76,835	7,886
2011	657,859	75,541	7,995
2012	631,705	70,084	7,515
2013	642,050	72,080	7,568
2014	639,692	72,335	7,719
2015	641,440	68,899	7,546
2016	657,402	67,962	7,448

Table 2.5 Developments in road transport (CBS, 2017k)

Passenger transport

In 2015, some 193 billion passenger kilometres were travelled (see Figure 2.25; CLO, 2017h[24]); 4% less than in 2014. In 2015 the majority (over 72%) of these passenger kilometres were travelled in private cars. Public transport accounted for 11%. The share of rail transport was 8%, with other forms of public transport making up the remaining 3%. Nearly 8% of passenger kilometres were travelled on bicycles.

Figure 2.26 shows the development of passenger kilometres in road transport since 1990. Until 2005 there was an increase of average 1.3% but after 2005 the increase has levelled off at around 0.3% per year.

[24] CLO, 2017h Passenger kilometres 2015
http://www.clo.nl/indicatoren/nl0024-reizigerskilometers-personenvervoer?ond=20897

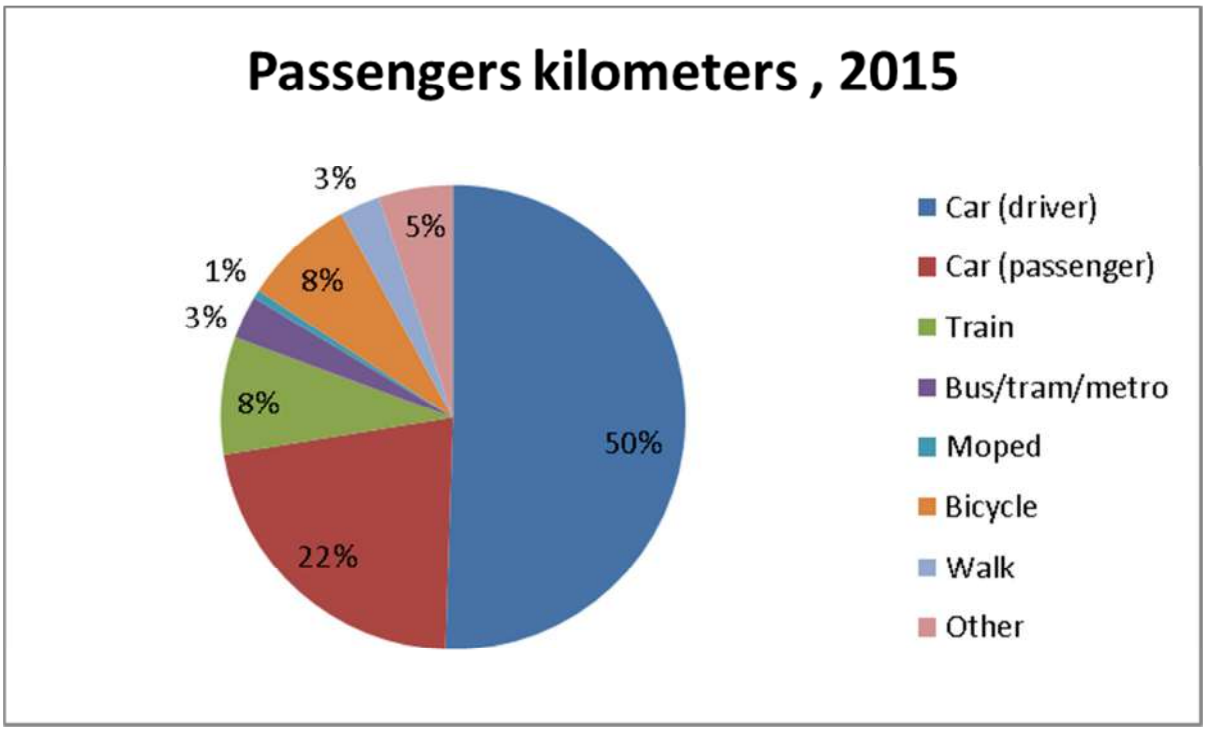


Figure 2.25 Passenger kilometres in 2015 (CLO, 2017h)

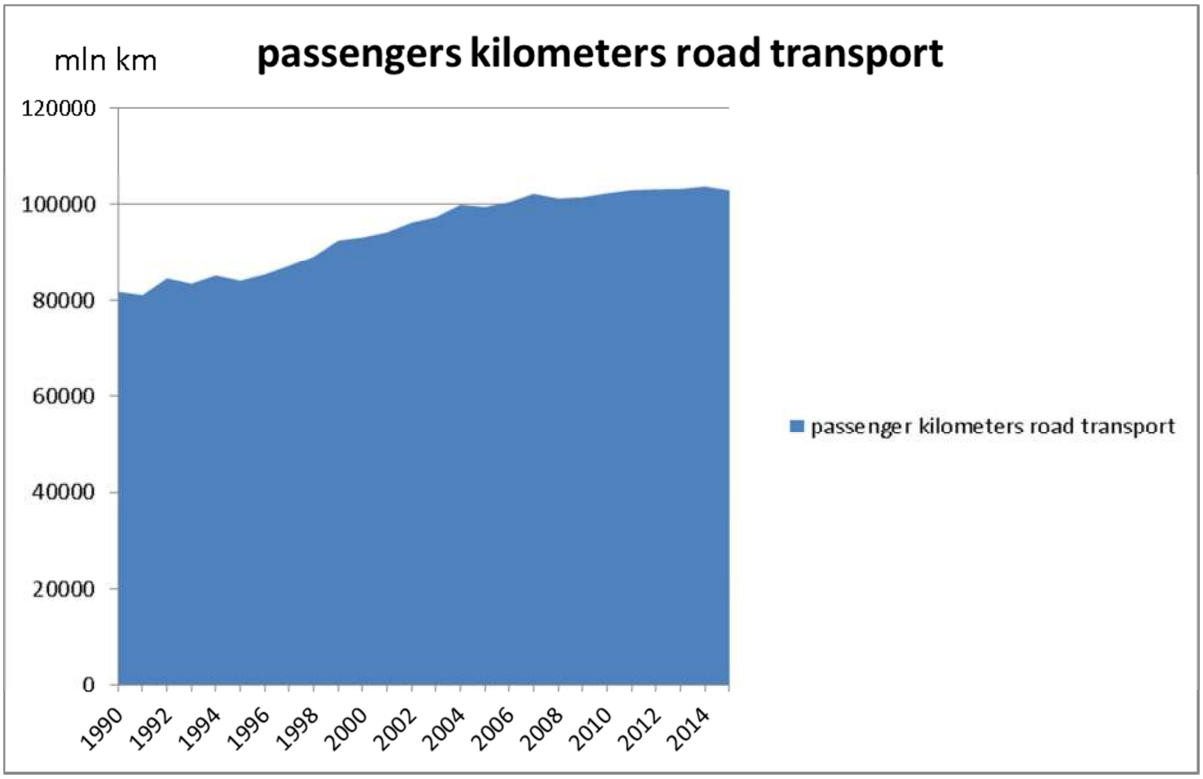


Figure 2.26 Development in passenger kilometres in road transport since 1990. (Klein et al, 2017)

2.8 Industry

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 caused by several factors, including the chemical industry, which produces a high percentage of base chemicals compared to chemical industries in Germany, the UK or Denmark. In the 1990–2016 period, the total industrial sector grew by 37% (2010 prices); see Figure 2.27 (CBS, 2017l[25]). The manufacturing industry made the largest contribution, at over 50%. The effect of the economic and financial crisis are clearly visible in this figure.

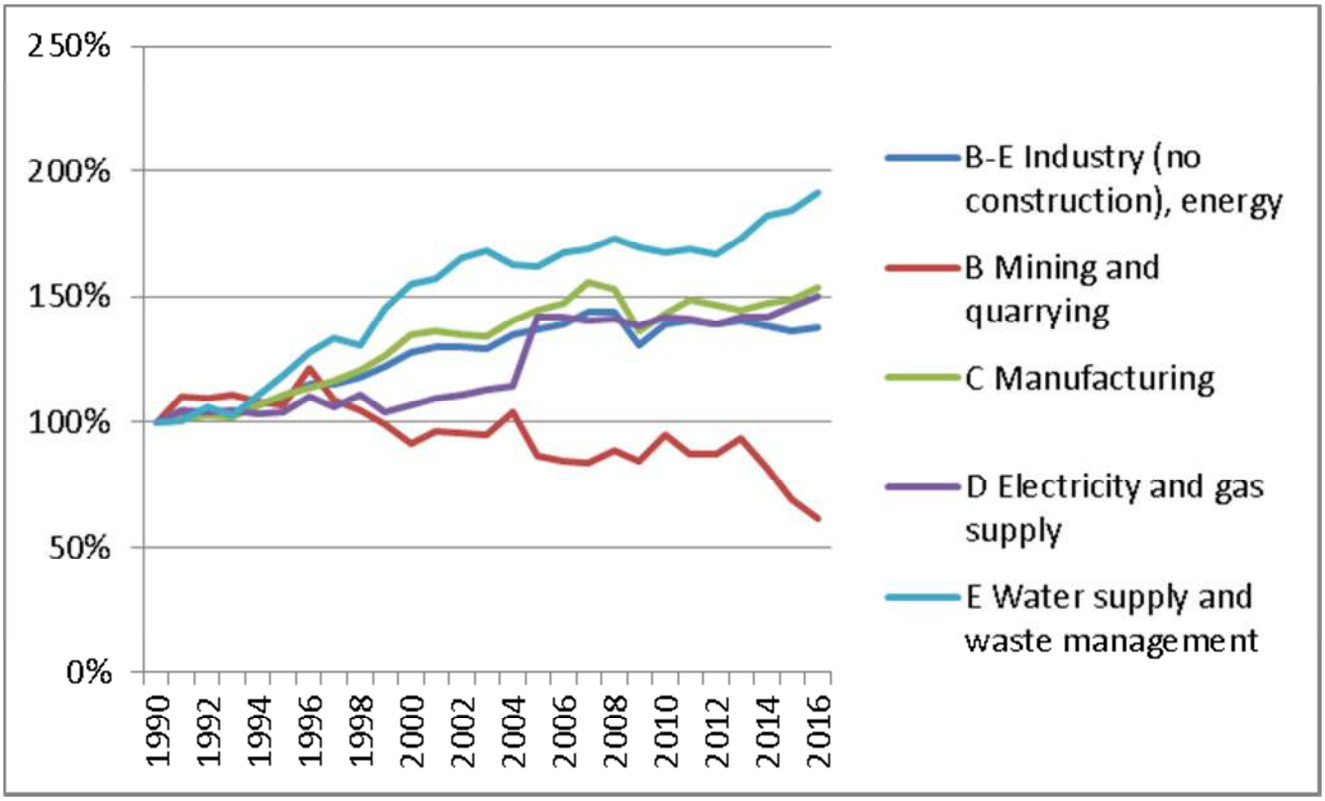


Figure 2.27 Industrial production 1990–2016 (Source: CBS, 2017l)

2.9 Waste

The total amount of waste produced in 2012 (excluding polluted soil, dredging sludge and animal manure) amounted to 60 million tonnes. Figure 2.28 (CLO, 2017i[26]) shows that, despite population growth and economic development, waste production has been rather stable at around 60 million tonnes since 2000. Governmental policies aimed at decoupling GDP growth and waste production have thus clearly been successful.

Between 1990 and 2014, the rate for reusing waste (i.e. recycling and the use of waste for energy production) increased from 62% to almost 93% of the total amount (Figure 2.28). This included half of residential and office waste, most industrial waste and almost all demolition waste. Waste products from agriculture and coal-fired power plants were almost fully recycled. Approximately 4 million tonnes are not reused or recycled, of which residential waste has the largest share, followed by office waste. As the figure shows, the amount of non-reused or recycled waste is still decreasing. In 2014, some 1.3 million tonnes of waste was disposed of in landfill sites; in 1990 this was almost ten times higher (13.9 million tonnes). This waste contained around 10% degradable carbon, leading to methane

[25] CBS, 2017l
http://statline.cbs.nl/StatWeb/publication/?DM=SLEN&PA=81810ENG&D1=0&D2=0-1,5,41&D3=16,101,118,135&LA=EN&HDR=G2&STB=G1,T&VW=T
[26] CLO, 2017i waste production and processing methods
http://www.clo.nl/indicatoren/nl0204-afvalproductie-en-wijze-van-verwerking?ond=20876

emissions (a few megatonnes CO_2 equivalent). The residual waste that is not reused or disposed of in landfill is incinerated; after increased volume of incineration in the 1990s, figures stabilised at around 7.5–8.5 million tonnes in the 2000s. From 2010 onwards incineration in waste incineration plants is reported under the category "reusing waste". Therefore the amount of waste that is reported under the category "incineration" has further been reduced; in 2014 only 2.0 million tonnes was incinerated.

The amounts of waste dumped on landfill sites have been substantially reduced as a result of the government's 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, as well as garden and food wastes (compost). In 2014, some 1.3 million tonnes of waste was landfilled.

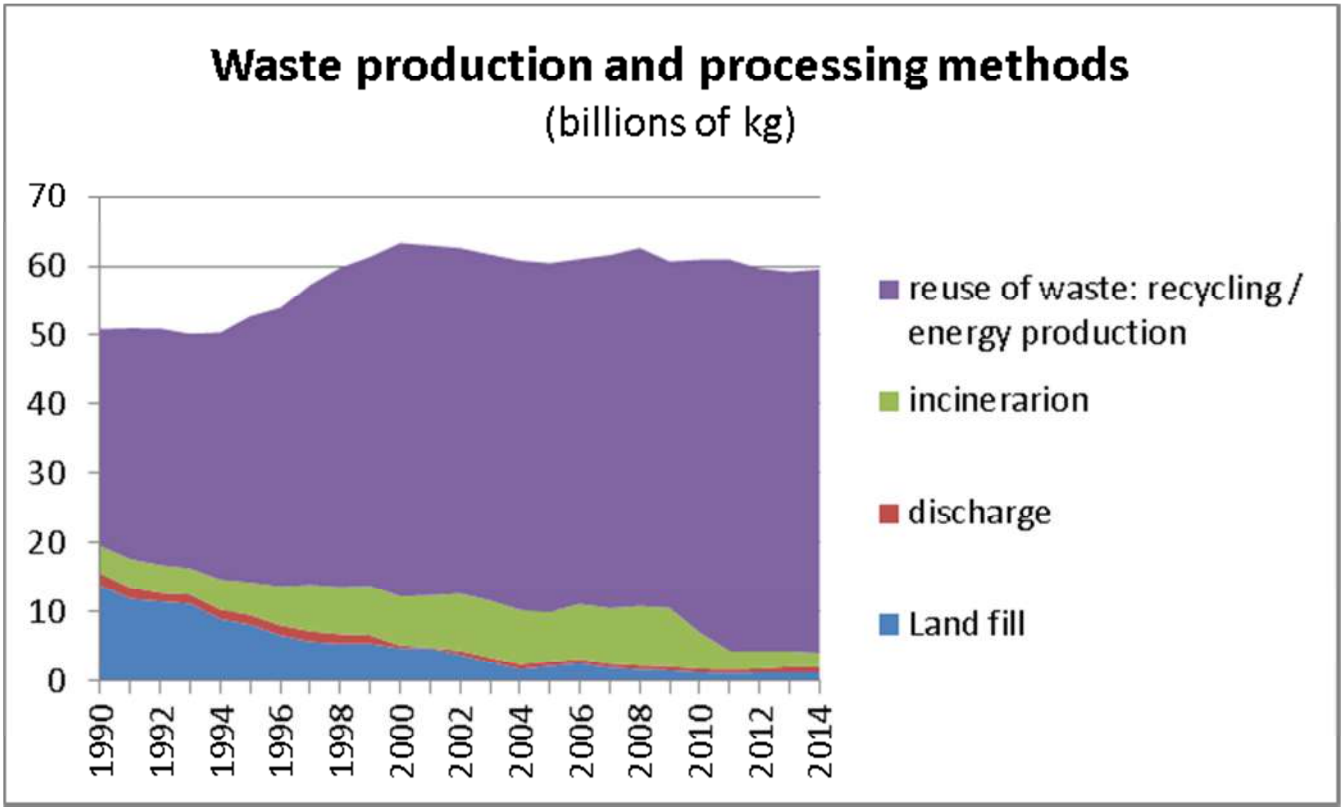


Figure 2.28 Waste generation and methods of disposal 1990–2014 (CLO, 2017i)

2.10 Building stock and urban structure

On 1 January 2017, there were 7.7 million homes in the Netherlands. That is an increase of 29% compared to 1 January 1990. There were 2.1 million homes built between 1990 and 2017 and more than 325 thousand demolished (see Figure 2.29; CBS, 2017m[27]).

[27] CBS, 2017m, Housing stock
http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82235ned&D1=a&D2=69-95&HDR=T&STB=G1&VW=T

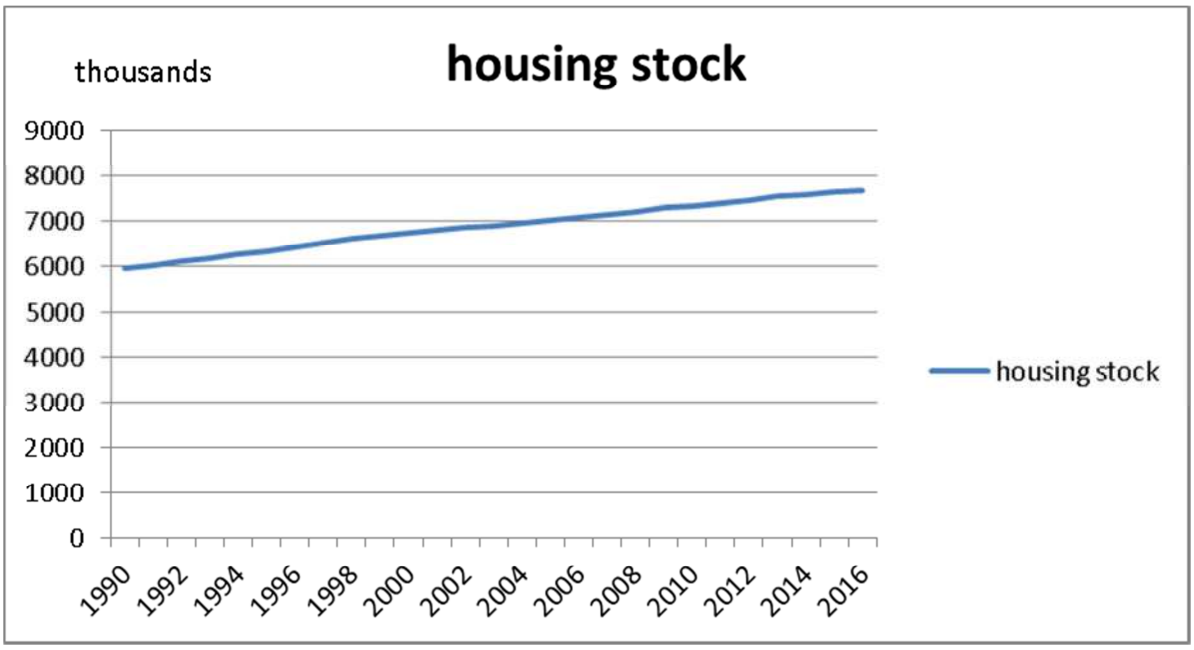


Figure 2.29 Housing stock in the Netherlands 1990–2016 (CBS, 2017m)

In the past 27 years, 2.1 million new homes have been completed. Over the entire period this is an average of 76,000 homes per year. But as is shown in Figure 2.30 there is a strong decreasing trend over time. In the 1990s the average number of new homes was 92,000. Between 2000 and 2010, housing stock increased by 8.9% (an average of 0.9% per year). The annual number of new homes built in the Netherlands (following a decrease in the period 2001–2003 to 64,000 homes) rose steadily to nearly 83,000 in 2009. Then, as a result of the financial and economic crisis, construction plummeted to a production of only 61,000 in 2010. This decrease continued until 2014 (45,170). Since then there has been a small increase in new homes.

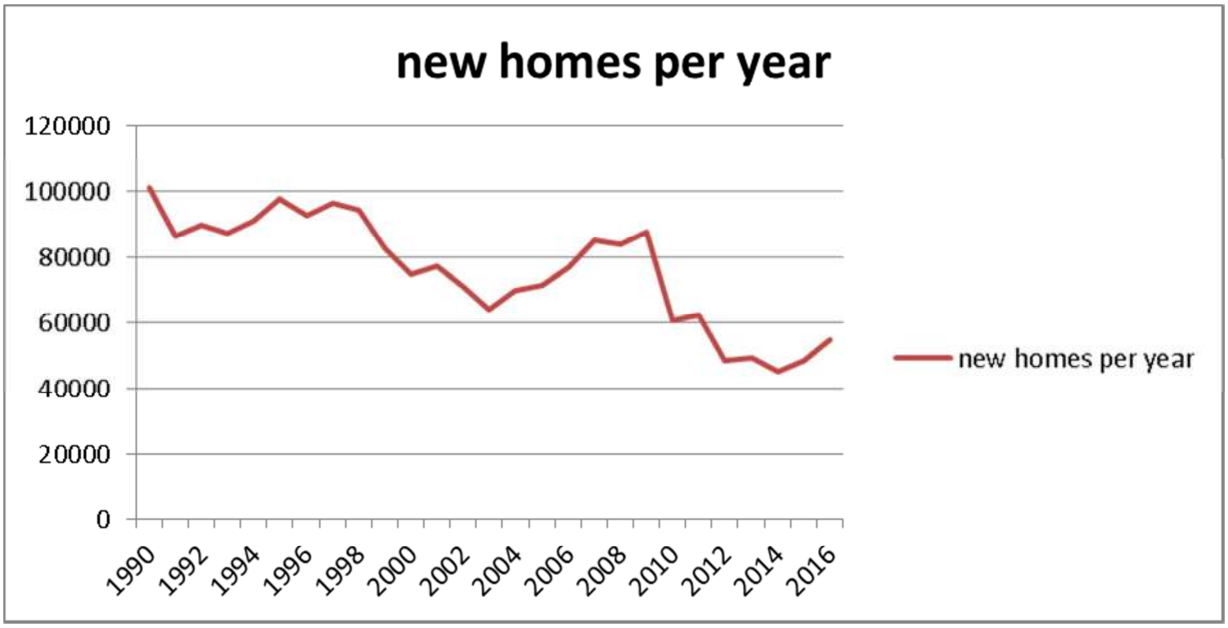


Figure 2.30 Development in new homes per year (CBS, 2017m)

The energy label for homes and buildings was created in 2007. This label gives a quick indication of energy use in a home. Of the more than 7.5 million homes in the Netherlands, as of 1 January 2017 around 3.2 million had an energy label. This corresponds to 42% of the total housing stock. Multi-family dwellings are more likely to have a label (59%) than single-family dwellings (33%).
The majority of homes have a C or D label (31% and 21%); see Figure 2.31. The most energy-efficient homes (A and B labels) make up around 27% of the housing stock. More than 11% of labels issued were for the most energy-efficient homes, Class A.

The majority of energy labels were issued in 2009, when a large number of housing associations had their housing stock assessed (see figure 2.32). If a home subsequently obtains a new label – after energy-saving measures have been implemented, for example – the old label is "overwritten". This prevents labels from being counted twice. A large number of new labels were also issued in 2015 and 2016. This was due to the simplification of the label application process, for which the costs were also lowered. In addition, in 2015 penalties came into effect for anyone who tried to sell or let a house without a label.

In 2007, 15% of new labels issued were green (A or B); in 2016, this figure was 35%. The proportion of the energy-inefficient labels E, F and G declined from 31% in 2007 to 22% in 2016. Issued labels are not representative of the entire housing stock. There are still over four million houses with no formal energy label. In many cases, energy labels are issued for newly built or rental properties.

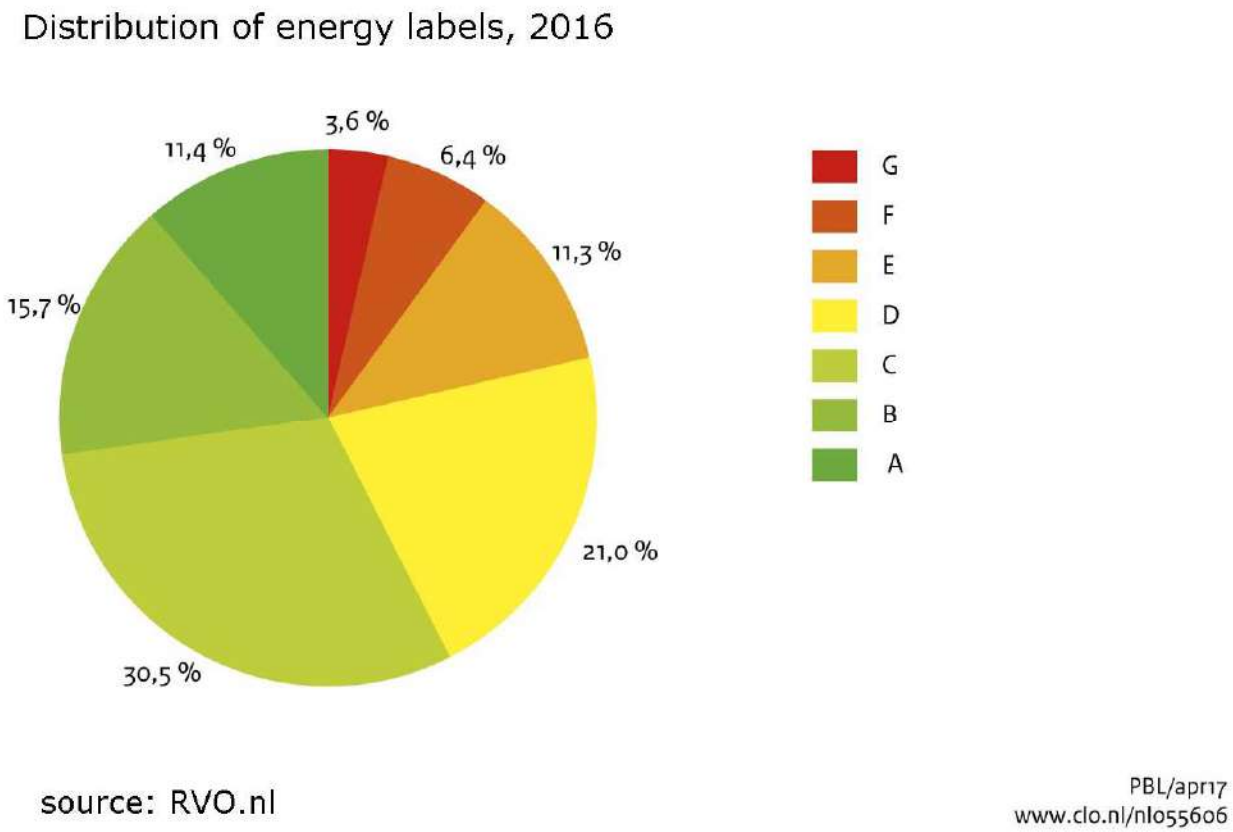


Figure 2.31 Distribution of energy labels, 2016 (CLO, 2017j[28])

[28] CLO, 2017j, energy labels homes
http://www.clo.nl/indicatoren/nl0556-energielabels-woningen?i=9-53

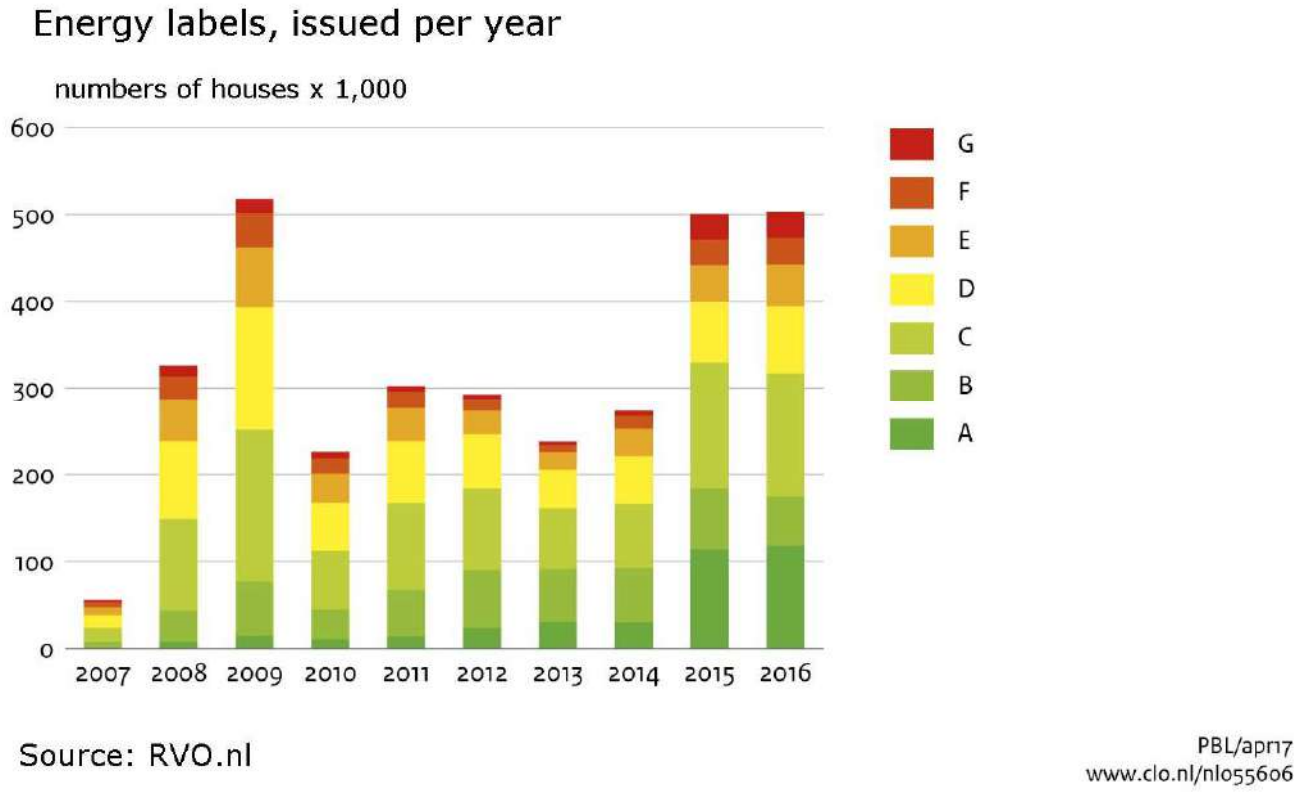


Figure 2.32 Number of energy label, granted per year, 2007-2016 (CLO, 2017j)

2.11 Agriculture

Agriculture in the Netherlands focuses on cattle breeding, crop production and horticulture; of which greenhouse horticulture is the most important subsector. The amount of horticulture in total agricultural production has been increasing. The amount of fuel consumed by the greenhouse horticultural 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 ending in 2015, the number of dairy cows has been slowly increasing since 2008.

In 2016 there were nearly 56 thousand farms and horticultural enterprises in the Netherlands (see Figure 2.33; CBS, 2017n[29]). Of these companies, 30% relates to dairy farms and 19% to arable farms. In 2000 there were 24% dairy farms and 15% arable farms. In the 2000–2016 period, the total number of farms decreased by 43%. The total land area used by the agricultural sector dropped by 9% since 2000 (see Figure 2.34).

The largest decrease was in the greenhouse branch, with reductions of 70% in cut flowers, 64% in vegetable production and 60% in both the bedding and pot-plant companies. The total land area used by the greenhouse branch has fallen since 2000 by 30%.

Dairy farming is the only subsector of where total land area used has increased since 2000 (+ 6%).

[29] CBS, 2017n Agricultural companies and size
http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=80785ned&D1=0,2&D2=0&D3=a&D4=a&HDR=T,G3&STB=G2,G1&VW=T

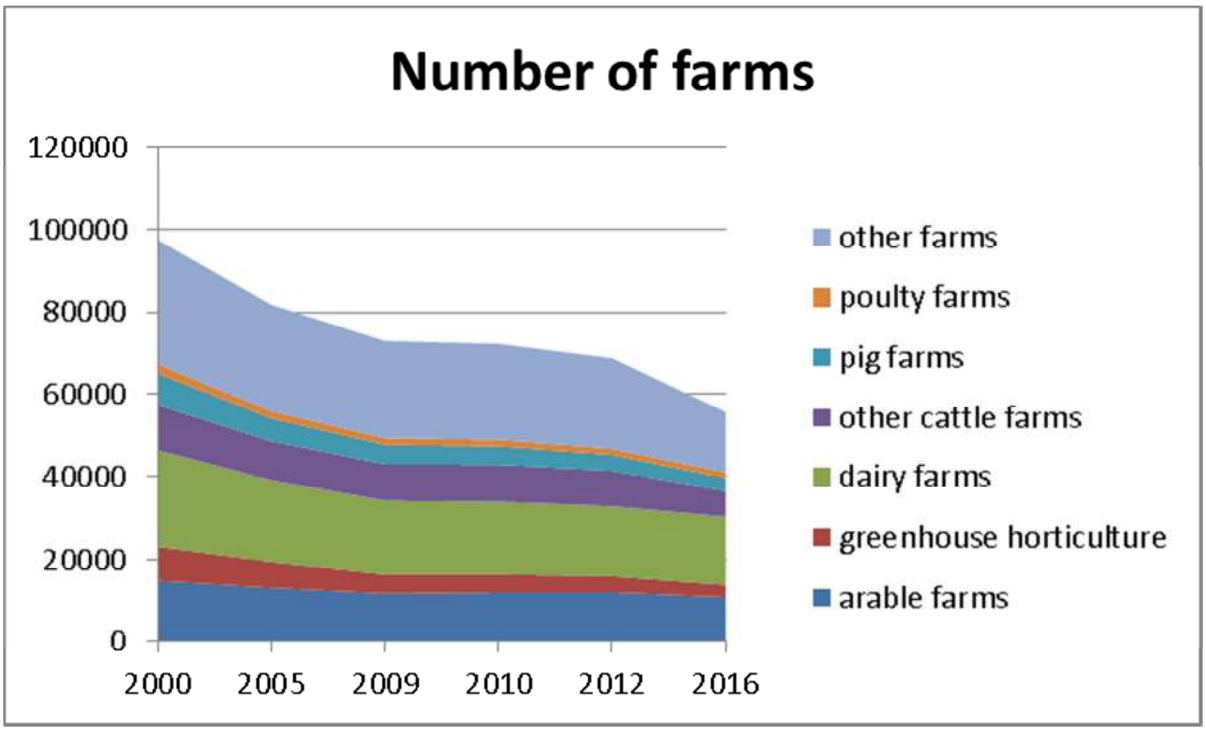


Figure 2.33 Number of farms, 2000–2016 (CBS, 2017n)

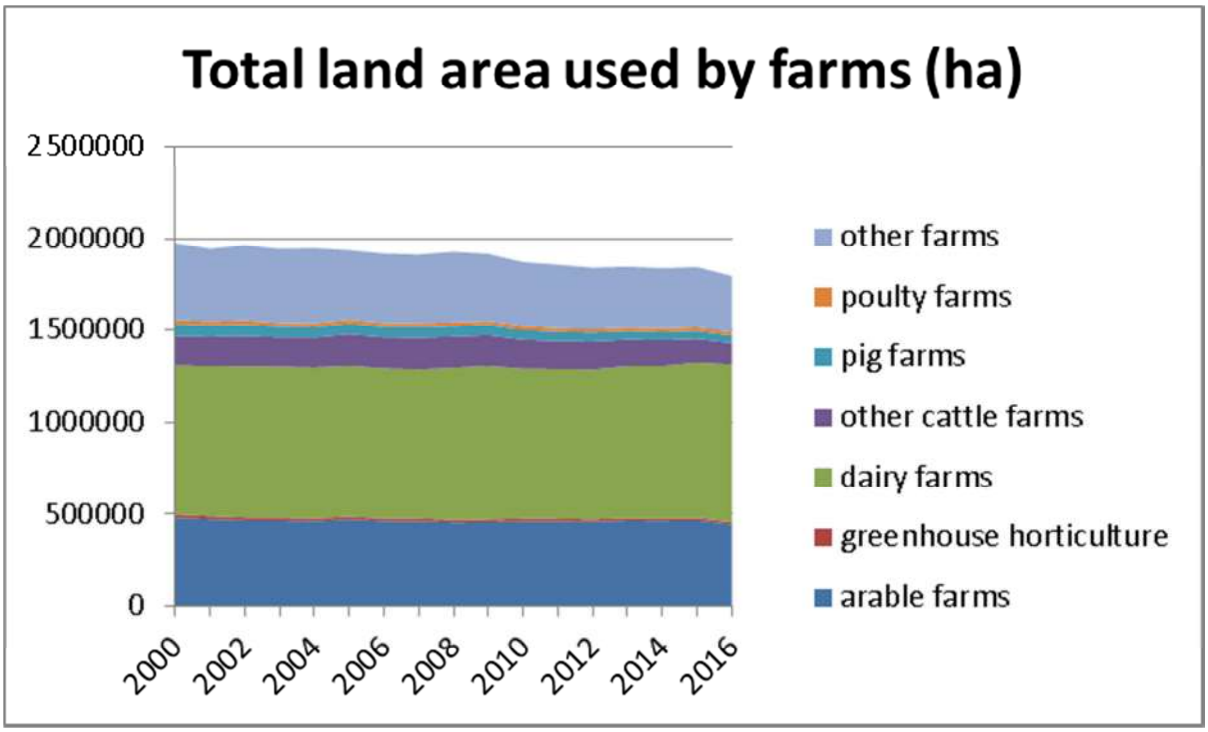


Figure 2.34 Total land area used by farms, 2000–2016 (CBS, 2017n)

The most important agricultural crops are cereals, maize for fodder, potatoes and sugar beets. Legislation concerning manure has resulted in a more even distribution of manure over agricultural areas. Excess manure is increasingly being 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, supposedly leading to higher emissions of nitrous oxide. Furthermore, more farmers are looking for ways to process manure (e.g. separation of liquid and solid fractions) or to use manure as an input for energy production (fermentation, biogas).

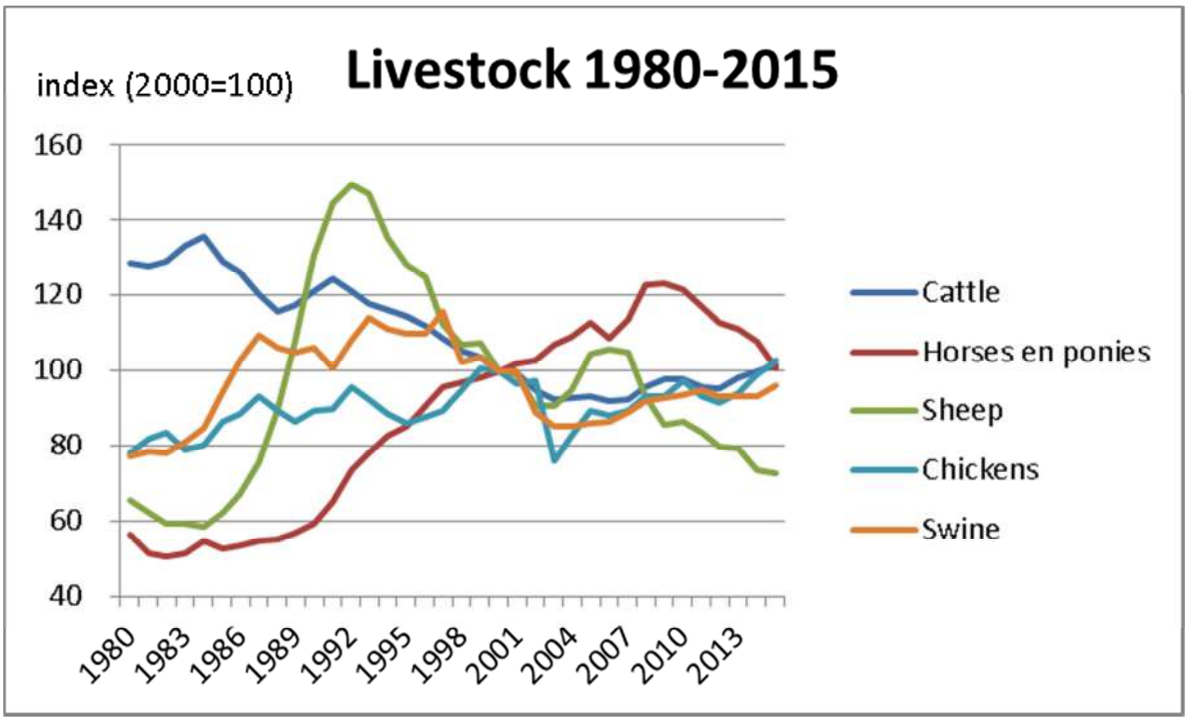


Figure 2.35 Animal numbers in the Netherlands 1990–2016 (CLO, 2017k)

	Unit	**1980**	**1990**	**2000**	**2014**	**2015**	**2016**
Cattle	x 1,000	5,226	4,927	4,069	4,068	4,133	4,251
o.w. Dairy Cattle	x 1,000	2,356	1,878	1,504	1,572	1,622	1,745
o.w. other cattle	x 1,000	2,870	3,049	2,565	2,496	2,511	2,506
Horses en ponies	x 1,000	67	70	117	127	118	82
Sheep	x 1,000	858	1,702	1,305	959	946	784
Goats	x 1,000	-	61	179	431	470	500
Chickens	x 1,000	76,064	85,492	94,973	93,590	96,791	95,400
Swine	x 1,000	10138	13,915	13,118	12,238	12,603	12,479

Table 2.6 Animal numbers in the Netherlands 1990–2016 (CLO, 2017k)

More dairy cattle, fewer horses

Since 1980, cattle numbers have fallen by a fifth, see Table 2.6 and Figure 2.35 (CLO, 2017k[30]). The number of cattle fell from 5.2 million in 1980 to 3.7 million in 2006, after which it rose again to 4.1 million in 2015. The sharp drop in 1984 coincided with the introduction of the milk quota within the European Union, which resulted in the numbers of dairy and calving cows falling by 42% between 1984 and 2011 to 1.47 million.

From 2011 to 2015, the number of dairy cattle and cows in calf increased by 10% to 1.62 million. In addition, since 2012 the proportion of young cattle in the national dairy herd has increased. The number of heads of young cattle rose by 149 thousand between 2012 and 2015 to 1.34 million, an increase of 13%. This increase occurred just in time for dairy farmers to take advantage of the abolition of the milk quota on 1 April 2015.

The number of horses (and ponies) kept on farms rose from 67 thousand to 145 thousand between 1980 and 2009. Partly due to the 2008 financial crisis, between 2009 and 2015 the number of horses fell to 118 thousand. A large number of horses are kept by other types of establishments, such as stables. The total number of horses in the Netherlands is unknown, but recent estimates place it between 400 and 450 thousand.

[30] CLO, 2017k Livestock
http://www.clo.nl/indicatoren/nl2124-ontwikkeling-veestapel-op-landbouwbedrijven-?ond=20885

Fewer sheep, more goats
One consequence of the introduction of the milk quota in 1984 was a diversification of farms, since dairy cows were largely no longer an option. Farmers began to keep more sheep, and the number of sheep quickly rose. In 1992 sheep were brought under the manure legislation and the ewe premium was cut, resulting in a decline in sheep numbers. In 2006 the ewe premium, which was intended to provide income support for owners of meat and milk sheep during adverse market conditions, was integrated into the single payment scheme. As a result, the number of sheep has fallen sharply since 2007. In 1980 there were 850 thousand sheep; the peak of 2.0 million was reached in 1992, and in 2015 the number was 950 thousand.

In 1980 there were only a couple of thousand goats in the Netherlands. Between 1980 and 2009, the number of goats rose enormously. The only decrease was recorded in 1992. Since 1992, goats have also been covered by the manure legislation. By 2009, the number of goats had risen to nearly 375 thousand. In 2010, as a result of culls in connection with Q fever, the number of goats dropped to just over 350 thousand. By 2015 the number had risen again to 470 thousand.

Chickens and pigs are increasing again
Chicken numbers have fluctuated, but the overall trend is upwards. In 1980 there were 76 million chickens, and in 2015 there were 97 million. The significant decrease in 2003 was a result of the bird flu epidemic. In the spring of 2003, nearly 30 million chickens were culled. Since 2003, the number of broiler chickens has fluctuated around the 44 million mark. The number of laying hens has shown an upward trend since 2003. In 2015 there were 49 million laying hens.

The Dutch pig herd was 10 million strong in 1980. The highest number of pigs was 15 million in 1997. In February 1997 there was an outbreak of swine fever, leading to a significant decrease in the pig herd in the course of a single year. Between 1997 and 2004 there was a downward trend, resulting from factors such as market developments, the Pig Production Restructuring Act and environmental and animal welfare measures. At the low point in 2004 there were 11.2 million pigs. Since then the trend has picked up, and in 2015 there were 12.6 million pigs.

2.12 Forests

The forested area in the Netherlands currently consists of 373,000 hectares (ha). The forested area therefore amounts to around 10% of total land area. Originally the largest part of the forested area in the Netherlands was planted using regular spacing and just one or two species in even-aged stands, with wood production being the main purpose. A change towards multi-purpose forests (e.g. nature, recreation), which was first started in the 1970s, has had an impact on the management of these even-aged stands .

Most of the forested areas in the Netherlands are currently managed according to Sustainable Forest Management principles. Newly established forests are also planted according to these principles. The results of this management style are clearly shown in the National Forest Inventory. Unmixed coniferous stands decreased in favour of mixed stands (see Figure 2.36 and Figure 2.37; CLO, 2017l[31]).

These figures show that there has been a relative increase in mixed stands and unmixed broadleaf stands. This increase is at the expense of unmixed coniferous stands, which have decreased by around 8%. This change is due to the fact that more native broadleaf stands have been planted and coniferous stands have been replaced by broadleaf stands. Furthermore, in 2001–2005 there were fewer young stands and fewer felled areas than in 1984–1985. The latter is due to the fact that, these days, logging consists more of thinning forests than of felling all the trees in an area of woodland.

Most forests are located in the provinces of Gelderland and North Brabant; the least-forested province is Zeeland (see Figure 2.38, CLO, 2017m[32]).

[31] CLO, 2017l Forest types http://www.clo.nl/indicatoren/nl1160-arealen-van-bostypen
[32] CLO, 2017m Land use in the Netherlands
http://www.clo.nl/indicatoren/nl0061-bodemgebruikskaart-voor-nederland

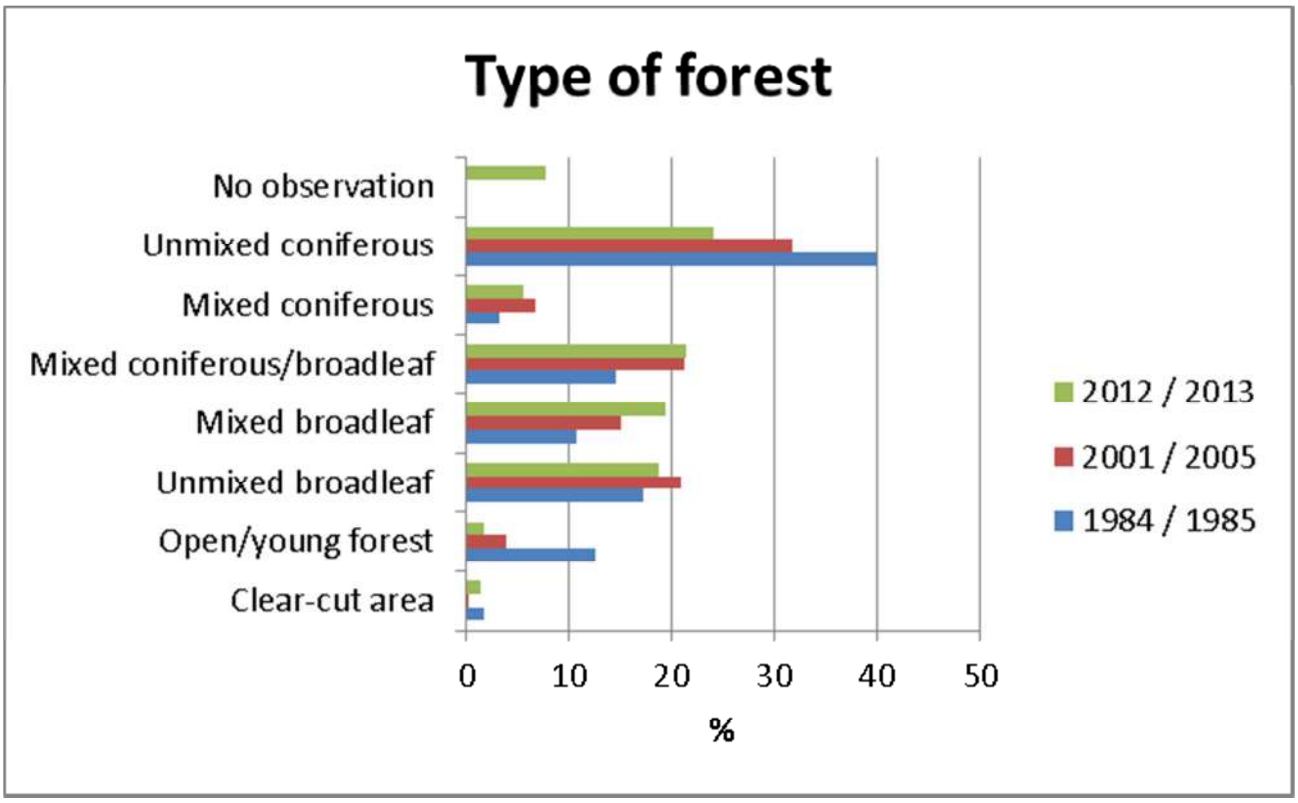


Figure 2.36 Composition of forests in the Netherlands (CLO, 2017l)

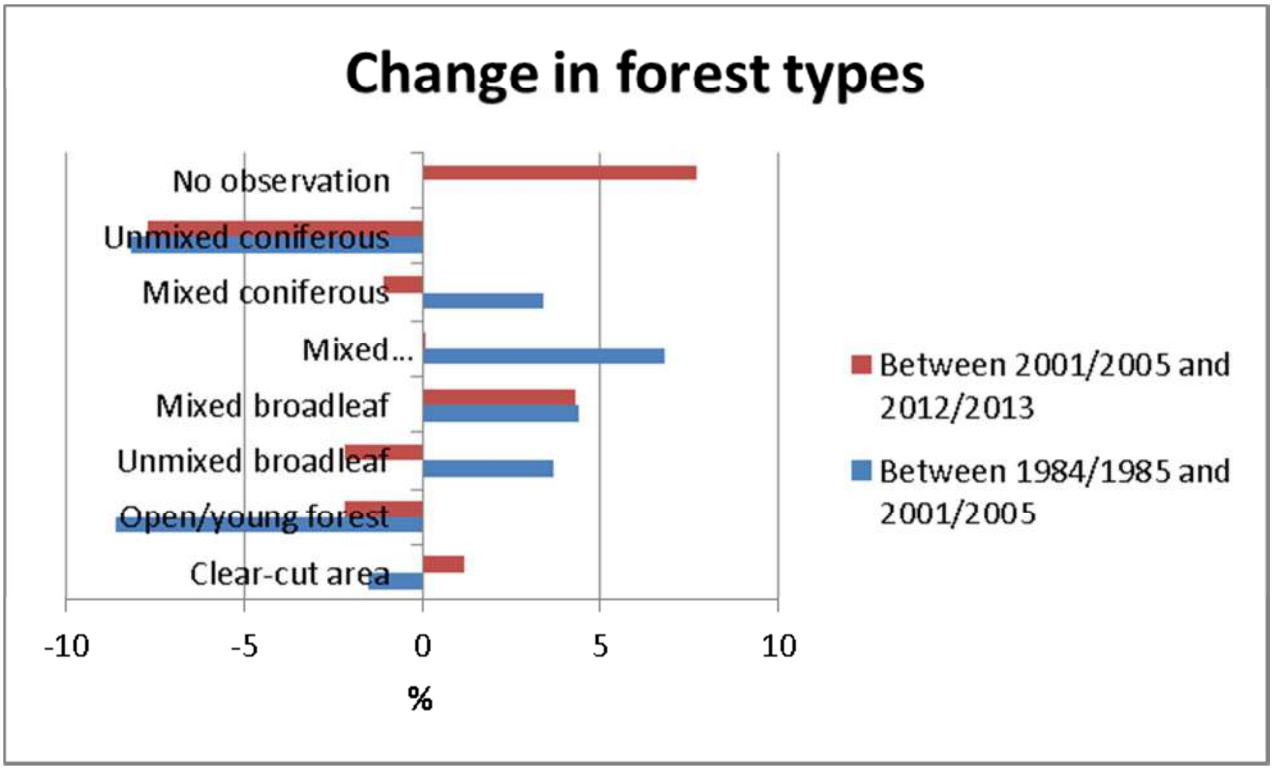


Figure 2.37 Change in composition of forests in the Netherlands (CLO, 2017l)

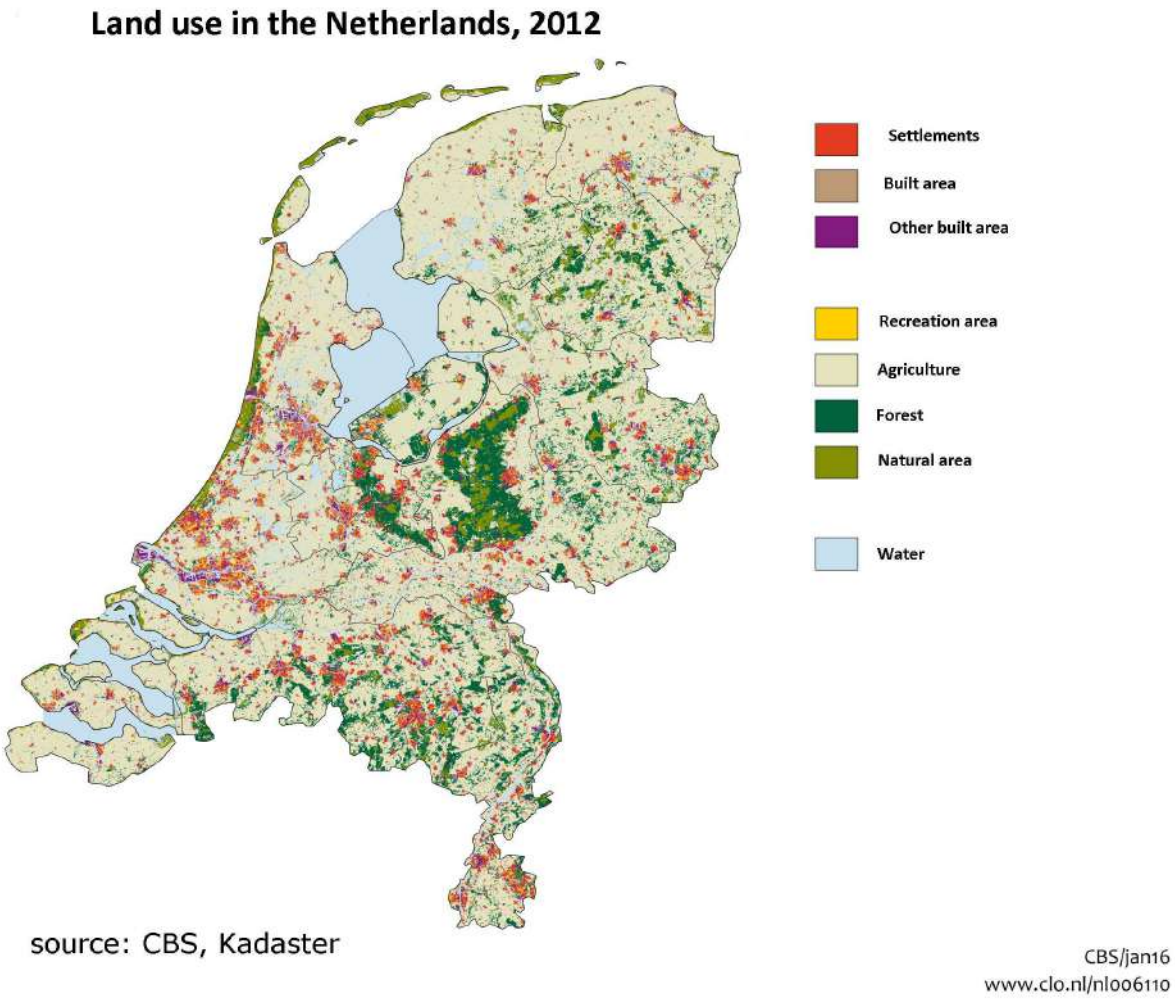


Figure 2.38 Land use in the Netherlands (CLO, 2017m)

3 GREENHOUSE GAS INVENTORY INFORMATION

3.1 (A) Summary tables

The Netherlands submitted its most recent greenhouse gas inventory (period 1990–2015) to the UNFCCC in April 2017. Summary tables, including trend tables for CO_2-equivalent emissions, are shown in Annex 1 of this National Communication. The main trends are explained in Section 3.2. below.

3.2 (B) Descriptive summary

This section summarises the trends in greenhouse gas emissions by greenhouse gas (GHG) and by sector over the period 1990–2015, as described in the National Inventory Report (NIR) 2017. More detailed explanations are provided in the NIR 2017[33]

Emission trends for aggregated greenhouse gas emissions
In 2015, the total GHG emissions (including indirect CO_2 emissions, but excluding emissions from land use, land-use change and forestry (LULUCF)) in the Netherlands amounted to 195.2 Tg CO_2 eq. This figure is approximately 12.5% below the emissions in the base year of 1990 (223.1 Tg CO_2 eq).

Figure 3.1 shows the trends and contributions of the different gases in relation to the aggregated national emissions of greenhouse gases. In the period 1990–2015, emissions of carbon dioxide (CO_2) increased by 1.5% (excluding LULUCF). Emissions of non-CO_2 GHGs, i.e. methane (CH_4), nitrous oxide (N_2O) and F-gases, decreased by 41%, 53% and 74% respectively.
Emissions of LULUCF-related sources increased by about 10% over the period 1990–2015. The total amount of GHG emissions in the Netherlands for the year 2015 (including LULUCF) was 202.0 Tg CO2 eq.

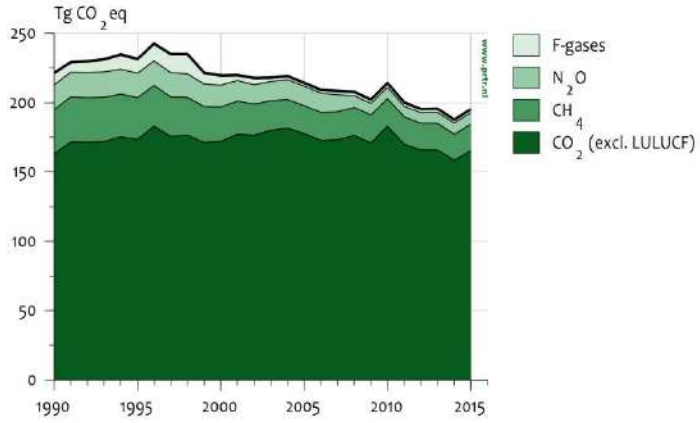


Figure 3.1: Trends and emission levels for greenhouse gases, 1990–2015, in Tg CO_2 eq

[33] Coenen et al., 2017).

Emission trends by gas

Carbon dioxide
Figure 3.2 shows the contribution of the most important sectors to the trend in total national CO_2 emissions (excluding LULUCF). In the period 1990–2015, national CO_2 emissions increased by 1.5% (from 162.9 to 165.3 Tg). The Energy sector is by far the largest contributor to CO_2 emissions in the Netherlands (97%), with the Subcategories 1A1 Energy industries (40%), 1A4 Other sectors (20%) and 1A3 Transport (19%) being the largest contributors in 2015.

Relatively high levels of CO_2 emissions in – for instance – 2010 is mainly explained by the relatively cold winter, which increased energy use for space heating in the residential sector. The resulting emissions are included in category 1A4 (Other sectors).

Indirect CO_2 emissions (calculated from the oxidation of NMVOC emissions from solvents) are only a minor source in the Netherlands (0.2 Tg in 2015).

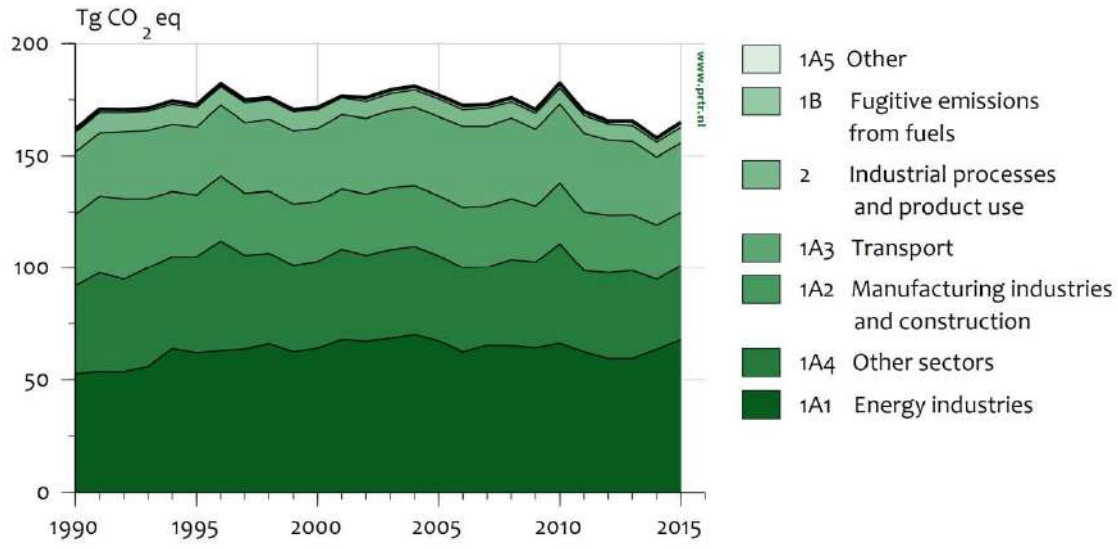


Figure 3.2: Trends and emission levels for CO_2 by sector, 1990–2015, in Tg CO_2 eq

Methane
Figure 3.3 shows the contribution of the most relevant sectors to the trend in total CH_4 emissions. National CH_4 emissions decreased by 41%, from 32.3 Tg in 1990 to 19.0 Tg CO_2 eq in 2015. The Agriculture and Waste sectors (67% and 18%, respectively) were the largest contributors in 2015.

Compared with 2014, national CH_4 emissions increased by about 1.2% in 2015 (0.2 Tg CO_2 eq). CH_4 emissions decreased in Category 5A (Solid waste disposal on land), but they were balanced by an increase in emissions from Agriculture.

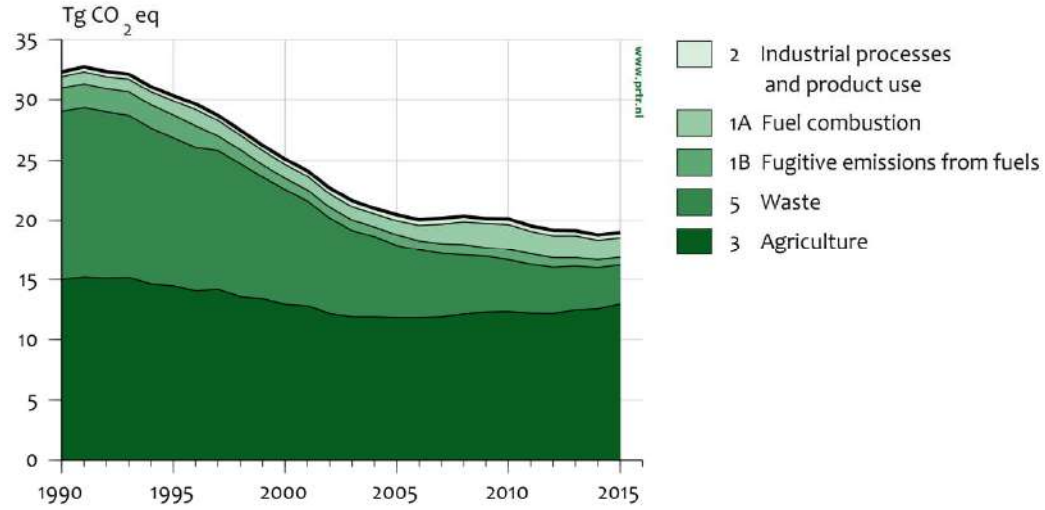


Figure 3.3: Trends and emission levels for CH_4 by sector, 1990–2015, in Tg CO_2 eq

Nitrous oxide

Figure 3.4 shows the contribution of the most relevant sectors to the trend in national N_2O emissions. In total, the national inventory of N_2O emissions decreased by about 53%, from 17.7 Tg CO_2 eq in 1990 to 8.3 Tg CO_2 eq in 2015. The Industrial processes sector contributed the most to this decrease in N_2O emissions (emissions were almost 81% lower than in the base year). Compared with 2014, the total N_2O emissions increased by 3.3% in 2015, mainly due to a rise of emissions in agriculture.

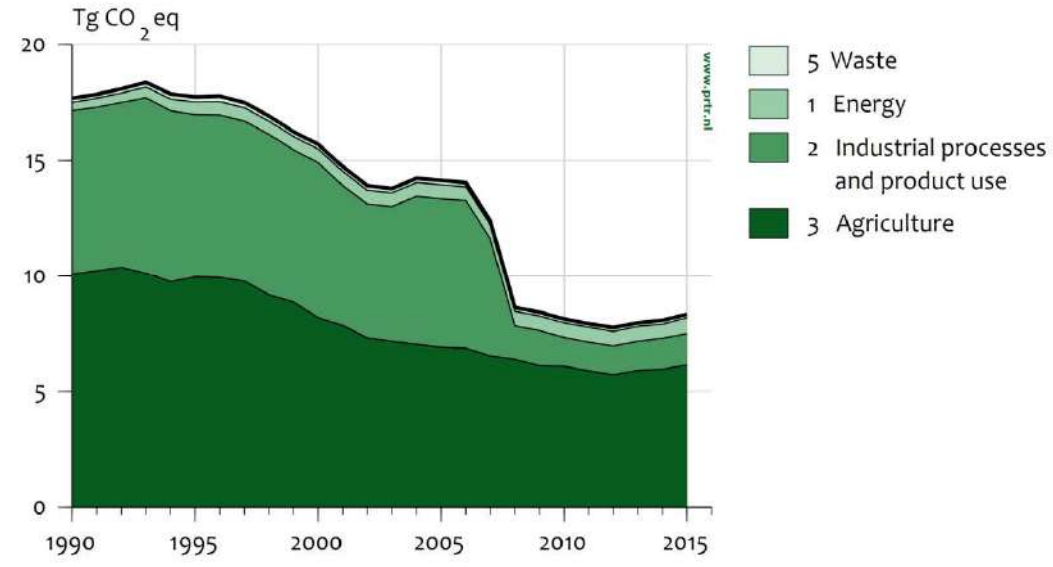


Figure 3.4: Trends and emission levels for N_2O by sector, 1990–2015, in Tg CO_2 eq

Fluorinated gases

Figure 3.5 shows the trend in fluorinated or F-gas emissions included in the national GHG inventory. The total emissions of F-gases decreased by 74% from 10.1 Tg CO_2 eq in 1995 (base year for F-gases) to 2.6 Tg CO_2 eq in 2015. Emissions of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) decreased by approximately 69% and 95% respectively during the same period, while sulphur hexafluoride (SF_6) emissions decreased by 47%. It should be noted that due to national circumstances, the emissions of NF_3 cannot be reported separately and are included in the PFC emissions.

Between 2014 and 2015, HFCs emissions increased by 3.6%, PFCs emissions increased by 10.6% and SF_6 emissions increased by 3.1%. The aggregated emissions of F-gases decreased by 1%.

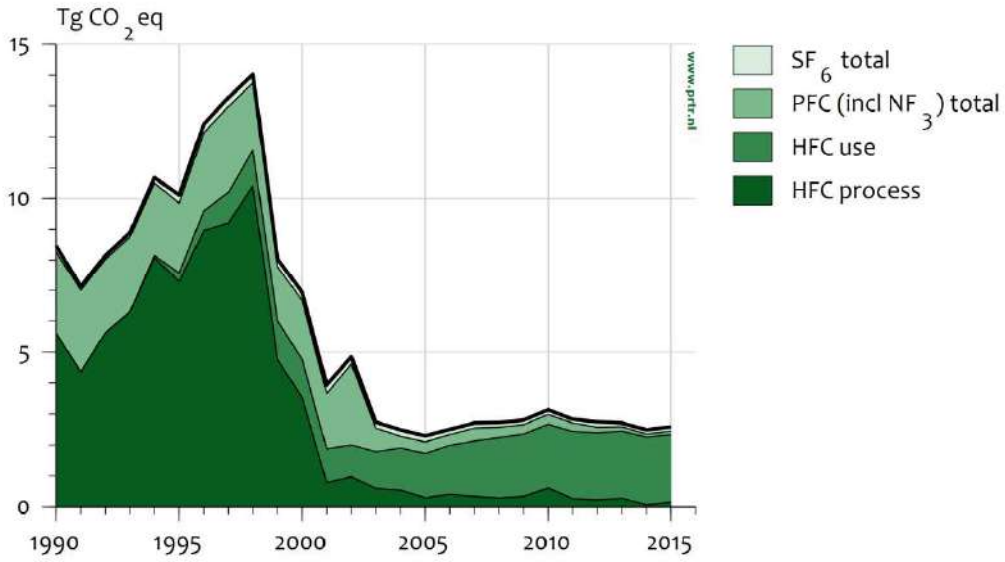


Figure 3.5: Trends and emission levels for individual fluorinated gases (F-gases), 1990–2015, in Tg CO_2 eq

Emission trends specified by source category

Figure 3.6 provides an overview of emissions trends for each IPCC sector in Tg CO_2 equivalents.

The Energy sector is by far the largest contributor to the total GHG emissions in the national inventory (contributing 68% in the base year and 78% in 2015). Emission levels of the Energy sector increased by approximately 3% in the period 1990–2015.

The total GHG emissions from the Waste, Industrial processes and Agriculture sectors in 2015 decreased by 77%, 57% and 24% respectively compared with the base year, while LULUCF emissions increased by 11% in the same period.

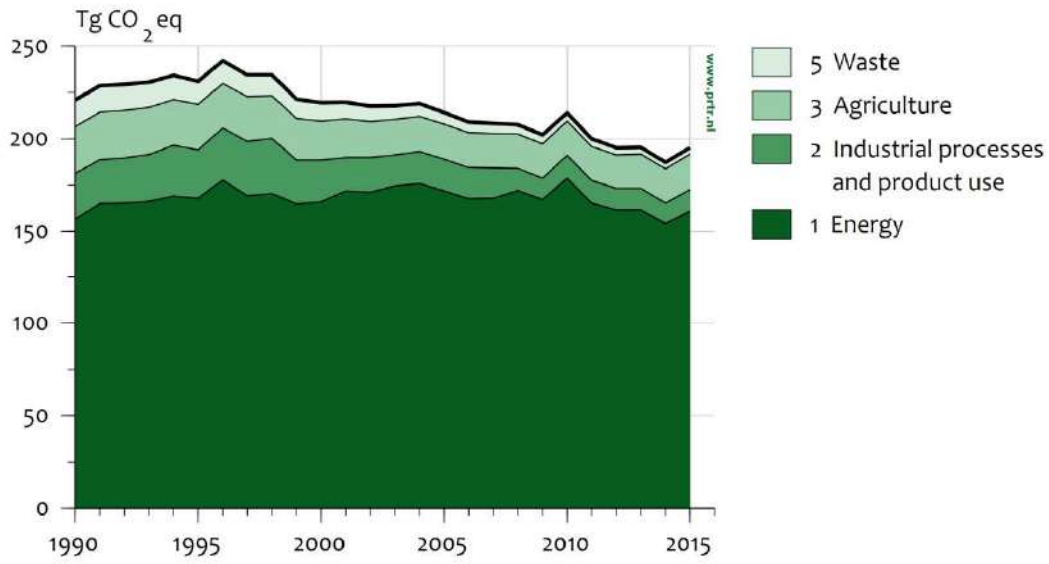


Figure 3.6: Trends and emission levels for aggregated greenhouse gases by sector, 1990–2015, in Tg CO_2 eq

Emission trends for indirect greenhouse gases and SO_2

Figure 3.7 shows the trends in total emissions of carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2). Compared with 1990, CO and NMVOC emissions in 2015 had decreased by 52% and 71%, respectively. For SO_2, the reduction was 84%; for NOx, the 2015 emissions were 64% lower than the 1990 level. With the exception of NMVOC, most of the emissions stem from fuel combustion.

Because of problems (incomplete reporting) identified with annual environmental reports, emissions of indirect greenhouse gases and SO_2 from industrial sources have not been verified. As a result, the emissions data for the years 1991–1994 and 1996–1998 are of a lesser quality.

In contrast to direct GHGs, calculations of the emissions of precursors from road transport are not based on fuel sales as recorded in national energy statistics, but they are directly related to transport statistics on a vehicle-kilometre basis. To some extent, this process is different from the IPCC approach.

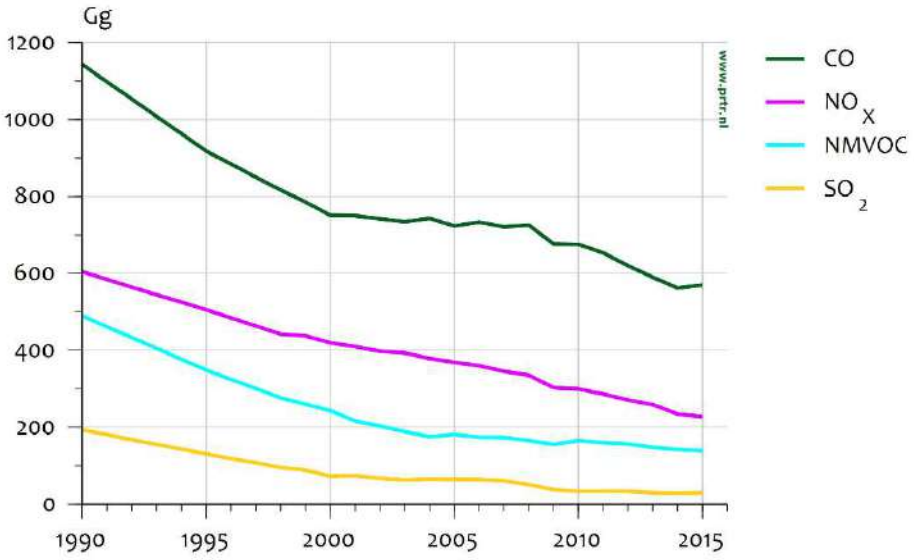


Figure 3.7: Trends and emission levels for NO_x, CO, NMVOC and SO_2, 1990-2015, in Gg

3.3 (C) Description of the national system

3.3.1 Scope and objectives of the National System

Introduction
As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, the Netherlands has in place a National System for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. The Netherlands established its National System in 2005. During the initial review, it was found to comply with all the necessary requirements. Since then, the system as such has remained unchanged, with three exceptions:

- Until 1 January 2010, the coordination of the Pollutant Release and Transfer Register (PRTR) – in which emissions of about 350 substances are annually calculated – was performed by the Netherlands Environmental Assessment Agency (PBL). As from 1 January 2010, coordination has been assigned to the National Institute for Public Health and the Environment (RIVM). Since that time, the processes, protocols and methods have remained unchanged. Many of the former experts from PBL have also moved to RIVM.
- In 2015, the Netherlands replaced the 40 monitoring protocols (containing the methodological descriptions as part of the National System) by five methodology reports. The methodology reports are also part of the National System. From 2015 onwards, the NIRs have been based on these methodology reports. The main reason for this change is that updating five methodology reports is simpler than updating 40 protocols. In addition, the administrative procedure is simplified because the updated methodology reports do not require an official announcement in the Government Gazette. For this reason, the Act on the Monitoring of Greenhouse Gases was updated in 2014. The methodology reports are checked by the National Inventory Entity (NIE) and approved by the chairperson of the PRTR Task Force concerned. As part of the National System, the methodology reports are available at the National System website[34].
- Finally, in 2017, the responsibility for climate policy shifted from the Ministry of Infrastructure and the Environment to the Ministry of Economic Affairs. The latter has been renamed the Ministry of Economic Affairs and Climate Policy (EZK). Other Ministries keep their responsibility for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g. the Ministry of Infrastructure and Water Mmanagement is responsible for climate adaptation).

This report details the system as it operates on 31 December 2017, describing how the required functions are performed in the Netherlands using the outline from the reporting guidelines (see Box 1).

[34] http://english.rvo.nl/nie.

Objectives of the National System

Under the Kyoto Protocol, a National System[35] includes all institutional, legal and procedural arrangements made within a Party (included in Annex I) for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, as well as for reporting and archiving inventory information. The objectives of the Dutch National System, in accordance with the guidelines, are as follows:

- to enable the estimation and reporting of anthropogenic GHG emissions by sources and removals by sinks[36];
- to facilitate meeting the commitments under Articles 3 and 7;
- to facilitate the review of the information submitted;
- to ensure and improve the quality of the inventory.

Netherlands Enterprise Agency (RVO.nl) coordinated the establishment of the National System and was subsequently assigned the role of "single national entity" (NIE).

Box 1 Outline

Institutional, legal and organisational aspects (Section 3.3.2), including:

(a) the name and contact information for the national entity and its designated representative with overall responsibility for the national inventory of the Party;

(b) the roles and responsibilities of various agencies and entities in relation to the inventory development process, as well as the institutional, legal and procedural arrangements made to prepare the inventory.

Methodology and process aspects (Section 3.3.3), including:

(c) a description of the process for collecting activity data, for selecting emission factors and methods, and for the development of emission estimates;

(d) a description of the process and the results of key source identification and, where relevant, archiving of test data;

(e) a description of the process for recalculating previously submitted inventory data.

Quality management aspects (Section 3.3.4), including:

(f) a description of the quality assurance and quality control plan, its implementation and the quality objectives established, and information on internal and external evaluation and review processes and their results in accordance with the guidelines for National Systems;

(g) a description of the procedures for the official consideration and approval of the inventory.

3.3.2 Institutional, legal and organisational aspects

Name and contact information for the national entity

(a)The name and contact information for the national entity and its designated representative with overall responsibility for the national inventory of the Party

Contact information of the National Entity:
Netherlands Enterprise Agency (RVO.nl), PO Box 8242, 3503 RE Utrecht, the Netherlands.
Designated representative with overall responsibility for the inventory:
Harry Vreuls, harry.vreuls@rvo.nl , telephone: +31 88 0422258.

The Minister of Economic Affairs and Climate Policy (EZK) has appointed RVO.nl by law as the single national entity (NIE)

.

Roles and responsibilities in relation to the inventory process

(b) The roles and responsibilities of various agencies and entities in relation to the inventory development process, as well as the institutional, legal and procedural arrangements made to prepare the inventory

The section below describes these elements, distinguishing between arrangements for data collection, data processing and reporting.

Introduction

35 Definitions used in this report are those used in UNFCCC guidelines.

36 As required by Article 5, and to report these emissions by sources and removals by sinks in accordance with Article 7(1) and relevant decisions of the Conference of the Parties (COP) and/or the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (COP/MOP).

The Ministry of Economic Affairs and Climate Policy (EZK) is the coordinating Ministry in the Netherlands for climate change policy. As defined in the guidelines under Article 5.1 of the Kyoto Protocol, the Minister of Economic Affairs and Climate Policy (EZK) has been given the authority by law to appoint a single national entity (also known as an NIE). The Minister has appointed RVO.nl as the NIE with overall responsibility for the national inventory. RVO.nl is responsible – among other things – for assembling and providing the annual reports to the UNFCCC, coordinating the QA/QC process and operating as focal point for the UNFCCC in relation to the report, which includes supporting the UN review process. Parts of the annual report are provided by other organisations.

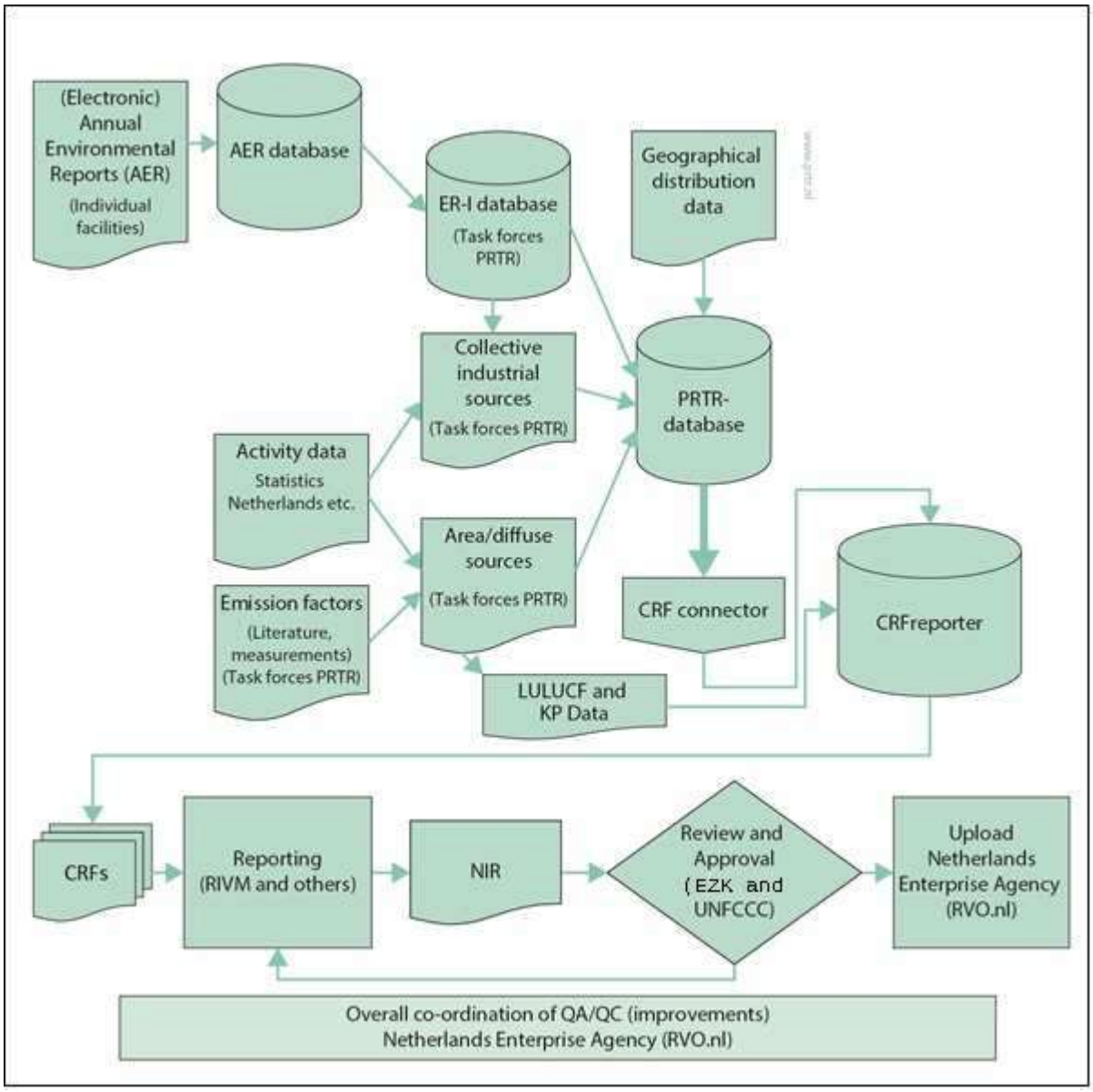


Figure 3.8: Schematic overview of main steps in the primary process; in practice, various feedback loops exist

The inventory and reporting process is illustrated in Figure 3.8 and briefly described below in three parts:

- arrangements for data collection;
- arrangements for data processing;
- arrangement for reporting.

Arrangements for data collection

The emission data are taken from the Pollutant Release and Transfer Register project (PRTR). This collaborative project (started around 1974) involves a series of bodies and ministries in the Netherlands. The objective of the project is to agree on one national data set for emissions inventories, covering some 350 pollutants to air, water and soil; this data set is used for a variety of international and national applications. Its coordination is assigned to RIVM (National

Institute for Public Health and the Environment), an agency under the Ministry of Health, Welfare and Sport (Ministry of VWS).

The data sources, methods and processes used for elaborating the greenhouse gas emission estimates are described in the National System documentation, notably in the form of methodology reports. These reports are drafted by the PRTR Task Forces, checked by the National Inventory Entity and approved by the chairperson of the PRTR Task Force concerned.

The PRTR project uses primary data from various data suppliers, as described below.

Statistical data
Statistical data are provided under various obligations and legal arrangements (not specifically related to greenhouse gases). These arrangements include national statistics from Statistics Netherlands (CBS) as well as a number of other data sources on sinks, water and waste. The provision of relevant data on greenhouse gases is guaranteed through covenants and an Order in Decree prepared by the Ministry of Economic Affairs and Climate Policy (EZK). For greenhouse gases, relevant agreements with Statistics Netherlands and Rijkswaterstaat Environment on waste management are in place. An agreement with the Ministry of Agriculture, Nature and Food Quality (LNV) and related institutions was established in 2005.

Data from individual companies
Data from individual companies are provided in the form of electronic annual environmental reports (e-AERs). A large number of companies have a legal obligation to submit an e-AER which includes, in addition to other environment-related information, emissions data validated by the competent authorities (usually provincial and occasionally local authorities, which also issue environmental permits to these companies). Some companies provide data voluntarily within the framework of environmental covenants. Large companies are also obliged to participate in the European Emission Trading Scheme (EU ETS). These companies have to report their CO_2 emissions in specific annual ETS emission reports.

The data in the AERs and EU ETS reports are used to verify the CO_2 emissions figures derived from energy statistics for the industry, the energy sector and refineries. Whenever reports from major industries contain plant-specific activity data as well as EFs of sufficient quality and transparency, these reports are used in the calculation of CO_2 emissions estimates for specific sectors. Plant-specific data is mainly used for the calculation of CO2 emissions from derived gases (chemical waste gas, blast furnace gas, coke oven gas). Since derived gases can have a highly variable emission factor, the use of plant-specific data will improve the CO2 calculations. The AERs from individual companies also provide essential information for calculating the emissions of substances other than CO_2. Calculations of industrial process emissions of non-CO_2 GHGs (e.g. N_2O, HFC-23 and PFCs released as by-products) are mainly based on information from these AERs, as are emissions figures for precursor gases (CO, NO_x, NMVOC and SO_2). Only those AERs with high-quality and transparent data are used as a basis for calculating the total source emissions in the Netherlands.

Additional data related to greenhouse gases
Additional data related to greenhouse gases are provided by other institutes and consultants specifically contracted to supply information on sectors not sufficiently covered by the aforementioned data sources. For example, RIVM concludes contracts and financial arrangements with various agricultural institutes and TNO. During 2004, the Ministry of Agriculture, Nature and Food Quality (LNV) issued contracts to a number of agricultural institutes; in particular, these contracts comprised the development of a monitoring system and a methodological description for the LULUCF data set. Based on a written agreement between the Ministry of Agriculture, Nature and Food Quality (LNV) and RIVM, these activities are also part of the PRTR.

Arrangements for data processing
The calculation of greenhouse gas emissions and sinks is the responsibility of the PRTR project. Data are collected and processed by five Task Forces (see Box 2) according to predetermined methods described in the methodology reports.

Arrangements for reporting, QA/QC coordination and review
The data are stored in the PRTR Central Database system. From this PRTR database, the CRF is generated automatically.

The overall annual report for the UNFCCC is drafted and coordinated by RVO.nl (the NIE). To ensure the involvement of the relevant experts from the various bodies (CBS, TNO, PBL, RIVM, Alterra, and so on) that supplied the relevant emission estimates, this procedure is implemented as an annual project in which each section of the NIR is assigned to one lead author. This lead author usually involves other experts, while a co-author is assigned for mutual checks. The NIE is closely involved, but the coordination and fine-tuning of the contents of Part 1 of the NIR is delegated to RIVM in order to ensure consistency with the PRTR data. Overall coordination, including the elaboration of Part 2 of the NIR, is carried out by RVO.nl/NIE. The elaboration of Part 2 involves various ministries (Ministry of Agriculture, Nature and Food Quality (LNV), Ministry of Economic Affairs and Climate Policy (EZK)) and institutes (Dutch Emissions Authority (NEa) and Alterra).

RVO.nl/NIE submits the annual report to the UNFCCC after approval by the Ministry of Economic Affairs and Climate Policy (EZK). It has also been assigned overall QA/QC coordination of the inventory, its process and the national system, facilitation of UNFCCC reviews and coordination of requests for clarification.

Box 2 Pollutant Release and Transfer Register (PRTR) project

Responsibilities for coordination of the PRTR project
Major decisions on tasks and priorities are taken by the Steering Committee ER (SCER) through approval of the Annual Work Plan. This committee consists of the representatives from the commissioning ministries, regional governments, RIVM and PBL.

The PRTR project leader at RIVM acts as coordinator and is responsible for the PRTR process; the outcomes of that process are the responsibility of the bodies involved. Contribution of the various bodies is ensured by means of contracts, covenants or other agreements.

Task Forces
Various emission experts from the participating organisations take part in the Task Forces that calculate the national emissions from 650 emission sources. A formal agreement is drawn up by all the participating organisations. After intensive checking, the national emissions are accepted by the project leader of the PRTR project and the data set is stored in the Central Database.

The 650 emission sources are logically divided into 55 work packages. An emission expert is responsible for one or more work packages, the collection of the data and the calculation of the emissions. The experts are also closely involved in developing the methodologies to calculate the emissions. Work packages are grouped into five Task Forces as described below.

Task Force on Energy, Industry and Waste Management (ENINA):
Covers the emissions to air from the Industry, Energy production, Refineries and Waste management sectors. ENINA includes emission experts from the following organisations: RIVM, TNO, Statistics Netherlands (CBS), Rijkswaterstaat Environment (Waste Management Department), Deltares and Fugro-Ecoplan.

Task Force on Transportation
Covers the emissions to soil and air from the Transportation sector (aviation, shipping, rail and road transport). The following organisations are represented: Netherlands Environmental Assessment Agency (PBL), Statistics Netherlands (CBS), Rijkswaterstaat, Deltares and TNO.

Task Force on Agriculture
Covers the calculation of emissions to soil and air. Participating organisations include RIVM, Netherlands Environmental Assessment Agency (PBL), LEI, Alterra, Statistics Netherlands (CBS) and Deltares.

Task Force on Water - MEWAT
Covers the calculation of emissions from all sectors to water. MEWAT includes Rijkswaterstaat, Deltares, Netherlands Environmental Assessment Agency (PBL), RIVM, Statistics Netherlands (CBS) and TNO.

Task Force on Consumers and other sources of emissions - WESP
Covers the emissions caused by consumers, trade and services. The members are emission experts from RIVM, TNO and Statistics Netherlands (CBS).

Legal arrangements for the National System
The Greenhouse Gas Monitoring Act came into effect at the end of 2005. This Act established a National System for monitoring greenhouse gases and empowered the Economic Affairs and Climate Policy to appoint an authority responsible for the National System and the National Inventory. The Minister has appointed RVO.nl as this authority (NIE; Government Gazette (Staatscourant), 2005).
The Act also specifies that the National Inventory must be based on methodologies and processes as laid down in the methodology reports.

3.3.3 Methodology and process aspects

Introduction
The annual cycle is a key quality management tool (based on the Deming cycle of plan-do-check-act) and encompasses:

- inventory planning;
- inventory preparation;
- inventory evaluation;
- inventory improvement.

The following sections describe how the required specific functions are performed for each of these steps. Figure 3.9 illustrates the steps and the QA/QC tools used in each step.

(c) A description of the process for collecting activity data, for selecting emission factors and methods and for the development of emission estimates is included in the methods and processes to be used

The roles and responsibilities in the process of collecting activity data, selecting emission factors and developing emission estimates are described in the previous section. This section describes the methodology and process aspects of this procedure.

The choices in relation to the activity data to be used, the emission factors to be chosen, the methods to be selected and the steps to produce the emission estimates have been made in various ways.
During the establishment of the national system, an improvement programme was implemented together with the relevant bodies and experts as well as with independent experts. This programme assessed all relevant data, factors and methods, which was done in workshops and through special background studies, among other things. Choices were made in line with the IPCC and UNFCCC guideline concerning changes in methods, data and factors. These choices were made together with the experts and a special committee in which relevant bodies participated. The resulting data sources, emission factors, methods and working processes were specified in monitoring protocols. In 2015, the Netherlands replaced the monitoring protocols (containing the methodological descriptions as part of the National System) by five methodology reports. These methodology reports are also part of the National System.

The annual QA/QC cycle (see below) guarantees that attention is constantly being paid to any necessary and/or possible improvements. Results of internal and external QA/QC and review processes form an important basis for this procedure.

In the past years, the five-year extensive review activities were aimed at the changes deriving from the introduction of the 2006 IPCC Guidelines (IPCC, 2006).
For the longer term, RVO.nl will consider how the improvement programme can be continued, albeit with a different scope. RVO.nl aims at a monitoring system which provides more useful feedback to sectors/policymakers/other stakeholders and which is more cost-effective (avoiding duplication in data gathering, adjusting the frequency of data gathering according to relevance and trends, and so on).

More detailed information on how these processes have been implemented is provided by a description (in the section below) of the implementation in the National System of various functions as part of an annual management cycle in the Netherlands.

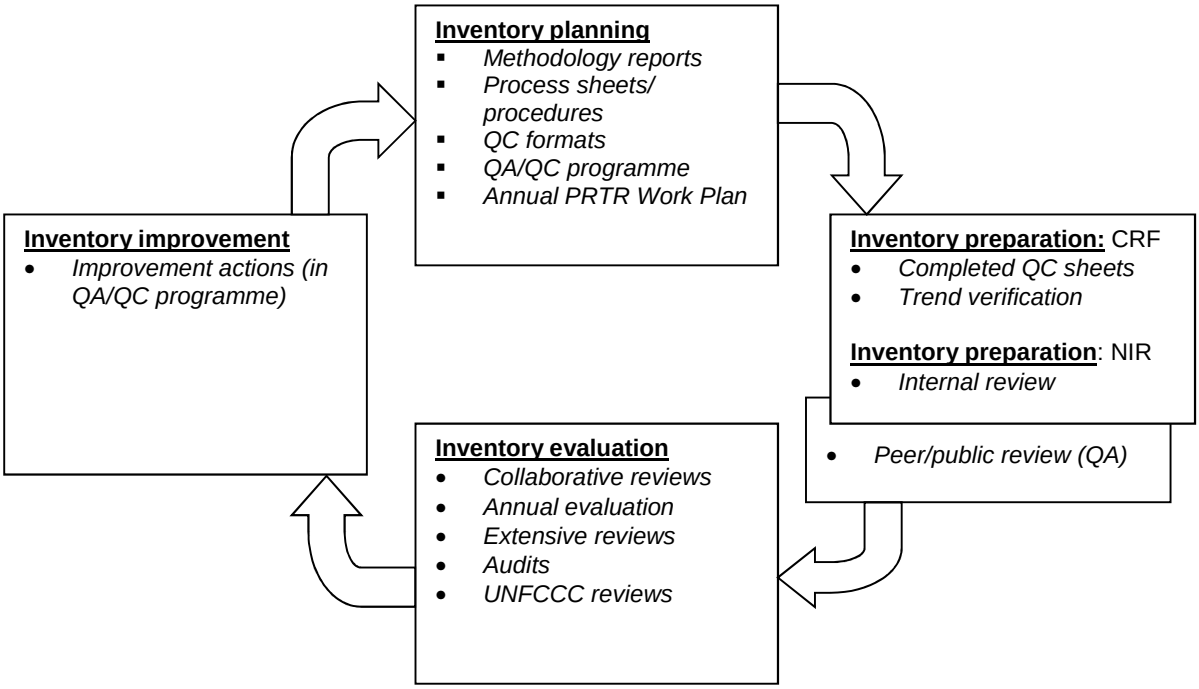


Figure 3.9: Annual cycle

Inventory planning

This step comprises the annual planning. QA/QC tools include the following set of planning documents, updated annually as part of the evaluation and improvement cycle:

- *methodology reports*, describing methodologies and processes for estimating emissions and sinks. These methodology reports replace the system of Monitoring Protocols that was used until 2014. The methodology reports will be checked by the National Inventory Entity and approved by the chairperson of the PRTR Task Force. They are also made accessible on the national system website[37] and listed in Annual Work Plans (ER, 2017);
- *set of procedures*, describing other relevant key processes in the national system, including a list of applicable procedures (SenterNovem, 2005);
- *set of agreements* on the basic institutional, legal and organisational structure. These agreements have been recorded in contracts, legal arrangements and covenants (see previous section);
- *QA/QC programme*, including the planning of activities and improvement projects. This programme is updated annually;
- *Annual Work Plans* of the ER (ER, 2017) providing more detail on planning of the PRTR process, such as the working procedures to be used and the documentation/registration sheets to be applied.

The agreements, methodology reports, procedures and QA/QC programme are reviewed annually, updated (if necessary) and approved for use in the next cycle. RVO.nl is responsible for updating the QA/QC programme, including the improvement cycle. Updates are approved by the Ministry of Economic Affairs and Climate Policy (EZK), in consultation with the Advisory Board NIE[38]. For LULUCF issues, the Ministry of Economic Affairs and Climate Policy (EZK) will seek agreement with the Ministry of Agriculture, Nature and Food Quality (LNV).

The annual planning is further detailed in the Annual Work Plans, which specify staffing, allocating time budgets and scheduling of the next inventory cycle. These plans also describe the tasks involved in performing the general QC (Tier 1), including the sample calculations, and further describe which work instructions, databases, documentation sheets and other tools should be used. The work plan is approved by the respective organisations[39] after consultation.

Inventory preparation

37 (http://english.rvo.nl/nie)

38 Consisting of representatives from the Ministry of Economic Affairs and Climate Policy (EZK), the Ministry of Agriculture, Nature and Food Quality (LNV) and the following institutes: Statistics Netherlands (CBS), National Institute for Public Health and the Environment (RIVM), Dutch Emissions Authority (NEa), Netherlands Environmental Assessment Agency (PBL).

39 For the PRTR Work Plan, approval is given by the Steering Committee ER.

The inventory preparation comprises the following functions and activities:

- collecting data, processing data and estimating emissions in accordance with the methodology reports and the timetable in the Annual Work Plan. The actual process is documented in documentation sheets that include information on data used, any necessary deviations from the agreed methods (including their approval) and any other relevant information needed for the "paper trail" of the estimates;
- performing the general QC procedures (Tier 1) as detailed in the Annual Work Plans (on non-confidential and confidential data), documenting results and corrections (as well as approval);
- elaborating the CRF and NIR in accordance with the related procedures, including the trend verification workshop and internal review.

(d) A description of the process and the results of key source identification and, where relevant, archiving of test data

The key source analysis is part of the annual process for the NIR (Part 1). This analysis will be executed by the PRTR under the responsibility of its coordinator after the annual emissions have been calculated. Any changes in key sources, together with the results of the uncertainty analyses, will be taken into account by the NIE in the improvement actions and planning for the next cycle. Performing the key source and uncertainty analyses is also described in the procedures of the National System.

(e) A description of the process for recalculating previously submitted inventory data

If necessary during the inventory preparation process, recalculations are also performed and documented in accordance with the related IPCC guidelines. Methods can only be changed after the formal approval of the revised methods by the NIE Advisory Board (Klankbordgroep NIE) and the Ministry of Economic Affairs and Climate Policy (EZK), since these changes also have to be included in the methodology reports. This approval is achieved by using the initiator's arguments for why a change in methods, data or factors is better and/or necessary. Such an assessment also looks into whether the change has been sufficiently reviewed and documented.

Changes can be initiated by all parties involved; they can be based on recommendations by the UN review team as well as on new scientific improvements and/or developments in data availability.

Inventory evaluation

The annual inventory evaluation consists of various elements:

- annual "internal" review of the draft NIR before submission to the UNFCCC. This review is coordinated by the NIE and comprises internal quality assurance, a basic peer review and a public review. The latter is performed using the National System website, together with the notification of experts and organisations with a potential interest;
- implementation of an annual internal evaluation and improvement cycle, performed jointly by NIE and PRTR. This cycle comprises two major steps:
    - around June – evaluating the previous cycle and updating the QA/QC programme;
    - around October – updating planning and methodology reports for the next cycle if needed.

Inventory improvement

The annual list of improvement actions is an integral part of the QA/QC programme. If any results – particularly those from UN reviews – give rise to urgent improvement actions, additional actions may be adopted. Improvements which influence methods or which may cause recalculations require formal approval in accordance with the relevant procedure. Proposals for methodological changes are submitted by the PRTR to the NIE, which adds a recommendation on the proposals and sends them to the NIE Advisory Board for approval (see also above text under point e). In addition, the QA/QC programme includes non-annual review and audit activities which contribute to the evaluation and continuous improvement of the National System.

Inventory management

Management of the inventory in the Netherlands encompasses:

- documenting and archiving the relevant information for each cycle, using an annual file of relevant documents. The Dutch archiving system is centrally accessible to the NIE, with the exception of confidential information. Confidential information is not archived centrally but is accessible on-site, in line with PRTR procedures. Such confidential information can be accessed by the project leader, the project secretary and the (deputy) work package leader. It is available on request for UN review in line with the CP decision and the code of practice. Non-confidential key documents are made accessible through the National System website as far as possible;

- facilitating UN reviews and responding to any related requests for clarification under the EU monitoring mechanism and the UNFCCC. This task is performed by RVO.nl as the NIE.

3.3.4. Quality management aspects

Introduction
The National System itself is a key tool in improving the quality and process management of the inventory process as described in the previous chapter. Various tools and QA/QC activities are further elaborated in the QA/QC programme. Several improvements have been implemented in recent years. The main inputs have been the results of internal and external evaluation and review processes.

> (f) A description of the quality assurance and quality control plan, its implementation and the quality objectives established, and information on internal and external evaluation and review processes and their results in accordance with the guidelines for National Systems.
>
> *The QA/QC system, programme and plan as well as their implementation are described in this section, which also highlights information on internal and external evaluations, as well as review processes and their results.*

QA/QC programme
The QA/QC programme describes the quality objectives of the inventory, the National System and the QA/QC plan. It is based on previous experiences with the inventory process, including relevant information and results from internal and external evaluation and review processes as well as the results of recent UN reviews. The QA/QC programme includes a timetable, tasks and responsibilities. This programme is essentially an internal document that is available for UN review. RVO.nl is responsible for the coordination and implementation of the programme. It will be updated about once a year where necessary, usually in the autumn as part of the planning cycle.

The objectives are further elaborated in the programme through the use of more specific quality objectives related to improving transparency, consistency, comparability, completeness and accuracy (the “inventory principles”).

This QA/QC plan consists of four groups of activities. In selecting activities, it takes into account general considerations such as practicality, acceptability, cost-effectiveness and existing experience. The activities are grouped as follows:

- quality control;
- quality assurance;
- documentation and archiving;
- evaluation and improvement.

Quality control
- Maintaining a transparent system through methodology reports, procedures and the QA/QC programme. This step is essential for the planning phase. It defines requirements and outputs;
- regularly reviewing and updating the information on QA/QC by external agencies;
- applying General QC (Tier 1) procedures as part of the standard working processes in accordance with the IPCC Guidelines and, where applicable, source-specific QC procedures for selected sources. The main responsibility for implementation lies with the PRTR, while the NIE regularly checks whether activities and outputs still comply with the guidelines;
- updating Tier 1 uncertainty analysis (annually) and Tier 2 uncertainty analysis (every five years).

Quality assurance
This procedure is primarily implemented by staff not directly involved in the inventory process which is coordinated or implemented by RVO.nl. The main activities include:
- basic peer review process of CRF/NIR before submission to the UNFCCC – internal review, public review and peer reviews;
- extensive review process – coordinating improvements for the longer term process (see section 3.3.3);
- annual audit on selected part(s) of the National System;
- outside agencies archiving the reports of internal audits as far as GHG activities are involved.

Documentation and archiving
The main activities relate to the cycle as a whole:
- documenting and archiving relevant information on the inventory, QA/QC programme, QA/QC activities, reviews and planned improvements;
- facilitating reviews and responses for clarification. The NIE coordinates this process.

Evaluation and improvement
The main activities include:
- implementation of the annual evaluation and improvement cycle as mentioned above; activities are determined annually in the QA/QC programme on the basis of experiences from reviews and QA/QC actions.

Results from internal and external evaluations and reviews
Various actions are taken to improve and maintain the quality of the National System, which include:
- annual UNFCCC reviews of the functioning of the National System. In 2007, the National System was reviewed during an initial review. The review team concluded that the Dutch National System had been established in accordance with the guidelines for National Systems under Article 5(1) of the Kyoto Protocol (decision 19/CMP.1) and that it met the requirements for implementation of the general functions of a national system as well as the specific functions of inventory planning, inventory preparation and inventory management. In the annual review reports, the expert review teams report that the National System continues to fulfil the requirements without providing further recommendations;
- follow-up to the annual recommendations of the UNFCCC reviews. In Chapter 10 of consecutive National Inventory Reports (NIR), an overview of recommendations and actions is incorporated. In a detailed table within this chapter, it is explained how the recommendations are implemented or why not (no data available, budget constraints, and so on). Of course, Saturday Paper issues are solved immediately, as was the case in 2016 for the emissions from Solid Waste Disposal (fraction of methane in landfill gas). This issue led to a resubmission of the CRF data in February 2017;
- annual review by the Technical Expert Review Team (TERT) under the Effort Sharing Decision (ESD) on behalf of the European Commission. This review takes place in the period from January to June. The TERT checks the draft data for greenhouse gas emissions, the elaborations in the draft National Inventory Report and the changes compared to previous years. If possible, results from this review are used in finalising the reporting to the UNFCCC. Otherwise, the results are used in the submission for the next year;
- annual QA activities by RVO.nl in its role as NIE – internal reviews on the entire NIR, audits on part of the NIR and a peer review on part of the NIR, outsourced to an external expert. These activities have led to separate recommendations on quality improvements of the NIR and methodological descriptions in the methodology reports.

Official consideration and approval

(g) A description of the procedures for the official consideration and approval of the inventory

The Ministry of Economic Affairs and Climate Policy (EZK) gives approval for the NIR/CRF to be submitted by the NIE to the UNFCCC after consulting the results of the checks by the NIE and, if needed, after consulting with the Ministry of Agriculture, Nature and Food Quality (LNV) on LULUCF issues.

3.3.5. Programmes to improve the quality of local emission factors, activity data and/or models (Art. 10 of the Kyoto Protocol)

The Netherlands actively aims for the continuous improvement of its inventory. Previous sections describe its quality improvement cycle and programmes as well as the main results. In addition, the Netherlands actively participates in what may be considered a "regional programme" activity; the experts within the EU regularly convene to discuss experiences with their respective inventories so as to identify and, where relevant, implement improvement actions. This procedure is achieved through expert workshops, working group meetings and joint EU research programmes.

The Netherlands has in recent years also participated in special programmes where experiences with inventories are exchanged. In 2016, the Netherlands received a delegation from Turkey within the framework of the EU-funded project "Technical Assistance for Support to Mechanism for Monitoring Turkey's Greenhouse Gas Emissions". The aim of the study tour was to improve reporting by Turkey to the UNFCCC, including national GHG inventories, National Communications and Biennial Reports. This programme consisted of presentations by and discussions with representatives from various ministries and bodies involved in the PRTR project.

3.4 (D) National Registry

This section describes the Dutch National Registry. It follows the outline for presenting information taken from the guidelines on the reporting of information under Article 7.2 of the Kyoto Protocol.

(a) The name and contact information of the registry administrator designated by the Party to maintain the National Registry

Registry administrator	
Name	Harm van de Wetering
Address	Koningskade 4 – PO Box 91503
City	The Hague
Postcode	2509 EC
Country	The Netherlands
Telephone number	+31 6 52595182
Fax number	+31 70 4568247
Email	harm.vande.wetering@emissieautoriteit.nl

(b) The names of the other Parties with which the Party cooperates by maintaining their National Registries in a consolidated system

The Netherlands maintains its National Registry in a consolidated manner within the central European Emissions Trading Registry (EU Registry) with all the Parties that are also members of the European Union. This European Emissions Trading Registry is hosted and facilitated by the European Commission.

(c) A description of the database structure and capacity of the National Registry

A description of the database structure and capacity can be found in the readiness documentation, available on the UNFCCC website[40].

(d) A description of how the National Registry conforms to the technical standards for data exchange between Registry Systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between National Registries, the Clean Development Mechanism Registry and the transaction log (decision 19/CP.7, paragraph 1)[41]

[40] https://extranet.unfccc.int/registry-systems/All%20Documents/Forms/EU%20Common%20Readyness%20Information.aspx
[41] See decision 24/CP.8.

The EU Registry software has been developed to implement the EU Emissions Trading Scheme and the Kyoto Emissions Trading Scheme. Both schemes require Registries to be compliant with the UN Data Exchange Standards (DES) referred to in the Kyoto Protocol. Through ongoing development, the Commission's registry software is continuously kept up to date with the current version of the DES specifications.

The EU Registry software implements functionalities to perform issuance, conversion, external transfer, voluntary cancellation, retirement and reconciliation processes by using XML messages and web services as specified in the DES.

In addition, the CIE registry software implements functionalities for 24-Hour Clean-up, Transaction Status Enquiry, Time Synchronisation, Data Logging requirements (including Transaction Log, Reconciliation Log, Internal Audit Log and Message Archive), Replacement of tCERs and lCERs, Carry-Over, Expiry Date Change (for tCER and lCER), ITL Notices (and the Notification Log) and the various identifier formats as specified in the DES.

(e) A description of the procedures employed in the National Registry to minimise discrepancies in the issuance, transfer, acquisition, cancellation and retirement of ERUs, CERs, tCERs, lCERs, AAUs and/or RMUs, and replacement of tCERs and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transactions

In order to minimise discrepancies between the EU Registry and the Transaction Log, the following approach has been adopted for the development of the registry software.

Communication between the EU Registry and the ITL is achieved via web services using XML messages, as specified in the DES. These web services, XML message formats and the processing sequence are as specified in the DES. As far as possible, the Registry validates data entries against the list of checks performed by the ITL – as documented in Annex E of the UN DES Annexes document – before forwarding the request to the ITL for processing. This procedure minimises the submission of incorrect information to the ITL for approval.

All units that are involved in a transaction are earmarked internally within the Registry, thereby preventing the units from being involved in another transaction until a response has been received from the ITL and the current transaction has been completed.

The web service that receives the transaction proposal messages logs and confirms the receipt of these messages if they are technically valid. Next, the content validation and processing is performed sequentially. This separation allows for swift communication with the ITL while still performing extensive business checks. It also significantly improves the transaction handling capacity of the Registry System.
Where a 24-hour clean-up message is received from the ITL regarding a transaction, the web service will roll back the units that were involved in this transaction, thus ensuring that the unit holdings in the Registry reflect the unit holdings as recorded in the ITL.

If an unforeseen failure were to occur, any data discrepancies between the EU Registry and the ITL can be corrected via a manual intervention function within the Registry which is initiated by the Service Desk of the EU. Following this procedure, reconciliation will be performed to confirm that the data are again in sync between the EU Registry and the ITL.

(f) An overview of security measures employed in the National Registry to prevent unauthorised manipulations and to prevent operator errors, and a description of how these measures are kept up to date

The security measures of the EU Registry are described in the EU Registry Security Plan, which can be found in the EU Readiness Security Plan that is part of the readiness documentation, available on the UNFCCC website[42].

(g) A list of the information publicly accessible by means of the user interface to the National Registry

[42] https://extranet.unfccc.int/registry-systems/All%20Documents/Forms/EU%20Common%20Readyness%20Information.aspx

The Registry consists of a public area and a restricted area. While the public area is accessible to everyone and can be used to find publicly available information[43], the restricted area is only accessible to authorised users[44].

Users wanting to access the restricted area are redirected to the restricted area through the public area. Although the public and restricted areas are technically distinct, referral links between these areas ensure that combined users perceive them as one area. The homepage of our website is linked to the CITL, which contains all information required by the European Regulation on Registries (2216/2004).

All publicly available information as described in 13/CMP.1, Annex II.E, Paragraphs 44–48, is also available via the website of the Dutch Emissions Authority[45].

The user terms and conditions are also available through the website of the Dutch Emissions Authority[46].

(h) A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of Registry services in the event of a disaster

The European Emissions Trading Registry is hosted and facilitated by the European Commission.
A description of measures taken to safeguard, maintain and recover data can be found in the readiness documentation, available on the UNFCCC website[47].

Physical security
The European Emissions Trading Registry is hosted and facilitated by the European Commission.
A description of the physical security can be found in the readiness documentation, available on the UNFCCC website[48].

(i) The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the National Registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between Registry systems

Testing of the Registry related to the technical standards for data exchange between Registry systems is carried out under the supervision of the European Commission. A description of the test procedure can be found in the readiness documentation (CSEUR - Readiness Questionnaire v1.1.doc), available on the UNFCCC website[49].

[8] https://ets-registry.webgate.ec.europa.eu/euregistry/NL/public/reports/publicReports.xhtml
[44] https://ets-registry.webgate.ec.europa.eu/euregistry/NL/index.xhtml
[45] https://www.emissionsauthority.nl/topics/public-information-kyoto
[46] https://www.emissionsauthority.nl/documents/publications/2016/10/26/user-terms-and-conditions-pha-ta-ka .
[47] https://extranet.unfccc.int/registry-systems/All%20Documents/Forms/EU%20Common%20Readyness%20Information.aspx
[48] https://extranet.unfccc.int/registry-systems/All%20Documents/Forms/EU%20Common%20Readyness%20Information.aspx
[49] https://extranet.unfccc.int/registry-systems/All%20Documents/Forms/EU%20Common%20Readyness%20Information.aspx

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 policies and measures implemented are outlined in Section 4.3, while Section 4.4 goes on to describe policies and measures that are no longer in place since the previous National Communication. Sections 4.5 and 4.6 are dedicated to the participation in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol and the supplementary of the Netherlands' climate change policies and measures. Sections 4.3.13 and 4.3.14 report on other issues required under Art. 7.2 of the Protocol, i.e. 'policies and measures in accordance with Article 2' and 'domestic and regional programmes and/or legislative arrangements, and enforcement and administrative procedures'.

4.2 (A) Policy-making process

4.2.1 The EU target under the Convention

In 2010, the European Union (EU) pledged to reduce its GHG emissions with 20% by 2020 compared to the 1990 levels[50] (UNFCCC, 2014a). As this target under the Convention has been submitted by the EU-28 as a group and not by each of its Member States (MS), there are no specified targets for individual Member States under the Convention. Due to that fact, the Netherlands – as part of the EU-28 – is pursuing this quantified economy-wide emission reduction target jointly with all other Member States.

The following assumptions and conditions apply to the EU's 20% target under the UNFCCC:

- Although the EU Convention pledge does not include emissions/removals from land use, land-use change and forestry (LULUCF), this category is estimated to be a net sink over the relevant period. EU inventories do also include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol. The target refers to 1990 as a single base year for all gases and all Member States.
- Emissions from international aviation, to the extent that it is included in the EU Emission Trading Scheme (EU ETS), are included in the target[51].
- A limited number of CERs, ERUs and units from new market-based mechanisms may be used to achieve the target. Under EU ETS, the use of international credits is capped (to no more than 50% of the reduction required from EU ETS sectors by 2020). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. In the ESD sectors (non-ETS), the annual use of international credits is limited to no more than 3% of each Member State's ESD emissions in 2005. A limited number of Member States are permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.
- The Global Warming Potentials (GWPs) which are used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report (AR2) of the IPCC when the target was submitted. In its submission to clarify the 2020 target dated 20 March 2012, the EU announced that the implications of the CMP Decision to revise the GWPs in conformity with those from the IPCC Fourth Assessment Report (AR4) were under review. This review has been completed and the revised GWPs from AR4 have been adopted for the EU ETS. In the revision of ESD targets, the revised GWPs were taken into account. For the implementation until 2020, GWPs from AR4 will be used consistently with the UNFCCC reporting guidelines on GHG inventories.
- The target covers the gases CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

[50] http://unfccc.int/resource/docs/2014/sbsta/eng/inf06.pdf
http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/europeanunioncphaccord_app1.pdf

[51] In the EU, the total emissions covered by the "international aviation" category would go beyond the scope of the EU target, as emissions from international aviation are included in the EU Climate and Energy Package and the EU target under the UNFCCC to the extent to which aviation is part of the EU ETS. As such emissions cannot be separated in the EU inventory nor in the projections for the entire time series, emissions from international aviation have been considered in their entirety throughout the report. Over the period, the total emissions from international aviation were between 1.2 and 2.9% of the total annual GHG emissions in the EU.

The above information is summarised in Table 4.1.

Parameter	Target
Base year	1990
Target year	2020
Emission reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global warming potential	AR4
Sectors covered	All IPCC sources and sectors, as measured by the full annual inventory, partly including international aviation
Land Use, Land-Use Change and Forestry (LULUCF)	Excluded
Use of international credits (JI and CDM)	Possible to certain extent under the EU ETS and the ESD
Other	Conditional offer to move towards a 30% reduction by 2020 in comparison with 1990 levels as part of a global, comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities

Table 4.1 Key facts of the Convention target of the EU-28

4.2.2 The EU target compliance architecture

The 2020 climate and energy package

In 2009, the EU established internal rules under its "2020 climate and energy package"[52] which underpin the EU implementation of the target under the Convention. The package introduced a clear approach to achieving the 20% reduction of the total GHG emissions from the 1990 levels, which is equivalent to a 14% reduction compared to the 2005 levels. This 14% reduction objective is divided between the ETS and ESD sectors. These two sub-targets are:

- a 21% reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10% reduction target compared to 2005 for ESD sectors, shared between the 28 Member States (MS) through individual national GHG targets.

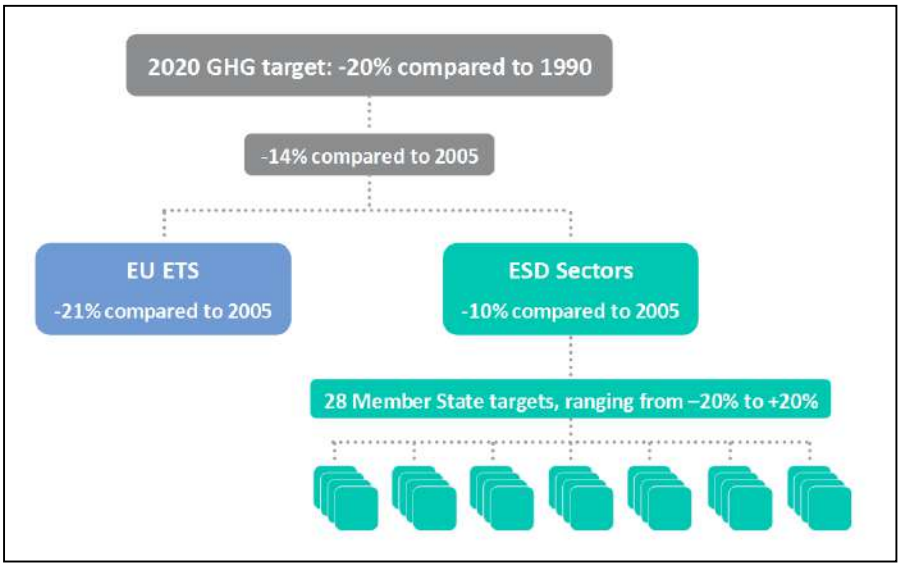


Figure 4.1: GHG targets under the 2020 climate and energy package

[52] http://ec.europa.eu/clima/policies/package/index_en.htm

Under the revised EU ETS Directive (Directive 2009/29/EC), a single ETS cap covers the EU Member States and three participating non-EU countries (Norway, Iceland and Liechtenstein), while there are no further individual caps by country. Allowances allocated in the EU ETS from 2013 to 2020 decrease by 1.74% annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012).

Within the EU, the vast majority of emissions which fall outside the scope of the EU ETS are addressed by the Effort Sharing Decision (ESD; Decision No 406/2009/EC). The ESD covers emissions from all sources outside the EU ETS, except for emissions from domestic and international aviation (which were included in the EU ETS from 1 January 2012), international maritime emissions, and emissions and removals from land use, land-use change and forestry (LULUCF). As a result, it includes a diverse range of small-scale emitters in a wide range of sectors: transportation (cars, vans), buildings (in particular heating), services, small industrial installations, fugitive emissions from the energy sector, emissions of fluorinated gases from appliances and other sources, agriculture and waste. Such sources accounted for 55% of the total GHG emissions in the EU over 2013[53].

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State (see Figure 4.1). Under the Effort Sharing Decision, national emission targets for 2020 are set, measured as percentage changes from the 2005 levels. These changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 (Commission Decisions 2013/162/EU, 2013/634/EU and 2017/1471), expressed in Annual Emission Allocations (AEAs)[54,55,56]. At the country level, the 2020 targets under the ESD range from -20% to +20% compared to the 2005 levels.

The target levels have been set on the basis of Member States' relative Gross Domestic Product per capita. In addition, different levels of development in the EU-28 are taken into account by the provision of several flexibility options. Up to certain limitations, the ESD allows Member States to make use of flexibility provisions for meeting their annual targets: carry-over of overachievements to subsequent years within each Member State, transfers of AEAs between Member States and the use of international credits (credits from the Joint Implementation and Clean Development Mechanism). MSs exceeding their annual AEA, even after taking into account the flexibility provisions and the use of JI/CDM credits, will face a penalty – a deduction from their emission allocation for the following year (excess emissions multiplied by 1.08).

Monitoring on progress to 2020 ESD targets
Monitoring, reporting and verification of the ESD targets mainly takes place through the submission of the national GHG inventories by Member States. Chapter III of Commission Implementing Regulation 749/2014 sets out strict criteria on which the national GHG inventories and GHG emissions of MSs are reviewed annually at the EU level. Based on this review, the European Commission issues an implementing decision on MS ESD emissions in the given year, which might lead to MSs facing penalties or other consequences.

The ESD and the MMR have introduced an annual compliance cycle requiring a review of Member States' greenhouse gas inventories to ensure compliance with their obligations under the ESD in the period 2013–2020. These reviews are carried out within a shorter time frame than the current UNFCCC inventory review so as to enable the use of flexibilities and the application of corrective action, where necessary, at the end of each relevant year. The following progress has been made on the reviews:

- In 2016, a comprehensive review was completed, establishing the GHG emission levels for the compliance years 2013 and 2014 in the ESD.
- A further review was completed in 2017 to establish the emission levels for the compliance year 2015.

[53] European Commission (2016). Commission Staff Working Document - Accompanying the document: Report from the Commission to the European Parliament and the Council on evaluating the implementation of Decision No 406/2009/EC pursuant to its Article 14 (SWD (2016) 251 final): https://ec.europa.eu/transparency/regdoc/rep/10102/2016/EN/10102-2016-251-EN-F1-1-ANNEX-1.PDF.
[54] Commission Decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/162/EU).
[55] Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/ EC of the European Parliament and of the Council (2013/634/EU).
[56] Commision Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020 (notified under document C/2017/5556).

4.2.3 The Dutch reduction target under the ESD

The Netherlands is committed to reducing its emissions in sectors covered by the Effort Sharing Decision (ESD, non-ETS) with 16% compared to 2005 emissions. Dutch quantified annual reduction targets set by EU Decisions[57] and Annual Emission Allocations (AEA) in tonnes CO_2-eq are 122.9 million AEA in 2013, decreasing to 107.4 million in 2020 (according to AR4 GWPs); see Table 4 .2 and Figure 4.2. The cumulative amount of AEAs for the period 2013–2020 is set at 921 Mton CO_2- eq.

Year	Annual Emission Allocations (ton CO_2-eq)	Year	Annual Emission Allocations (ton CO_2-eq)
2013	122,948,129	2017	114,050,540
2014	120,675,928	2018	111,821,315
2015	118,403,725	2019	109,592,091
2016	116,131,523	2020	107,362,866

Table 4.2 Dutch annual ESD emission allocations using GWPs according to AR4, 2013–2020, in ton CO_2-eq

Compared to the Second Biennial Report, the numbers for the years 2017-2010 in Table 4.2 are slightly higher. The reason for this fact is as follows. In accordance with Article 27 of Regulation (EU) No 525/2013 and on the basis of the GHG inventory data as reviewed under Article 19 of that Regulation, the Commission examined the impact of the use of the 2006 IPCC Guidelines – and of the changes to the UNFCCC methodologies used – on Member States' GHG inventories. The difference in the total greenhouse gas emissions relevant to Article 3 of Decision No 406/2009/EC exceeds 1% for most Member States. In the light of this examination, all Member States' annual emission allocations for the years 2017 to 2020 as contained in Annex II to Decision 2013/162/EU should be revised in order to take into account the updated inventory data reported and reviewed pursuant to Article 19 of Regulation (EU) No 525/2013 in 2016.
Table 4.3 presents the AEAs as reported for the years 2017–2020 in the Third Biennial Report with the revised values.

Year	Annual Emission Allocations (ton CO_2 eq) As reported in BR3	Year	Annual Emission Allocations (ton CO_2 eq) Revised
2017	113,859,321	2017	114,050,540
2018	111,587,118	2018	111,821,315
2019	109,314,916	2019	109,592,091
2020	107,042,714	2020	107,362,866

Table 4.3 Dutch annual ESD emission allocations, previous AEAs and revised AEAs using GWPs according to AR4, 2017–2020, in ton CO_2 eq

[57] Decision 2013/162/EU http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0162&rid=1 and 2013/634/EU http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0634&rid=1 and Commision Decision (EU) 2017/1471 of 10 August 2017 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2017:209:TOC.

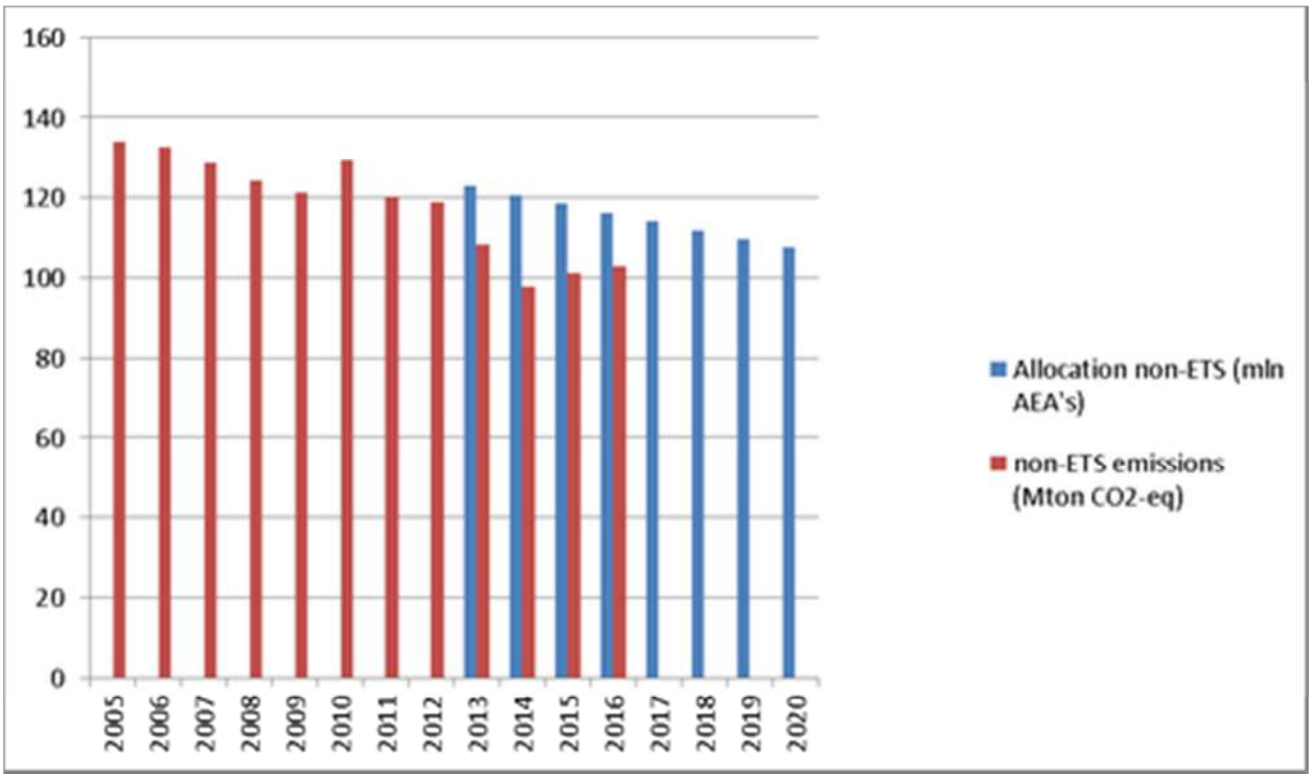


Figure 4.2: Dutch total greenhouse gas emissions, 1990–2013 (including a breakdown of the 2008–2013 figures in emissions under ETS, emissions under ESD (non-ETS) and the ESD target for 2012–2020), in Mton CO_2-eq

In 2011, the Dutch government agreed on a translation of the Dutch non-ETS goal for 2020 into sectoral 2020 goals, along with agreements about which ministry is responsible for achieving each goal[58]. These goals are presented in Table 4.4. The responsible ministries are updated due to the new Cabinet and the changes of ministries by the end of 2017.

Sectoral goals were set using GWPs from AR2. There is no current schedule to recalculate these targets for non-CO_2 greenhouse gases using the GWPs from AR4.

Sector	**Sectoral Goal (2020, in Mton)** GWPs as in AR2	**Responsible Ministry**
CO_2 Industry & Energy	10.7	Ministry of Economic Affairs and Climate Policy
CO_2 Transportation	35.5	Ministry of Infrastructure and Water Management
CO_2 Built environment	22.5	Ministry of the Interior and Kingdom Relations
CO_2 Agriculture	5.75	Ministry of Agriculture, Nature and Food Quality
Non-CO_2 GHG Agriculture	16.0	Ministry of Agriculture, Nature and Food Quality
Non-CO_2 GHG Other sectors	8.8	Ministry of Economic Affairs and Climate Policy
Total	**99.25**	

Table 4.4 Sectoral goals for 2020

When these sectoral goals were determined in 2011, the process of Annual Emission Allocations was still ongoing. As reported above, the Dutch emissions reduction target of 16% and the resulting cap on Annual Emission Allocations

[58] Kabinetsaanpak Klimaatbeleid op weg naar 2020 (Cabinet Approach to Climate Policy on the road to 2020), 2011.

are key for the Dutch contribution to the EU target for 2020 under the Convention. As the table shows, however, the Netherlands is likely to contribute more to meeting the EU target than required. The Dutch government has decided to cancel any surplus of AEAs for the period up to 2020.

In June 2015, the Dutch government faced a court decision in the case filed by Urgenda on the overall national reduction of greenhouse gas emissions in the Netherlands by 2020. The court ruled that by 2020, the Dutch government should reduce national greenhouse gas emissions by 25% compared to the 1990 levels. Although the government has appealed against this decision, it is obliged to start executing the ruling. An evaluation of the effectiveness of the GHG reduction measures, which is ongoing, will therefore be used to decide on additional steps for GHG reductions.

4.3 (B) Policies and measures and their effects

4.3.1 Introduction

This section describes current policies and measures implemented since 1990 that have had (or are expected to have) a significant impact on greenhouse gas emissions in the Netherlands, even if the primary objective of the policy is (or was) not directly related to climate change. It also describes cross-sectoral policies and measures. The scope of the section is limited to domestic and EU policies and measures implemented or planned in the Netherlands. A distinction is made between a scenario "with existing measures" (WEM) and a scenario "with additional measures" (WAM). The WEM scenario describes the policies that have been implemented up to the autumn of 2017. The WAM scenario is similar to the WEM scenario but also includes policies that are formally planned by the government. Unless specified otherwise, the report describes the scenario with additional measures (WAM).
The focus is also on policies that contribute to targets up to 2020. Most policies have an impact on the GHG emissions in both the ETS and non-ETS sectors.

The following sections further describe the groups of policies and measures organised per sector and greenhouse gas. Only the most relevant measures are described in detail. The projected effects have been estimated on the basis of the projections described in the National Energy Outlook 2017. Estimated impacts of the packages of the main policies and measures on GHG emissions reduction are summarised in Table 4.5.

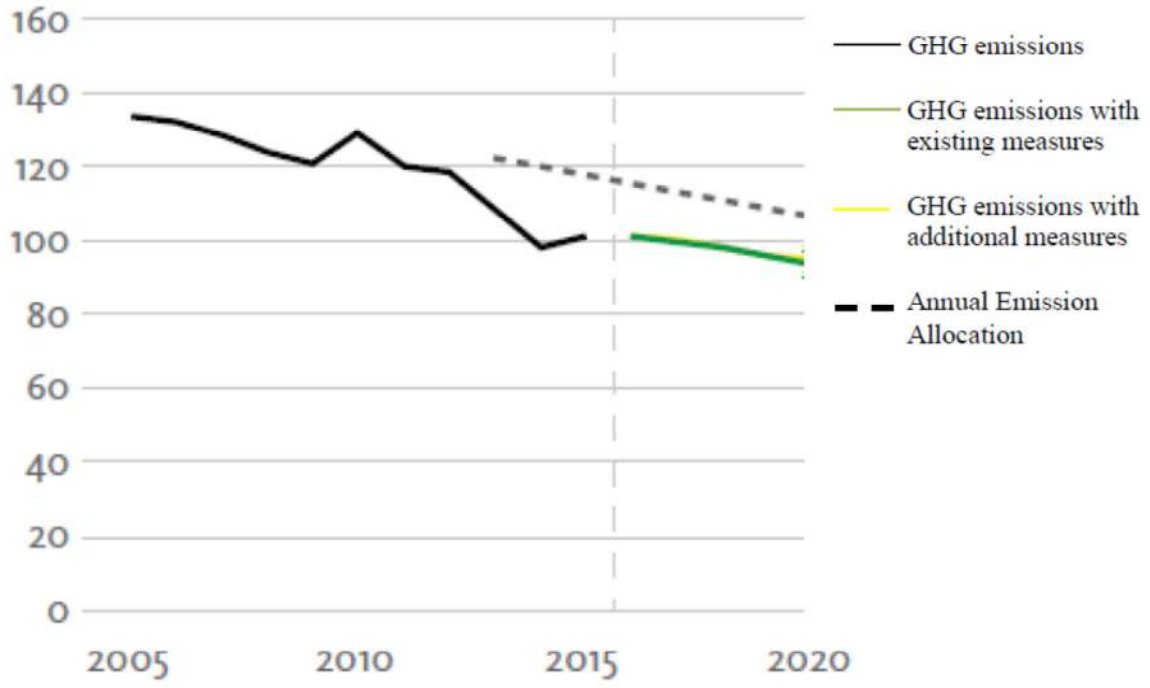


Figure 4.3 Greenhouse gas emissions for the non-ETS sectors, 2005–2016, and AEA allocation, 2013–2020, in Mton.

As elaborated in section 4.3, the Dutch quantified annual reduction targets up to 2020 are set by EU Decisions and amounted to 122.9 Mton CO_2 eq in 2013 for the non-ETS sectors, decreasing to 107.4 Mton in 2020. This target results in a cumulative amount of 921 Mton for the period 2013–2020. The non-ETS emissions in the period 2013–2016 were nearly 411 Mton CO_2 eq[59] (see table 4.5). In 2013 and 2014, emissions fell due to mild winters resulting in less energy use for space heating and emission reductions for transport. In 2015, emissions increased again mainly due to a colder winter. Emissions in 2016 increased again, partly due to another relatively cold winter but also as the result of increased industrial activities, more transport and a larger dairy herd.

Year	Non-ETS Emissions (Mton CO_2 eq.)	Annual Emission Allocations (tons CO_2 eq.)
2013	108.3	122,948,129
2014	97.9	120,675,928
2015	101.1	118,403,725
2016	102.7*	116,131,523

* 2016 preliminary data

Table 4.5 Non-ETS emissions and Assigned Emission Allocations (in tonnes CO_2-eq)

The non-ETS emissions in the remaining period (2017–2020) are projected to decrease mainly due to further energy savings in buildings and in the agricultural sector, lower sales of fossil fuel in transport and lower non-CO_2 emissions. By 2020, the non-ETS emissions are expected to have dropped to 94 Mton CO_2 eq (WAM), with an uncertainty range of 90–97 Mton CO_2 eq[60]. The cumulative non-ETS emissions in the entire budget period (2013–2020) are projected at 798 Mton CO_2 eq, excluding weather influences. As a result, it is expected that the Netherlands will meet its reduction targets up to 2020 (see Figure 4.3).

The following sections further describe the groups of policies and measures organised per sector and greenhouse gas. Only the most relevant measures are described in detail. The projected effects have been estimated on the basis of the projections described in the National Energy Outlook 2017. Estimated impacts of the packages of the main policies and measures on GHG emissions reduction are summarised in Table 4.5.

The effects are usually presented for groups of policies and measures affecting the different sectors rather than for individual measures. In the analyses performed at a fairly high level of aggregation, it is often neither possible nor meaningful to distinguish the impacts of individual instruments and programmes that focus on the same emissions source or activity. Some degree of double counting cannot be avoided, as policies and measures are implemented simultaneously. The policy descriptions in the main text include the actual and expected interactions with other relevant policies and measures, as well as with Common and Coordinated Policies and Measures (CCPMs) of the European Union.

Impacts other than emission reductions are included in the text as far as possible (including economic impacts, costs and non-greenhouse gas mitigation where feasible).

4.3.2 Cross-sectoral policies

This section describes the most relevant cross-cutting policies and measures, notably the Agreement on Energy for Sustainable Growth, the CO_2 Emissions Trading System, the Reduction Programme for Non-CO_2 Gases (ROB), the Energy Tax and the Local Climate Agenda. By contrast, some other cross-cutting instruments such as the Energy Investment Tax Allowance (EIA), Sustainable Energy Production (SDE+) schemes and Long-Term Agreements have a major impact in specific sectors and are consequently described in their respective sections.

[59] http://www.emissieregistratie.nl/erpubliek/erpub/international/ets.aspx; 2016 is based on preliminary data
[60] See The National Energy Outlook 2017 (p. 107) assuming the implementation of WEM and WAM.

Agreement on Energy for Sustainable Growth ("Energy Agreement'')
The Energy Agreement is pivotal for the climate and energy policies that are implemented in the Netherlands. In 2013, the Netherlands concluded a cross-sectoral agreement with more than 40 parties, including central and regional governments. This Agreement on Energy for Sustainable Growth marks a significant step in the transition towards a sustainable energy system in the Netherlands. Signatories to the Agreement share a responsibility and commitment to achieve the following overarching objectives:

- an average improvement in energy efficiency of 1.5% per year (adding up to a reduction of 100 PJ by 2020);
- a 14% share of renewable energy in the total Dutch consumption of energy by 2020 and 16% by 2023;
- the creation of at least 15,000 additional jobs by 2020, of which a significant number to be created in the next few years.

The 2013 agreement includes some 160 actions for the participating parties to implement this commitment, including actions by the central government. While some of the actions were new, others imply the intensification or modification of then existing policy measures. In 2015, additional actions were agreed in order to attain the 2020 targets for energy efficiency and renewable energy (see also Section 4.3.11). We describe the most relevant measures in the sections where they have the most impact.

CO2 Emissions Trading
As prescribed by Directive 2003/87/EC, the European Trading System for greenhouse gas emissions (EU ETS) started in the EU on 1 January 2005, focusing on CO_2 emissions from large industrial emitters. It is a "cap and trade" system, where participants are assigned a set amount of allowances up front and are required to submit annual allowances that are equal to their actual emissions. Companies are allowed to use credits from Kyoto mechanisms to comply with their obligations. The EU ETS includes more than 11,000 power stations and industrial plants in 31 countries, as well as airlines. It covers around 45% of the EU's greenhouse gas emissions. In the Netherlands, around 450 companies are included in the ETS, responsible for around 45% of the total emission of greenhouse gases in the Netherlands[61].

In 2013, the EU ETS entered its third phase, running up to 2020. A major revision (Directive 2009/29/EC) in 2009 to reinforce the system means that the third phase is significantly different from the first two phases and is based on rules that are far more harmonised than was previously the case. One of the changes is a single, EU-wide cap on emissions instead of the previous system of national caps. Auctioning is now the default method for allocating allowances. For those allowances that are still free, harmonised allocation rules apply that are based on ambitious EU-wide benchmarks for emissions performance. The ETS now also includes more sectors (i.e. aviation) and gases (nitrous oxide, PFCs). Its allowances will be reduced by 21% between 2005 and 2020 in order to lower the total emissions.

Although emission allowances are decreasing, the carbon price has remained below € 10 per tonne of CO_2 since shortly after the start of the third phase up until now. According to analysts, this fact was mainly due to a growing surplus of allowances, largely because of the economic crisis which limited emissions more than anticipated. Increasing renewable energy production and energy savings also contributed to a lower demand for allowances. As a consequence, measures to strengthen the ETS have been debated within the EU[62]. In 2014, the "backloading" amendment was implemented, resulting in the postponed auctioning of 900 million allowances. Moreover, a market stability reserve will start operating in 2019. The postponed allowances and any other unallocated allowances will be transferred to the reserve. These measures have so far had limited impact on the CO_2 price, as the total allowances in the third phase remain unchanged.

In 2015, the European Commission proposed further changes to the ETS, including a sharper rate for the reduction of allowances in the period after 2020. This proposal is still under debate in the EU as part of a broader package of climate and energy proposals for the period up to 2030 (not included in the WEM and WAM scenarios).

As one of the Green Deals the Netherlands is initiating a pilot of a national carbon market for emissions that are not covered by the EU ETS. This market enables organisations to sell certificates that prove emission reductions and allows other parties to offset their emissions by buying these certificates, creating a market value for CO_2 emissions. The pilot started in 2017 and is expected to be operational by 2018. This measure is not included in the WEM and WAM scenario.

[61] https://www.emissieautoriteit.nl/binaries/nederlandse-emissieautoriteit/documenten/publicatie/2016/09/05/rapport-voortgang-emissiehandel-2016/Rapport+Voortgang+Emissiehandel+2016.pdf
[62] https://ec.europa.eu/clima/sites/clima/files/ets/reform/docs/com_2012_652_en.pdf

Energy tax
The objective of this policy is to boost energy savings by incentivising the reduction of gas and electricity consumption, which should direct consumers towards more energy-efficient behaviour. The Regulatory Energy Tax (REB) was introduced in 1996, changing its name to Energy Tax in 2004. Taxing energy use makes energy saving (by changing behaviour or investing in energy-saving measures) more attractive. The Energy Tax is levied on electricity and natural gas, while the level of the Energy Tax depends on 1) the consumer's energy consumption – the higher the consumption, the lower the energy tax levied (degressive tariff structure) – and 2) specific agreements between different sectors and the government. Tariffs are updated annually.

For small, residential consumers, the Energy Tax accounted for approximately 40% of the market price for natural gas and 30% of the market price for electricity in 2016. Industrial consumers pay a much lower tariff in order to secure a level playing field for these exposed companies. In addition, companies that are considered as energy-intensive according to the European Energy Tax Directive (2003/96/EC) and who have entered a Long-Term Agreement with the government (see Section 4.3.4) are eligible for a tax refund in so far as the overall tax tariff for electricity exceeds the minimum tariff of € 0.05 per kWh. The Energy Tax also has a separate lower gas tariff for the horticulture sector, linked to the specific sectoral emission system in the horticulture sector.

Several changes have been made in recent years to promote the production of renewable energy for cooperatives or associations of private homeowners. Since 2004, private homeowners are allowed to settle the amount of electricity returned to the grid with their consumption (since 2012 up to their annual consumption taken from the grid). This is referred to as net metering, which stimulates the installation of PV-panels on roofs of homeowners. Since 2014, a lower tariff has been introduced for cooperatives and associations of private homeowners that produce their own renewable energy. Since 2015, the electricity produced by lessors and tenants using solar panels has been exempted from taxation.

In order to support renewable heat options such as heat pumps and waste heat utilisation, the tariff for natural gas (up to the use of 170,000 cubic metres) has increased by 32% since 2016 while the tariff for electricity (up to the use of 10,000 kWh) has decreased by 16%.

Energy Investment Tax Allowance
The Energy Investment Tax Allowance (EIA) is a tax relief programme. It offers a direct financial advantage to companies in the Netherlands that invest in energy-saving equipment and sustainable energy. Entrepreneurs may deduct 55% of the investment costs for such equipment from their company's profits for tax over the calendar year in which the equipment was purchased. The list of eligible technologies is published annually. As part of the Energy Agreement for Sustainable Growth, this list now focuses more on energy-saving technologies instead of renewable energy options; for the latter options, companies are referred to other policies and measures (such as SDE+). A similar programme (MIA Vamil) exists for other environmental measures.

Green Deals
The Dutch government set up the Green Deal programme in 2011 to stimulate green growth. More than 200 Green Deals have been signed, of which the majority in the areas of energy and climate[63.] This instrument supports civil society parties, companies and local authorities which embark on initiatives related to green growth, but which face obstacles that may require assistance from the national government to tackle. Exploiting opportunities for saving energy and generating local sustainable energy is not only a matter of access to finance. In practice, there are often other obstacles and difficulties to finding innovative solutions in society for scaling up green growth options; e.g. difficulties regarding regulations or permits, appropriate forms, networks for cooperation, and so on. The government helps to lower such obstacles.

The outputs of green deals are not measured in terms of CO_2 reduction of energy saved or produced, but rather in terms of creating better access to financial resources, providing more space for innovative solutions in permits and regulations, reinforcing network cooperation for more innovative projects that require joint action of various sectors in the industrial chain, and so on. This fact explains why no figures on CO_2 reduction are reported. In addition, this procedure avoids double counting of CO_2 reductions through other measures (such as energy taxes and feed-in premiums for renewable energy). Annual progress reports to Parliament give examples of Green Deal achievements[64.]

[63] http://www.greendeals.nl/green-deals/overzicht-green-deals/
[64] http://www.greendeals.nl/wp-content/uploads/2015/06/Progress_reoprt_2011_2015_Green_Deals_ENG.pdf

Local Climate Agenda
The Local Climate Agenda is a joint initiative bringing together local authorities (provinces, municipalities and regional water authorities) and the central government. They exchange knowledge on best practices, and report and address obstacles in legislation, with the aim of realising more successful initiatives and facilitating processes such as regional climate agreements. The Agenda has also played a role in national processes such as the Energy Agreement. Under the Energy Agreement, actions were concluded for the further intensification of support actions by regional governments. Similar to the Green Deals, the effects are difficult to measure in terms of CO_2 reductions and/or energy savings or production. Its progress was evaluated in 2015, with the main conclusion that it is highly valued by participants from local authorities[65]. As a result, the government has decided to continue the agreement through a follow-up (until 2020). One of the main ambitions in this follow-up is to support municipalities in developing robust plans to reach climate neutrality by 2050[66].

Energy innovation policy
The government stimulates innovations in energy technologies, products and services through various policy instruments, both generic (non-energy-specific) and specific. The main generic innovation instrument is the Research and Development (Promotion) Act (WBSO; budget in 2017 is € 1.2 billion), which provides fiscal benefits for research and development activities by companies. In addition, public or semi-public knowledge institutes (such as universities) have their research programmes financed. In the case of specific instruments, the Top Sector Energy (TSE)[67] has been the main framework since 2012 where governments, knowledge institutes and companies from all sectors cooperate. TSE has its own subsidy scheme and several associated subsidy schemes such as the MIT (for small and medium-sized enterprises), DEI (demonstration projects) and HER (reducing the costs of renewable energy technologies). Public spending on energy innovations is monitored by RVO.nl[68.]

The impact of energy innovation policy on CO_2 reduction is not calculated, as this figure is difficult to determine. Innovation subsidies support innovation projects that are still in development and that are not market-ready. As a consequence, the uncertainties in their market roll-out are significant. This approach also prevents double counting of the effects of other policy instruments, such as SDE+ and EIA, which aim to stimulate the market roll-out of new low-CO_2 technologies.

Energy Transition Financing Facility (ETFF)
Since 2017, the investment fund Energy Transition Financing Facility (ETFF) has been operative. The fund provides attractive loans to other banks that finance innovative energy projects with higher financial risks, such as geothermal, energy storage and biomass. The fund, which starts with a budget of € 100 million, is operated by the Netherlands Investment Agency (NIA).

Reduction Programme for Non-CO2 Greenhouse Gases
This programme (Dutch acronym: ROB) was set up in 1998 and focuses on reducing Dutch emissions of non-CO_2 greenhouse gases. The target is a reduction of 8–10 Mton CO_2 eq in 2020, working towards the desired level of 25–27 Mton CO_2 eq. This figure would mean a reduction of 50% in these gases compared to the reference year (1990). By 2016, a reduction of about 50% (relative to 1990) had already been achieved on the basis of reductions in the nitric acid industry (through admission into the EU Emissions Trading System, ETS), the aluminium industry, HCFC-22 production, the waste disposal sector and agriculture, among other areas.

Over the period 1998–2009, ROB subsidised the development and implementation of innovative reduction technologies (demonstration projects and market introduction) as well as supporting research and communication projects. This support was organised in close cooperation with private companies, research institutes, universities, and provincial and municipal authorities.

Since 2009, the focus of ROB has been on targeting the most significant sources: cooling (fluorinated gases), the industry (semiconductor industry, caprolactam production), sewage treatment facilities (methane and nitrous oxide), agriculture (methane and nitrous oxide), CHP engines (methane) and monitoring sources of non-CO_2 greenhouse gases. Subsidies have stopped, as they are not considered to be as effective any more. Other areas of focus for the reduction policy were research, communication, and cooperation and deals with the sectors and stakeholders. The reduction of fluorinated gases is mainly based on the national implementation of EU legislation concerning ozone and

[65] https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2015/06/29/evaluatie-lokale-klimaatagenda-2011-2014/evaluatie-lokale-klimaatagenda-2011-2014.pdf
[66] https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2015/06/29/lokaal-klimaatbeleid/lokaal-klimaatbeleid.pdf
[67] https://topsectorenergie.nl/
[68] https://www.rvo.nl/monitor-publiek-gefinancierd-energieonderzoek

F-gases. Since its implementation in 2015, the European F-gas regulation (517/2014) has been the main driver of the further reduction of fluorinated gases in the Netherlands.

Where emission reductions in agriculture (the major source of non-CO_2 greenhouse gas emissions in the Netherlands) are concerned, a voluntary agreement between the government and the sector was agreed in 2008 (the "Agrocovenant"). For more information on the Agro covenant, see 4.3.6.

Though the programme has been phased down, it is still having an effect on emissions and it is therefore included in the reporting and projections.

Developments in long-term policy planning
The Energy Agreement is considered as the first major step in achieving international long-term climate objectives laid down in the Paris Agreement of 2015. For this reason, the Ministry of Economic Affairs published its Energy Report in January 2016 through which the long-term ambition of a low-carbon energy system by 2050 was set[69]. In the Energy Report, three main principles of future policies were identified for energy transition: 1) focus on CO_2 reduction, 2) make the most of the economic opportunities that the energy transition offers and 3) integrate energy in spatial planning policy.

The Energy Report further distinguished four main energy functionalities in order to concentrate the efforts required for the transition: energy for space heating, energy for industrial process heat, energy for transport, and energy for power and light. An extensive public consultation was performed in the spring of 2016 to raise awareness, collect views on the future energy system and contribute to the design of the future policy agenda.

The Energy Agenda was adopted in early 2017[70] and draws several preliminary conclusions on future climate and energy policies. First, the reduction of greenhouse gas emissions is seen as the primary goal in order to attain the climate ambition of the Paris Agreement in the most cost-effective way. The best and most cost-effective mix of energy conservation, renewable energy and other low-carbon options will arise on the market by targeting CO_2 reduction. For this purpose, the EU ETS is considered as an appropriate tool, although the Netherlands supports an ambitious strengthening of the ETS. Second, the Netherlands is in favour of a gradual and timely transition both in ETS sectors such as energy and the industry and in non-ETS sectors such as housing, agriculture and transport in order to control national costs. More specific conclusions are also drawn for the four energy functionalities.

It is up to the new government, following the elections in the spring of 2017, to design and implement new policies in order to continue the transition towards a low-carbon economy. The new government is also ambitious with regard to climate and energy. It aims to reduce greenhouse gases with 49 per cent by 2030, which is more ambitious than the 40 per cent agreed with the EU[71]. In order to realise that ambition, a new Climate and Energy Agreement will be concluded, as a follow-up of the 2013 Energy Agreement that will end in 2020 (2023 for renewable energy). One of the measures the new government has announced is to close all coal fired power plants by 2030. In line with this measure, the Netherlands is member of the coalition to phase out coal which was launched at the COP23. The ambitions of the new government and new policies that will follow are not part of the policies and measures included in the projections described within this report.

4.3.3 Energy

For the energy sector, the Energy Agreement is a major overarching framework for energy saving and renewable energy targets in the Netherlands. Several national policies and instruments within that framework are especially important for the energy sector, such as SDE+ subsidies. Key European instruments are the EU ETS, the Renewable Energy Directive and the Energy Efficiency Directive (which includes smart metering). The most important policy instruments currently in effect that have a major impact on the energy sector are described below.

SDE+: Stimulation of Sustainable Energy Production incentive scheme

General development of SDE+

[69] https://www.government.nl/binaries/government/documents/reports/2017/03/01/energy-agenda-towards-a-low-carbon-energy-supply/Energy+agenda.pdf
[70] https://www.government.nl/binaries/government/documents/reports/2017/03/01/energy-agenda-towards-a-low-carbon-energy-supply/Energy+agenda.pdf
[71] https://www.kabinetsformatie2017.nl/documenten/verslagen/2017/10/10/coalition-agreement-confidence-in-the-future

The production of renewable energy has already been encouraged by the government for many years, mostly using feed-in premium schemes which evolved over time. The current scheme is the so-called SDE+ (Stimulation of Sustainable Energy Production) incentive scheme, which has been in place since 2011. The SDE+ scheme is a floating feed-in premium system, financed by a surcharge on the energy tax paid by the end consumers of natural gas and electricity. This surcharge is referred to as the Sustainable Energy Surcharge (ODE). SDE+ takes an innovative tender approach based on a selection of projects that are proposed by the private sector along the lines of cost-effectiveness with regard to the expected cost of the various available technologies. The premium is to be paid once the facility is in operation on the basis of the power production for a period of up to 10 or 15 years. Annual budgets for the tenders are set by the government. The budgets have been increasing substantially in recent years. In 2011, the annual budget was set at € 2 billion. This figure increased to € 3.5 billion in 2014. In 2016, this amount was increased again to € 8 billion. Payments within the context of the previous feed-in premium schemes MEP and SDE are still ongoing, as the subsidies run for 10 to 15 years. These payments are financed through the government budget.

SDE+ definition of the feed-in premium
The SDE+ scheme works as an operating grant. Producers receive financial compensation for the unprofitable component of the cost of the renewable energy that they generate. The production of renewable energy is not always profitable because the cost price of renewable energy can be higher than that of energy derived from fossil fuel. SDE+ compensates producers for the unprofitable part of the cost price over a fixed number of years, depending on the technology used. The scheme is available for the production of renewable electricity, renewable gas and renewable heat or a combination of renewable heat and electricity (combined heat and power, CHP).

The cost price for the production of renewable energy is set off in the base sum for the technology. These prices are defined annually in order to incorporate technological improvements and other developments on the market which affect the cost price (such as installation, construction materials, and so on). The yield of fossil energy is established in the correction sum. This method makes the level of the SDE contribution dependent on energy price developments. When the energy price is high, producers receive less SDE+ and more from the energy consumer. If the energy price is lower, they get more SDE+ and less from the energy consumer. This correction amount is the average energy price per category during the year of production. The base energy price is the lower limit for the correction amount. When the correction amount is equal to the base energy price, the maximum grant is reached. The final payments are calculated per year according to the amount of energy produced and the actual energy price.

Primary target groups for SDE+ are companies, institutions and non-profit organisations. The project must be implemented in the Netherlands and the national government is excluded from participation. SDE+ is implemented through Netherlands Enterprise Agency (RVO.nl).

The impending decrease in combined heat and power (CHP) will not help energy efficiency. However, apart from the generic measures mentioned here, the government has chosen not to interfere in the market economy process for mature technologies such as CHP. Support for CHP under the SDE/SDE+ scheme ceased in 2010.

SDE+ Offshore Wind Energy
Increasing the production of offshore wind energy is pivotal to attaining renewable energy target in the Energy Agreement. In order to encourage the production of offshore wind energy, new regulations were issued in 2015. The Regulation on Offshore Wind Energy 2015 and the Implementation Regulation on the Offshore Wind Energy Act were published on 3 July 2015. Both regulations have applied since 1 December 2015. This legislative framework establishes statutory provisions for the allocation of suitable sites for offshore wind farms as well as the process of issuing permits and awarding subsidies for the construction and operation of offshore wind farms.

In addition, the Wind Energy Roadmap was adopted as part of the Energy Agreement. This roadmap outlines how the generation capacity of offshore wind energy is to be increased from 1,000 MW to 4,500 MW in 2023. Five offshore wind farm zones have been designated for the development of new wind farms and a new scheme has been launched to facilitate the establishment of these farms. The development of two zones was awarded to project developers in 2015 and 2016. The first zone concerns the Borssele Wind Farm Sites I and II, 22 kilometres off the coast of the province of Zeeland. The offshore wind farms built on Borssele Sites I and II will have a capacity of 350 MW per site. The second zone concerns Borssele Wind Farm Sites III (330 MW) and IV (350 MW). In 2017, tenders were opened for the Borssele Wind Farm Innovation Site V (20 MW) and the so-called “Hollandse Kust” (Dutch Coast; 700 MW). The remaining two zones, both 700 MW, will be opened to tender in 2018 and 2019.

Onshore wind energy agreements (Intergovernmental Wind Energy Agreement (BLOW) and the new Energy Agreement)

The BLOW target of 1,500 MW in onshore wind power by 2010 was reached in 2007. In March 2009, the Government Coordination Rule was introduced for onshore wind projects exceeding 100 MW. This rule means that, in these projects, the Minister of Economic Affairs is responsible for spatial planning and for coordinating the attribution of environmental and other permits. Early in 2013, new agreements were concluded between provincial governments and national government in order to increase the onshore wind capacity to 6,000 MW in 2020. The Energy Agreement of 2013 has integrated these agreements. As per 1 January 2015, all provinces have included the spatial possibilities for their part of the agreement into their spatial planning and are now focused on integrating these elements into specific regional plans and permit processes. In this process, the provinces aim to maximise the support for these plans within society. Larger projects are coordinated with the national government, small installations with the municipalities. After 2010, the amount of wind power capacity installed has increased rapidly. At the end of 2016, more than 4,200 MW was installed[72] and some 700 MW was under construction.

Investment Subsidy Renewable Energy (ISDE)
While SDE+ focuses on supporting large-scale projects in renewable energy, a subsidy for small-scale investments in renewable heat installations was introduced in 2016. Both consumers and businesses can apply for a one-time investment subsidy to purchase heat pumps, biomass boilers, pellet stoves and solar collectors. Subsidy budgets are set annually by the government. In 2016, the budget was set at € 70 million, resulting in 27,000 applications for a subsidy. It is expected that this scheme leads to investments in around 24,000 installations[73]. In 2017, the budget was set at € 90 million. The number of applications in the first half of 2017 increased, especially for heat pumps and solar collectors[74].

Subsidy scheme for energy savings and renewable energy in sports facilities
In the Netherlands, there are many sports facilities such as swimming pools and enclosed accommodations that consume a great deal of energy. In order to stimulate the reduction of energy consumption and the production of renewable energy, the Netherlands introduced a subsidy scheme in 2016. The subsidy can be 15–30% of the investment in certain categories of measures, such as LED lighting, heat pumps, insulation and renewable energy production with solar panels, collectors or biomass boilers. The maximum subsidy per applicant is € 125,000 per year. The annual budget is € 6 million over the period 2016–2020[75.]

Financial insurance for geothermal energy
Projects in geothermal energy are often seen as investments with higher financial risks, as the results of drilling – which is often a major part of the investment costs – are relatively uncertain. In order to mitigate the financial risks of geothermal projects, the government offers a financial insurance which compensates the costs of drilling when results are disappointing[76.]

Smart metering (dissemination of smart meters)
In order to improve the possibilities for consumers to conserve energy, smart meters are being installed in most households within the Netherlands. The smart meter is being rolled out in two stages. A small-scale roll-out was used for pilot purposes starting 2012. During this small-scale rollout, some 600,000 smart meters for electricity and gas were installed during regular meter replacements (e.g. depreciation), in newly built houses, with large-scale renovations and by customer request. This phase and its effects were monitored; based on these experiences, it was decided to continue with a larger-scale roll-out from 2015 onwards. The aim is to have smart meters fitted in at least 80% of households and small businesses by 2020, as mandated by the third Energy Package of the EU.

Emission Standards for Medium-Sized Combustion Plants Decree (BEMS)
Gas engines are widely used for the combined production of heat and electricity (CHP) in the horticulture sector within the Netherlands and in the service sector to a lesser extent. Part of the natural gas in these engines remains unburnt and is emitted as methane. This process is called “methane slip”. Through the Emission Standards for Medium-Sized Combustion Plants Decree (BEMS), the government has set maximum emission levels for methane (hydrocarbons) and other air pollutants, which were evaluated in 2013. This regulation, together with a series of other regulations on emissions from installations, was integrated into the Activities Decree and the Activities Regulations in 2013, both part of the Environmental Management Act (see section 4.3.13). These laws regulate about 100 activities, such as storage in tanks and packages, medium-sized combustion plants, work on materials (mechanical labour,

[72] http://www.clo.nl/indicatoren/nl0386-windvermogen-in-nederland
[73] NEV (2017), p. 150 .
[74] https://www.rvo.nl/subsidies-regelingen/investeringssubsidie-duurzame-energie-isde
[75] https://zoek.officielebekendmakingen.nl/stcrt-2015-25937.html
[76] https://www.rvo.nl/subsidies-regelingen/risicos-dekken-voor-aardwarmte-2017

coating, and so on), agricultural activities and some industrial processes (such as large combustion plants). For some of these activities, the regulations are an implementation of EU legislation such as the Industrial Emissions Directive.

4.3.4 Industry

For the industrial sector, both European and national policies are relevant. In addition to the aforementioned Industrial Emissions Directive, the EU ETS is the other key European policy instrument which regulates CO_2 emissions (see 4.3 Cross-sectoral policies). Most national policies are aimed at improving industrial energy efficiency. These policies include the Long-Term Agreements (LTA) with industrial sectors backed up by environmental permits on the basis of the Environmental Management Act, renewable energy subsidies (SDE+), innovation policy and the Energy Investment Tax Allowance (EIA) scheme, included in parallel with the corporate tax system (see above).

Long-Term Agreements on Energy Efficiency (LTA and LEE)

In order to improve the energy efficiency of companies, the first series of Long-Term Agreements (LTA) started in 1992. LTAs are voluntary agreements on energy efficiency between the national government, the trade associations and the participating companies. In LTA1 (1992–1998), the focus was on process efficiency. In 1998, most parties continued the covenant through LTA2, while the large industrial enterprises adopted the Benchmarking Covenant. Apart from the Ministry of Economic Affairs, the Ministries of Housing, Spatial Planning and the Environment, of Agriculture, Nature and Food Quality and of Transport, Public Works and Water Management were also involved with LTA2. The focus in LTA2 was still on process efficiency, but the scope was broadened to include sustainable energy and chain efficiency, among other things. In 2008, LTA2 was continued into LTA3 for the period 2001–2020. The choice was made to intensify, extend and broaden the LTA instrument. Among other things, this intensification means that businesses aim to attain an improvement in energy efficiency of 30 per cent in the period 2001–2020. Roadmaps for the longer term (2030) have been introduced as well. There is also an increased focus on chain efficiency and cooperation across sectors. For companies that are obliged to participate in the EU ETS, a separate LTA – the Long-Term Agreement on Energy Efficiency for ETS companies (LEE) – was adopted in 2009. Results of LTA/LEE covenants are described annually in a report "Convants result brochure Long-Term Agreements on energy efficiency"[77]

Within the scope of the Energy Agreement for Sustainable Growth, a series of reinforcing measures were agreed in 2013:

- Participating companies are required to produce an annual declaration of progress, based on their annual monitoring reports, in order to benefit from certain advantages of participating in the LTA (eligibility for lower energy tax, eligibility for participation in the ETS compensation measure, and so on). These declarations are only issued after compliance checks by RVO.nl, i.e. based on the progress in fulfilling their agreed commitments. If the declarations are not issued for a specific company, this situation has repercussions for the energy tax relief and ETS compensation.
- Large energy-intensive companies – the ones that are covered by the ETS – join the government in striving to supplement the Long-Term Voluntary Agreement on Energy Efficiency Covenant) with a framework of company-specific (i.e. one-to-one) agreements. These agreements focus on improving the energy efficiency and competitiveness of the companies concerned.
- There is an EPA (Energy Performance Assessment) pilot project (including an evaluation) for other companies. An independent centre of expertise is set up to assist businesses and funding bodies in identifying the most effective measures for energy efficiency in the industry (and agriculture). At the time of writing this report, the pilots are running within the framework of a specific Green Deal.

In 2015, additional measures were adopted in order to meet the target of 100 PJ in energy savings of the Energy Agreement for Sustainable Growth. One of the measures is to intensify the promotion and facilitation of energy savings at LTA companies. This process is done by providing more insight into ways to reduce energy consumption and to remove obstacles (WAM scenario only).

Long-Term Agreements are enforced using environmental permits: companies not participating are required (in their permits) to implement all energy-saving measures with a payback period of less than five years. Participants of LTA3 or LEE are exempted from the obligation to carry out an energy audit under Article 8 of the EU Energy Efficiency

[77] https://www.rvo.nl/sites/default/files/2015/11/Resultatenbrochure%20Meerjarenafspraken%20energie-effici%C3%ABntie%202014%20English_0.pdf

Directive. Instead, participants in LTA draw up an Energy Efficiency Plan (EEP) every four years for the next four-year period. They have to submit annual monitoring reports on projects that have actually been implemented in addition to their results. In 2016, new four-year plans were submitted by the companies, which are scrutinised by RVO.nl.

Policies for non-CO2 greenhouse gases in the industry
The main policy instrument in this field was the Reduction Programme for Non-CO_2 Greenhouse Gases (described in Section 4.3.9). Around the year 2000, substantial reductions in non-CO_2 greenhouse gases were achieved through 1) environmental permit requirements for the producers of HCFC-22 and aluminium; 2) limitations on emissions of fluoride and other pollutants, resulting in a reduction of HFC emissions achieved through the implementation of an afterburner system; 3) reductions in PFC emissions; 4) voluntary agreements with both the oil and gas and the aluminium industries to improve their energy efficiency, resulting in reductions of CH_4 and PFC emissions; and 5) adaptations to regulations for reducing the emissions of methane from landfill sites, which were introduced to reduce local safety hazards due to the potential build-up and explosion of methane, as well as cutting down on odours associated with landfill sites.

From 2008, significant N_2O reductions were achieved in nitric acid production. Whereas emissions in 2007 were 4.4 Mton CO_2 eq, they had fallen to 0.6 Mton CO_2 eq in 2008 after the introduction of reduction techniques. The emissions in recent years are less than 0.4 Mton CO_2 eq. In 2008, the Climate Commission of the European Member States ratified the European Commission proposal to incorporate the nitrous oxide emissions (N_2O) into the European Emissions Trading System (ETS) for greenhouse gases. In the Netherlands, two production facilities for nitric acid – DSM and Yara – were affected by this decision and given a permit for an emissions ceiling of 1.2 Mton CO_2 eq in 2010, decreasing to 1.0 Mton CO_2 eq by 2020.

PFC and SF_6 are used to clean processing chambers as well as in the etching process within the semiconductor industry. SF_6 is also used in the power current sector and in the production of double glazing and electron microscopes. The total Dutch emissions of SF_6 (as reported under IPCC sector 2F8) amount to less than 0.5%. There is only one producer of semiconductors in the Netherlands, with a single production location. Thanks to several PFC reduction measures, the producer realised a significant emission reduction. With a new Voluntary Agreement for the Global Semiconductors Industry (2010–2020), the semiconductor industry aims to achieve a 30% reduction of F-gases in 2020 as compared to 2010.

Though these measures were taken years ago, significant reductions are still included in the projections, which is the reason for a brief mention of these policies and measures in this report as well.

4.3.5 Transport

Mobility and Transport is one of the areas within the Energy Agreement for which a common target and working programme has been agreed. Ambitious European measures for cleaner fuels and more fuel-efficient cars play a crucial role in this working programme. This programme includes the continuation of fiscal measures to boost the production of cleaner vehicles, pilots for zero-emission distribution into cities and stimulating action plans for large companies in order to achieve a 20% reduction of CO_2 emissions in the area of mobility.

Transition to a sustainable fuel mix
In the 2013 Energy Agreement, an ambitious goal was agreed to limit the CO_2 emissions to 25 Mton CO_2 by 2030 and 12.2 Mton by 2050. For such an ambition, a new government vision on fuels for transport was adopted in 2014[78]. This vision encompasses a wide variety of CO_2-low fuel combinations for transport, including electricity, hydrogen, advanced biofuels and LNG. In 2015, actions were proposed in order to meet these ambitions[79]. One of the adopted measures is a Green Deal on electric vehicles. Government and business organisations agreed to promote electric vehicles by developing the consumer market and the EV infrastructure as well as initiating innovation projects. The ambition is that by 2025, 50% of the new cars sold are electric. At present, the roll-out of electric vehicles and infrastructure is ongoing, with most of the measures being implemented within the framework of the Green Deals and

[78] http://www.energieakkoordser.nl/~/media/files/energieakkoord/nieuwsberichten/2014/brandstofvisie/duurzame-brandstofvisie-met-lef-2e-druk.ashx
[79] http://www.energieakkoordser.nl/~/media/files/energieakkoord/nieuwsberichten/2015/20150710-ministerraad-duurzame-brandstofvisie/actie-agenda-duurzame-brandstoffen.ashx

– in recent years – fiscal policies. Registration of new semi-electric or electric vehicles has been increasing sharply in recent years[80].

Biofuels
European Directive 2009/28/EC on renewable energy has been implemented into Dutch legislation. This Directive states that Member States should ensure that a minimum of 10% of all energy consumption in transport must come from renewable sources by 2020. In practice, this target is fulfilled with biofuels. In 2016, the share of this energy source was 7%[81]. More than 66% of the energy content is from advanced biofuels. Dutch policy is aimed at maximising the share of advanced biofuels that are not produced from food/feed crops. Because blending biofuels is obligatory, there are no additional tax incentives or subsidy programmes.

In 2006, a total of € 60 million was set aside for the production of innovative biofuels in the Netherlands. This programme helped to build biodiesel plants that can produce biodiesel from waste and residues[82]. In addition, several subsidy programmes aimed at filling stations for alternative fuels were implemented in the period 2008–2013[83]. This policy resulted in the construction of around 100 filling stations for biogas and 35 for high-blend bio-ethanol (E85).

Eco-Driving (The New Driving) and Truck of the Future programmes
In order to promote a fuel-efficient driving style among car users, the Dutch Eco-Driving programme was initiated in 1999 by the former Dutch Ministry of Transport and Water. The programme The New Driving (*HNR 1.0*) used information campaigns, financed demonstration projects and employed other kinds of dissemination (i.e. cooperation with businesses) to promote the benefits of a fuel-efficient driving style. In 2010, the Ministry provided four-year funding to the Institute for Sustainable Mobility (IVDM). During this period, the IVDM acquired and supported 19 projects and initiatives which were aimed at reducing fuel use by promoting eco-driving (*HNR 2.0*). In 2013, as part of the 2013 Energy Agreement, parties agreed to continue the eco-driving programme after 2014 without government funding. As from 2015, the programme is financed by automotive associations RAI, BOVAG and ANWB (*HNR 3.0*). One of the instruments used is a website (launched in 2017) where consumers can find information on the benefits of eco-driving and which shows car owners information on applying eco-driving specified for each car and type. Other means of communication are also used, such as informing car owners through car dealers.

A similar programme for the trucks of the future was launched in 2010. In the demonstration programme “Truck of the Future”, various measures are examined that allow companies from the transport sector to save fuel, thereby reducing CO_2 emissions. Through the programme, for which the government provided subsidies in the period 2010–2014, insight is gained into fuel-saving measures and the extent to which these measures are commercially interesting.

Apart from the Eco-Driving programme, other communication campaigns have been implemented by the former Ministry of Infrastructure and Environment in recent years. These projects include a campaign promoting carpooling, car-sharing and modal shift (“I am a hopper”) as well as a campaign about choosing the right energy-efficient tyres and applying the correct tyre pressure “Choose the best tyre”), in cooperation with stakeholders.

EU CO2 emission performance standards
In 2009, the legislation on CO_2 emissions from passenger cars was officially published in the shape of Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community’s integrated approach to reduce CO_2 emissions from light-duty vehicles. The fleet average to be achieved by all cars registered in the EU is 130 grams per kilometre (g/km). A so-called “limit value curve” implies that heavier cars are allowed to produce higher emissions than lighter cars while preserving the overall fleet average. In 2012, 65% of each manufacturer’s newly registered cars had to comply (on average) with the limit value curve set by the legislation. This figure rose to 75% in 2013, to 80% in 2014 and to 100% from 2015 onwards. A target of 95 g/km is specified for the year 2021.

The Netherlands had already achieved the 130 gram level by 2011, with the Dutch car tax system contributing to this achievement. Due to fiscal policy, the sales of fuel-efficient, electric and especially PHEV cars have risen sharply over the past years. Fiscal policy includes a purchase tax (BPM) that must be paid when a car, motorcycle or light-goods vehicle is registered in the Netherlands for the first time. The BPM payable on a passenger car is determined by the

[80] https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/elektrisch-rijden/stand-van-zaken/cijfers
[81] https://www.emissieautoriteit.nl/onderwerpen/rapportages-en-cijfers-ev/documenten/publicatie/2017/06/30/totaalrapportage-2016
[82] https://zoek.officielebekendmakingen.nl/stcrt-2006-247-p24-SC78346.pdf
[83] Subsidy programme “Filling Stations Alternative Fuels” and the experimental programme for sustainable transport.

car's CO_2 emissions. BPM is not charged for electric cars and low-emission cars. CO_2 emission figures for each type of vehicle are listed in the register that is kept by the vehicle registration authority RDW. In addition, beneficial fiscal rules apply to business drivers leasing low-emission cars.

In 2011, the legislation on CO_2 emissions for light commercial vehicles was officially published in the shape of Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO_2 emissions from light-duty vehicles. The fleet average to be achieved by all cars registered in the EU is 175 grams per kilometre (g/km). A so-called "limit value curve" implies that heavier cars are allowed to produce higher emissions than lighter cars while preserving the overall fleet average. In 2014, 70% of each manufacturer's newly registered light commercial vehicles had to comply (on average) with the limit value curve set by the legislation. This figure rose to 75% in 2015, to 80% in 2016 and to 100% from 2017 onwards. A target of 147 g/km is specified for the year 2021.

In November 2017, the Commission published a proposal for new fuel efficiency targets for the time after 2021. The outcome of the negotiations with the Council and Parliament is not known yet.

4.3.6 Agriculture

For the agricultural sector, including horticulture, the main policy framework is the Agrocovenant.

Agro covenant
In 2008, the sectors in agriculture and horticulture agreed with the government on ambitious targets and measures in the Agro covenant (also referred to as the Clean and Efficient programme for the agricultural sectors). The main aims of the Agro covenant (Clean and Efficient Agricultural sectors) are:

- a reduction in CO_2 emissions of 3.5 to 4.5 Mton in 2020 as compared to 1990;
- a reduction in non-CO_2 greenhouse gases of 4.0 to 6.0 Mton CO_2 equivalents in 2020 as compared to 1990;
- an average annual energy efficiency improvement (energy saving) of 2% over the period 2011–2020;
- a production of 200 PJ in biomass and 12 PJ in wind energy by 2020.

The covenant also aims to make the agricultural sector more sustainable through a "green growth strategy". In addition, the agricultural sector wants to be a producer of sustainable energy and to reduce its dependence on fossil fuels.

The sector is expected to take cost-effective measures that contribute to emission reductions of greenhouse gases on a voluntary basis. This covenant distinguishes three separate main areas of concern over policy measures for the reduction of CO_2 emissions in agriculture:

- The agricultural processing industry is mainly issued with "industrial" policy measures from the Ministry of Economic Affairs such as Long-Term Agreements and innovation policy (see above).
- The 2013 Energy Agreement sets a target for energy savings in the horticulture sector of 11 PJ in 2020 (this figure is equivalent to a CO_2 reduction of 0.7 Mton). This target is implemented through energy savings and sustainable production of the energy demand (electricity and heat), as well as through developing energy-efficient greenhouse systems and new growing methods. Policy instruments include LTAs, specific innovation programme ("The greenhouse as an energy source"[84]) and a sectoral emission trading system[85] in which the total allocation declines annually to a level of 6.2 Mton CO_2 in 2020. After an evaluation in 2017, the allocation was lowered to 4.6 Mton CO_2[86]. Two subsidy programmes are available for horticulture in order to stimulate investments in innovative and energy-efficient installations: Energy efficiency and renewable energy horticulture ("EHG") with a budget of € 6 million in 2017 and Market introduction energy innovations ("MEI") with a budget of € 5 million in 2017.
- Other agricultural activities (e.g. primary sectors) focus on energy savings, the sustainable production of energy through fermentation, among other things, and the production of biomass to generate energy. The main policy instruments are LTAs and SDE+.

[84] https://www.kasalsenergiebron.nl/en/
[85] The covenant "*CO_2 emissieruimte binnen het CO_2 sectorsysteem glastuinbouw voor de periode 2013–2020*" (Scope for CO_2 emissions within the CO_2 greenhouse horticulture sector system for the period 2013–2020) .
[86] https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2017/07/06/kamerbrief-over-evaluatie-co2-sturing-in-de-glastuinbouw/kamerbrief-over-evaluatie-co2-sturing-in-de-glastuinbouw.pdf

Reduction measures for methane (CH4) and nitrous oxide (N2O)
For non-CO_2 emissions, there are three categories of measures that can contribute to reducing emissions:

- Best Management Practices for reducing nitrogen input on farms, such as precision soil cultivation using GPS. In 2017, the government and businesses started a pilot programme for precision agriculture using innovative technologies such as satellite data and drones[87];
- measures for cattle feed to reduce CH_4 emissions. The composition of feed can affect the production of methane through the cattle's digestive systems. Generally speaking, the better the digestibility, the lower the methane emissions;
- measures for manure storage to reduce CH_4 emissions. Manure fermentation is the main option for reducing methane emissions from manure.

A committee was formed for each agricultural sector, in which both the government and sector associations participate, describing the specific way in which a sector will contribute to the realisation of the policy target. RVO.nl performs the monitoring of the Agrocovenant. The latest monitoring report was published in 2014[88]. This report showed that the agricultural sectors play an important role in the production of renewable energy and that they are able to reduce the use of energy. Some agricultural sectors have set up their own monitoring, such as Flower bulbs[89], Mushrooms[90] and the Dairy sector[91]. The progress in the horticulture sector was evaluated in 2017[92].
The covenant was evaluated in 2015, including a re-assessment of its objectives. A new document is expected to be published in the beginning of 2018. Partners are currently also making plans for the period up to 2030 and 2050.

Legislation on manure management and the EU milk quota
The EU milk quota, which ended in 2015, limited the number of dairy herds held in the Member States including the Netherlands. After its abolishment, the number of cattle increased. Since then, restrictions in manure management and the emissions of minerals such as phosphates have had a strong influence on the limits to dairy herds and consequently on the emissions of methane and nitrous oxide from agriculture. In order to limit phosphate emissions, it was decided to introduce a trading system for phosphate emission allowances starting from 2018[93]. The number of allowances is set at the situation in July 2015, resulting in a reduction of the dairy herd.

4.3.7 Forestry (CO_2) and LULUCF

In the Netherlands, emissions and removals of CO_2 within the scope of LULUCF occur in forests, grass- and cropland, the conversion of grassland into cropland (or vice versa), the loss of grass- or cropland due to new infrastructure and building, and the oxidation of peatland due to water management and the conversion of forest into grassland (including non-forest nature like heathland), infrastructure, settlements or other land use categories and vice versa. Currently, no direct policies for implementing measures explicitly dedicated to reducing GHG emissions from LULUCF exist in the Netherlands. However, other policies with different objectives result also in restricting carbon emissions or improve removals from LULUCF.

Forest and Nature policy
Over the past decades, forest policy in the Netherlands has been integrated into the nature policy, which reflects the change towards multi-purpose forests in which more functions are combined (e.g. nature, recreation). The development of a nature network is a central theme of the nature (and forest) policy. Implementation of nature policy including the development of the nature network has been decentralised from the central government to the provincial governments. The nature network is a cohesive network of high-quality nature wetland and terrestrial reserves, including Natura 2000 sites that is foreseen to get a total size of 668,000 ha in 2027. 620,000 ha of this network was completed by 2017[94]. Depending on the balance between wood production or nature conservation forest owners within the nature network can apply for lower or higher nature protection subsidies; as a general condition for nature subsidy forests must be open to the public. The aim is to have converted an additional 40,000 ha of land to become part of the nature network by 2027. Part of this will be achieved through afforestation and reforestation, which over time will also

[87] https://www.rijksoverheid.nl/actueel/nieuws/2017/02/13/staatssecretaris-van-dam-kondigt-nationale-proeftuin-precisielandbouw-aan
[88] https://www.rvo.nl/sites/default/files/2014/05/energie-en-klimaat-in-de-agrosectoren.pdf
[89] https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/groene-economie/schone-en-zuinige-agrosectoren/sectoren/bloembollen-en-bolbloementeelt
[90] https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/groene-economie/schone-en-zuinige-agrosectoren/de-sectoren/agrosectoren-paddenstoelen
[91] https://www.duurzamezuivelketen.nl/files/DZK%20jaarverslag%202015.pdf
[92] https://www.kasalsenergiebron.nl/content/user_upload/Tussentijdse_evaluatie_meerjarenafspraak_energietransitie_glastuinbouw_2014-2020.pdf
[93] https://www.rijksoverheid.nl/actueel/nieuws/2017/07/12/duidelijkheid-over-fosfaatrechten-voor-melkveehouder s
[94] http://www.ipo.nl/publicaties/provincies-op-koers-met-realisatie-natuurnetwerk-nederland

contribute to increasing removals from LULUCF. The scale of such afforestation is, however, not known yet. Provinces are having the lead in making policy for this. Initiatives from the private sector, such as the Action plan for Forest and Wood sector[95], where an additional 100,000 ha of new forests and improved forest management is targeted, will have additional influence.

Cropland and grazing land management
Most Provinces with substantial areas of pastures on peat are developing plans to limit subsidence through setting limits to the maximum lowering of ground water tables. Additional the Rural Development Plan includes a measure for meadow bird management to raise the groundwater level in peat pasture areas (during part of the year). Implementation of such higher groundwater level will reduce degradation of soil organic matter in the peat soils.

Some European policies also have impact on cropland and grazing land management in the Netherlands and have – indirectly- impact the carbon content of soils. The EU Nitrates Directive (1991) limits the application of nitrogen fertilizers on agricultural lands. As part of a derogation, Dutch dairy companies are allowed to apply a higher amount of fertilizer under certain conditions. Some of those conditions have impact on the carbon content of soils. For example, dairy companies are required to have grassland that amounts at least 80% of their area and croplands are required to use catch crops.

Relevant European regulation, such as the LULUCF regulation (EU 479/2016) and the revision of the Renewable Energy Directive are under negotiation. Implementation of these regulations
will most probably incentivize further policy action in the Netherlands to optimise the capacity for carbon sequestration in the land use sector and will influence the use of biomass both from agricultural as from forest sources as well.

4.3.8 Waste (CH_4)

According to the Environmental Management Act, the former Ministry of Infrastructure and the Environment (I&M) was tasked with issuing a Waste Management Plan once every six years. The National Waste Management Plan 2002–2012 was the first such plan. It was replaced in 2009 by a second plan for the period 2009–2021, which is in force up to December 2017. The third plan, for the period 2017–2029, is currently being prepared.

The policy of the current – second – plan aims to minimise the production of waste, maximise recycling and other recovery, and minimise the amount of waste that remains for disposal, especially landfill. An important target of the waste policy for the period until 2025 is a decrease by 50% of the amount of waste sent to incineration plants or landfills. In order to achieve this target, the focus has been on the separation of household and commercial waste for collection, because almost 50% of this waste flow is still incinerated. Non-recyclable waste is incinerated in energy-efficient incinerators, which are all designated as installations for other recovery in accordance with the EU Waste Framework Directive.

The optimisation of waste management makes an important contribution to the mitigation of the greenhouse effect. Landfill of organic waste, for example, generates substantial methane emissions. This fact is one of the reasons why waste policy focuses on maximising waste recycling and limiting waste disposal. In 2014, around 2% of waste produced in the Netherlands was sent to landfill. This waste could not be recycled or incinerated.

The draft third plan builds on the second plan, but now also focuses on the contribution to a circular economy. Waste will be considered more as a reusable material for new products. This policy will also contribute to lower energy consumption and reduced greenhouse gases.

4.3.9 Building sector (households and services)

The building stock is an important sector where significant CO_2 emission reductions and energy efficiency improvements can be achieved for both new and existing buildings. The policies developed by the Dutch government for the building sector can be divided into three main categories:

- new buildings

[95] https://www.staatsbosbeheer.nl/Over-Staatsbosbeheer/Nieuws/2016/10/plan-bos-en-houtsector-levert-bijdrage-aan-klimaatdoelen

- existing buildings
- Ecodesign (appliances)

For buildings, a broad package of national policy instruments has been developed over the years, which also implement European policy instruments such as the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED). The EU Ecodesign Directive is the main policy instrument for appliances.

For the building sector, the 2013 Energy Agreement is the main policy framework up to 2020. In the Energy Agreement, parties set the ambition for the sector to reduce energy consumption by some 110 PJ between 2008 and 2020 (and CO_2 by some 22.5 Mton CO_2 eq in 2020). This reduction should mainly be realised by renovating 300,000 existing residential buildings annually up to 2020. The renovation is such that energy performance is increased by two steps on the energy label. In addition, the energy performance of new buildings is improving such that from 2020, new buildings are nearly energy neutral. The sections below describe the policies and measures for this policy horizon in more detail.

In recent years, government and stakeholders are developing new policies for the period after 2020. As already arranged in the Energy Agreement, the entire building sector should be energy neutral by 2050. This ambition is also reflected in the Energy Report 2016 (see above), in which the government set its vision on a low-carbon energy system. In the Energy Agenda (2016) , it was decided that this ambition should be realised by a steep reduction of both energy and natural gas consumption in buildings and by an increase in renewable power and heat production[96]. The supporting policy instruments are being developed and are expected to be set by the new government.

New buildings
The European Energy Performance of Buildings Directive (EPBD) requires that new buildings are almost energy neutral by 2020 (2018 for buildings from the central government). This requirement is implemented in national legislation (the Building Decree). Since 1995, this decision has defined minimum standards for energy performance, which have been slowly increasing over the years. In 2015, the energy efficiency requirements for houses and buildings in the utility/services sector were made more stringent again. The next steps are the requirements for nearly energy-neutral government buildings by the end of 2018 and for other buildings in the utility/services sector by the end of 2020 (included in the WAM projections only).

Existing buildings
For existing buildings, the national policy framework is more complex, as it distinguishes between private and social housing as well as utility buildings. In the last decade, several agreements between the government and stakeholders were concluded. This framework builds on earlier agreements with stakeholders from 2008 (“More with Less”) and later (such as the “Umbrella covenant” in 2012). The 2013 Energy Agreement serves as a framework agreement. It was again agreed that the energy efficiency of some 300,000 dwellings should be improved every year until 2020 by two steps on the energy label.

For *private-sector housing*, the support actions are focused on awareness, financial support and new arrangements (“unburdening” of homeowners and/or using new business models) to implement energy-saving measures. These instruments include:

- the mandatory energy label system. Five million homeowners have received a notification with their preliminary label. The label is required when the house is newly built, sold or rented. It contributes to raising awareness and stimulates the application of measures for energy saving. This system is implemented with the Energy Performance of Buildings Decree[97];
- the National Energy Savings Revolving Fund (“NEF”), founded in 2014 for loans related to energy savings, with a budget of € 300 million. This fund makes higher mortgages available for investments in energy-saving measures. The NEF is flanked with a support programme by the joint municipalities means that regional governments are developing energy programmes (usually in regional clusters), including the so-called local energy “counters” (for information, among other things) as arranged in the Energy Agreement. Loans increased from € 6 million in 2014 to € 16 million in 2015 and € 27 million by September 2016[98];
- the development of new servicing and business models in energy services by energy suppliers, the installation sector and other companies. New arrangements and services are being developed and tested; for example, in

[96] https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2016/12/07/ea/Energieagenda-2016.pdf
[97] http://wetten.overheid.nl/jci1.3:c:BWBR0023734&z=2016-07-01&g=2016-07-01
[98] https://www.vvebelang.nl/media/kamerbrief-over-energiebesparing-gebouwde-omgeving.pdf

various Green Deals and in “block-by-block” trial projects (a set of some 10 pilot projects with new service arrangements, each for a block of more than 1,500 houses). Successful arrangements are intended to be rolled out further;
- smart metering. Energy distribution companies aim to furnish 80% of the dwellings with a smart meter by 2020 (see Section 4.3.6);
- subsidies for homeowners who invest in at least two energy-saving measures (such as insulation and high-performance glass). For renovations that lead to very efficient buildings, an additional subsidy is available. The budget for the period 2016–2018 is € 61 million[99];
- the ISDE subsidy scheme, which can be used by homeowners to invest in renewable heat installations (see Section 4.3.3 above);
- a 2016 information campaign to provide homeowners with insight into ways of saving energy. The campaign, which will run for the coming three years, uses TV and radio commercials as well as a comprehensive website[100] that also links to local energy “counters”.

For the *social housing sector*, the parties agreed in the Energy Agreement to aim for energy savings of 24 PJ by 2020. This aim is mainly supported by the following instruments:
- a subsidy scheme (STEP) for improving energy efficiency in social housing. Owners of social housing may apply for a subsidy when they invest in improving the energy performance of their home by at least two steps on the energy label. The amount of subsidy depends on the level of improvement. The budget is € 395 million for the period 2014–2018;
- a fund for improving the energy efficiency of rental housing (FEH). Owners of social housing as well as tenants of rental housing may apply for an attractive loan when the energy performance is improved to nearly energy neutral[101]. The budget is € 75 million for the period 2014–2019;
- a programme to realise as a first step 11,000 “zero-energy” dwellings by 2016 (scaling up to 100,000 in 2020) alongside a support programme with parties at the local level;
- further intensification of the measures agreed in the Energy Agreement, which means that housing associations have to realise an average energy label B for social dwellings by 2021 (WAM scenario only).

Measures that influence savings in the utility sector*:*
- The Long-Term Agreements on energy efficiency (LTAs, see under Industry, Section 4.3.4) also include some services sectors: universities, buildings for higher professional education and university hospitals.
- The Energy Agreement includes a stricter control of energy requirements under the Environmental Protection Act with the help of a list with economically viable energy-saving measures, an expert information centre on energy-saving measures and the use of periodical energy performance assessments (EPK) by recognised energy service providers to support parties in their energy-saving actions as well as to check on progress and updates. In 2016, the capacity of regional environmental agencies to enforce the energy requirements was increased. The requirement to conduct a periodical energy audit (according to Directive 2012/27/EU) also facilitates stricter control.
- Utility buildings that are newly built, sold or rented are required to have an energy label. As part of the further intensification of the measures agreed in the Energy Agreement, it was arranged in 2016 that offices are required to have a minimum energy label C by 2023 (WAM scenario only).
- Various subsidy schemes exist, such as for sports facilities, SDE+, ISDE and energy innovation (see above).

In 2017, an agreement between the central government, energy suppliers and distributors, the installation service sector and sector associations was concluded in order to reduce energy consumption in households (both private owners and tenants) and small enterprises with 10 PJ by 2020[102]. This reduction will be realised by improving the information on energy consumption by consumers, the energy services offered to consumers and the conditions of existing subsidy schemes for energy savings, as well as increasing the ISDE subsidy budget (see Section 4.3.3) by € 160 million for the period 2017–2020 (included in the WAM scenario only).

Ecodesign

[99] https://www.rvo.nl/subsidies-regelingen/subsidie-energiebesparing-eigen-huis
[100] https://www.energiebesparendoejenu.nl/
[101] https://www.rvo.nl/subsidies-regelingen/fonds-energiebesparing-huursector-feh
[102] https://www.rijksoverheid.nl/documenten/convenanten/2017/05/23/convenant-energiebesparing-gebouwde-omgeving

The Ecodesign Directive (2009/125/EC) and its earlier 2005 version provide consistent rules for setting product-specific regulations at the EU level and improving the environmental performance of energy-related products. At the moment, 28 product regulations are in force, covering a wide range of products and horizontal aspects such as electric motors, ventilation units, space and water heaters, process chillers, household appliances, televisions, lamps and network standby. Implementing regulations establish minimum mandatory requirements for energy efficiency and, if relevant, for other environmental aspects such as noise, NOx emissions or durability. Implementing regulations are revised regularly.

The Energy Labelling Directive has recently been revised and transformed into a Regulation (EU/2017/1369) providing consistent rules for setting product-specific regulations on mandatory energy labels at the EU level. This revision will result in product labels that after revision will again have an A–G scale (instead of A+++ to D), because it has been shown that the A–G scale provides more of a motivation for consumers to buy the most efficient products. Further revisions are envisioned when the market has transformed in such way that a large number of the products are in the A class. The new Framework Regulation will also introduce a mandatory product database by 1 January 2019 which supports market surveillance and the provision of product data to inform consumers by electronic means, e.g. websites and apps. Energy labels have to be displayed on products for sale in physical shops and online. Currently, 16 energy labelling regulations are in force, covering products such as household appliances, televisions, space and water heaters, and lamps.
For products that have eco-design requirements as well as an energy label, both instruments are developed in the same policy process.

4.3.10 Impact of policies and measures on reduction of greenhouse gases

Table 4.6 contains information on the policies and measures (PAMs) described in the sections above including their impact on the reduction of greenhouse gases.

The impact on greenhouse gases is determined by comparing the With Additional Measures variant of the NEV2017 projections (see Chapter 5 for more details) with the situation where no policies changes are assumed after 2012. In this way, the impact of the Energy Agreement of 2013, which is the main policy framework in the Netherlands, can be taken into account. For the establishment of this reference, the policy variant “Without the Energy Agreement” in the NEV2017 has been used.

In order to determine the impact of European regulations and other national policies and measures adopted before 2013, the projections from 2012 were used as a reference[103]. For these European and national policies and measures, the impact of changes after 2012 was determined by comparing the policy variant “With Existing Measures” with the policy variant “Without the Energy Agreement” in the NEV2017.

The calculation of CO_2 emission reductions of the renewable energy production incentive scheme (SDE+), the most important renewable energy policy in the Netherlands, is based on the (expected) production of renewable energy from projects that were granted with a subsidy.

Some measures are mentioned more than once in table 4.1, such as the EIA, LEE / LTA. This is due to the fact that the Energy Agreement from 2013 contains changes of policies and measures of already existing policies. The impact of those (partial) changes have been attributed to the Energy Agreement. The effects of some PAMs within a sector, cannot be singled out from other measures in that sector. This method has been chosen in order to prevent double counting of policies and measures within a sector. As a result, the effects of those measures are summed in one row for that sector in this table.

[103] http://www.pbl.nl/sites/default/files/cms/publicaties/PBL_2012_Referentieraming-energie-en-emissies-2012_500278001.pdf

Name of mitigation action	Estimate of mitigation impact in 2020 (not cumulative, in Mton CO_2 eq.)			Estimate of cumulative mitigation impact (period 2013-2020, Mton CO_2 eq.)
	Total	*ETS*	*non-ETS*	*Total*
Non Energy Agreement policies				
Group of PAM's industry: VAMIL/MIA/EIA, Ecodesign, ETS, MEE, Long Term Agreements (MJA3/MEE)	1.2	0.7	0.4	4.1
Group of PAM's transport: Fiscal policy on car efficiency (BPM), green deals, fuel tax	3.1	0.0	3.1	10.8
Group PAM's built environment: VAMIL/MIA/EIA, ETS, EPC	4.9	1.7	3.2	17.0
Groups PAM's agriculture: Agrocovenant, with various sectors in horticulture and agricultures, incl. effects of fiscal measures, Ecodesign, sectoral emission trading system and ETS in this sector	0.9	0.4	0.5	1.6
Smart metering	0.2	0.1	0.1	0.4
Ecodesign Directive	2.0	2.1	-0.1	7.0
EU CO2 emission standards for cars and light duty vehicles	0.9	0.0	0.9	2.7
Actions under the Energy Agreement 2013				
Additional actions for private dwellings	0.9	0.3	0.6	2.3
Investment subsidies small renewable energy systems (ISDE)	0.0	-0.1	0.1	0.1
Additional actions for social housing	0.3	-0.2	0.4	0.6
Subsidy scheme for energy saving measures and renewable energy in sport accommodations (EDS)	0.0	0.0	0.0	0.0
minimum energy label "C" for utility buildings	0.2	0.1	0.1	0.2
Enhanced Energy Investment Allowance (EIA)	0.4	0.2	0.2	1.1
Enhanced Long-Term Agreements (MEE) on Energy Efficiency with industrial enterprises that have to participate in the EU ETS scheme	0.8	0.8	0.0	1.6
Enhanced Long-Term Agreements on Energy Efficiency (LTA3/MJA3) (with industrial sectors and some sectors in built environment and transport)	0.1	0.1	0.1	0.3
Maintaining the Environmental Protection Act in industry and the built environment	0.6	0.4	0.2	1.2
Eco Driving Campaign, carpooling, tire choice and pressure; Truck of the Future	0.5	0.0	0.5	1.3
Renewable energy policies				
SDE+ Subsidy scheme for renewable energy production (Stimulation of Sustainable Energy Production)	14.9	11.6	3.3	45.7
Decision Biofuels as renewable energy for transport	3.0	0.0	3.0	9.0
Net metering	1.7	1.7	0.0	6.0
Non-CO_2 policies and measures				
Reduction Program for non-CO_2 greenhouse gases (ROB)	0.4	0.0	0.4	3.6
EU F-gases regulation	0.3	0.0	0.3	1.1
Legislation on manure management	0.1	0.0	0.1	0.7
Legislation on landfill and waste	1.3	0.0	1.3	4.6
Total	38.8	20.0	18.8	123.0

Table 4.6 - Impact of policies and measures on reduction of greenhouse gas emissions in 2020 and 2013-2020

4.3.11 Monitoring and evaluation of progress in climate change measures

The overall development of greenhouse gas emissions is being monitored through the emission inventory system (described in Section 2.3). Emissions under the EU ETS are being monitored through annual reporting in accordance with EU ETS. Non-ETS emissions are reported annually to the European Commission, as regulated in Commission Implementing Regulation (EU) No 749/2014. Starting in 2015 and every two years thereafter, all EU Member States have to report to the European Commission all information on national policies and measures related to greenhouse gas reductions by 15 March, in line with Regulation (EU) 525/2013.

Since 2014, an annual National Energy Outlook (*NEV*) has been published. The NEV describes the development observed from 2000 up to the present, as well as expected developments up to 2030 (since 2016, up to 2035; see Chapter 5). It covers physical indicators such as energy supply, energy demand and greenhouse gases emissions, in addition to economic indicators such as Economic Value Added and energy-related employment. The NEV aims to provide a fact base for the societal debate on energy in the Netherlands and is prepared by a consortium consisting of the Energy Research Centre of the Netherlands (ECN), the Netherlands Environmental Assessment Agency (PBL), Netherlands Statistics (CBS) and Netherlands Enterprise Agency (RVO.nl). The former two agencies are responsible for projections, evaluative analyses and final editing, while the latter two provide information on realised progress and ongoing actions, within society at large as well as in policies and measures. Much of the information required by the EU and UNFCCC is provided by this annual NEV, which is why this report – along with the organisation procedures and methods underlying the NEV process – is a cornerstone of the Dutch National System for projections and reporting on policies and measures that was established in 2015 (see Section 5.5).

In order to monitor the progress of the SER "Agreement on Energy for Sustainable Growth" (see Section 4.3.1), it was agreed to appoint a "Standing Committee" comprising representatives of the parties. Progress reports are made annually and are available for the years 2014, 2015 and 2016. The projections from the annual National Energy Outlooks are used in these progress reports to track the progress on the main targets. Action is undertaken by parties when progress is falling behind expectations. Based on the progress up to 2015 and 2016, new actions have been added to the Energy Agreement in order to attain the energy savings and renewable energy targets for 2020[104].

The Netherlands Environmental Assessment Agency (PBL) publishes "The assessment of the human environment", a biennial report on the current status and future trends within the Dutch environment in relation to government policies and societal developments. The most recent publication is "Providing direction – Creating space 2016"[105].

Monitoring, reporting and verification of the ESD targets mainly takes place through the submission of the national GHG inventories by Member States. The ESD and the MMR have introduced an annual compliance cycle requiring a review of Member States' greenhouse gas inventories to ensure compliance with their obligations under the ESD in the period 2013–2020 (see also section 3.2.2).

4.3.12 Assessment of the economic and social consequences of response measures

Foreign policy agenda
As Dutch support for climate action is part of development cooperation, both our bilateral and our multilateral climate finance are characterised by a strong focus on poverty. Poorer people and communities are typically affected the most by climate change, not only because they are often the most exposed but also because they have the least resources to cope and adapt . To support mitigation, we focus on providing access to renewable energy and on halting deforestation; to support adaptation, we focus on climate-smart agriculture, integrated water resource management and the provision of climate-resilient WASH services. Disaster risk reduction is an integral part of our programmes for integrated water resource management, while it also receives support through Partners for Resilience. Gender is an important cross-cutting issue, as climate action is the most effective when it builds on the capacities of both genders and addresses the needs as well as the vulnerabilities of both.

[104] http://www.energieakkoordser.nl/~/media/files/energieakkoord/publiciteit/voortgangsrapportage-2015.ashx page 60 and https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/ip2020
[105] http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2016-balans-van-de-leefomgeving-2016-1838.pdf

International financial support
Committed to scaling up its support for mitigation and adaptation activities in developing countries, the Netherlands has continued to realise a year-on-year increase in its climate finance after having delivered on its commitment of Fast-Start Finance during 2010–2012. Public climate finance amounted to € 420 million in 2015 and € 472 million in 2016. In addition, public finance from the Netherlands in 2015 mobilised € 73 million of private finance for climate-relevant activities in developing countries. In 2016, mobilised private finance amounted to € 171 million. For more detailed information we refer to chapter 6.

Collaboration between authorities, businesses, knowledge institutes and civil society
Dutch public climate finance is first and foremost intended to assist the poorest communities and the poorest countries. To address their needs, we work with a multitude of actors, including national, regional and local authorities, multilateral organisations, non-governmental organisations, private-sector organisations, farmers organisations, water boards, and so on. These organisations all have their own processes to ensure that their activities meet the needs of their target populations.

Support for technology development and transfer forms an integral part of many activities related to climate change mitigation and/or adaptation, encompassing both hardware (equipment) and software (know-how, methods, and practices). Both the private sector and several knowledge institutes are partners in providing this support. A number of examples are presented in chapter 6

Market mechanisms
The flexible mechanisms under the Kyoto Protocol – International Emissions Trading, Joint Implementation and the Clean Development Mechanism – are all tools incorporated into the Protocol in order to share efforts aimed at reducing greenhouse gases. Their goal is to ensure that investments are made where the money has optimal effects to reduce greenhouse gases with a minimum impact on the world economy. In the first commitment period of the Protocol, the Netherlands made use of each of the flexible mechanisms by acquiring emission credits from CDM and JI projects across the world, mainly through investment programmes of the World Bank and regional development banks (such as CAF)[106]. Credits were also acquired through national banks (i.e. the Rabobank) and through a tender carried out by RVO.nl. Acquiring activities started in the early 2000s. Since April 2011, the Netherlands has also been supporting the World Bank's "Partnership for Market Readiness" (PMR) with a total pledge of $ 7.2 million[107]. The PMR will help countries to make use of the benefits and advantages of the carbon market. It promotes collective innovation and piloting of market-based instruments for GHG emissions reduction. In addition, the PMR provides a platform for technical discussions about instruments to spur innovation and support implementation. During the first commitment period of the Kyoto Protocol, the Netherlands contracted a total of 33.2 Mton in carbon credits from CDM projects, 17.1 Mton from JI projects and 2.2 Mton from participation in Carbon Funds (PCF).

Biofuel production
All biofuels on the market in Europe and the Netherlands must comply with the sustainability criteria laid down in the Renewable Energy Directive (2009/28/EC). Only sustainable biofuels are allowed to be used for fulfilling the blending target. Compliance with these criteria must be demonstrated through one of the adopted certification systems[108]. These certification systems are controlled by an independent audit. All biofuels produced in the Netherlands fulfil these requirements. The national policy aims to increase the production of biofuels in an effort to achieve the target of renewable energy sources accounting for 10% of the energy use in the transport sector by 2020. In 2016, this share of renewable energy was 7%[109]. More than 66% of the energy content is from advanced biofuels. The raw materials for advanced biofuels are waste and residual materials such as used frying fat. Most of the frying fat is imported from other western European countries, Asia (China and Taiwan) and North America. The raw materials of non-advanced biofuels are mainly maize and wheat originating from Europe. The share of renewable electricity, which also contributes to the 10% target, is still small (0.1% in 2016).

Sustainability requirements for co-firing and large-scale heat production

[106] https://www.rijksoverheid.nl/documenten/rapporten/2014/06/17/beleidsevaluatie-clean-development-mechanism-cdm
[107] https://www.thepmr.org/pmrimplements/1
[108] http://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes
[109] https://www.emissieautoriteit.nl/onderwerpen/rapportages-en-cijfers-ev/documenten/publicatie/2017/06/30/totaalrapportage-2016

The sustainability requirements for co-firing and large-scale heat production were changed in the SDE+ subsidy programme (see Section 4.3.3) as from 1 January 2015 to ensure a high level of sustainability[110].
The use of biomass that competes with food (or food production) for the production of bioenergy is prohibited. In addition, organisations should be in possession of documentary evidence for all forest biomass showing that the forest management unit from which the wood is sourced has been managed with a view to the long-term conservation or expansion of carbon stocks. Overall, these requirements can be considered as very stringent compared to policies in other countries.

4.3.13 Domestic and regional programmes and/or legislative arrangements, as well as enforcement and administrative procedures

Arrangements and procedures: European policy context
As an EU Member State, the Netherlands is also subject to EU climate policy and so it applies the EU Common and Coordinated Policies and Measures (CCPMs) relevant to climate change. These policies include Directive 2003/87/EC, which introduced the European system for CO_2 emissions trading, and the Effort Sharing Decision 406/2009/EC. Also included are the European Council Decision 2002/358/CE on sharing the burden of the EU's emission reduction target for the Kyoto Protocol and Regulation (EU) No 525/2013 on the Monitoring Mechanism, which ensures that EU progress towards meeting the Kyoto target is assessed annually and that Member States provide sufficient information to the European Commission in order to achieve this aim. Other CCPMs concern the promotion of renewable energy, the introduction of biofuels for transport, the stimulation of energy savings and the reduction of methane (CH_4) emissions from landfill waste sites.

Arrangements and procedures: national policy context
Environmental Management Act
Almost all national legislation on the environment is incorporated in the Environmental Management Act. This Act sets out an integrated approach to environmental management in the Netherlands and provides a legal framework by defining the roles of national, provincial or regional, and municipal governments[111].

The Act stipulates the tools to be used in environmental management, including:

- environmental plans; for instance, the national waste management plan that regulates municipal waste collection, disposal of discarded equipment such as refrigerators and TVs, and permits for hazardous waste shipment;
- environmental quality criteria for emissions and discharges of harmful substances, such as greenhouse gases and heavy metals, to air, water and soil;
- environmental impact assessment, a prerequisite for the construction of major infrastructure such as oil refineries, nuclear power plants, chemical plants, roads, railways, and oil and gas pipelines;
- environmental reporting, which is directed at stimulating companies to make their production cleaner and more environmentally friendly. Many companies, such as those involved in metal processing and chemical production, are required to publish an annual environmental report. The Ministry I&W is responsible for ensuring that the reporting requirements of the EU Pollutant Release and Transfer Register (PRTR) are met. Those companies and organisations required to prepare an integrated PRTR report on waste, air emissions (greenhouse gases) and discharges into water sources are listed in Annex II of the PRTR Regulation, which is published in the Official Journal of the European Union;
- The Human Environment and Transport Inspectorate is largely responsible for ensuring that the provisions of the Environmental Management Act are enforced. Enforcement is also a task of the municipalities, the police and the justice system.

The Environmental Management Act therefore provides the legal basis for most environmental regulations that affect emissions of greenhouse gases (for example, regarding waste prevention, landfill policy and CO_2 emissions trading).. The Act also provides the framework for enforcing commitments undertaken in Long-Term Agreements on energy efficiency (see section 4.3.4)

[110] https://english.rvo.nl/file/sde-sustainability-requirements-co-firing-and-large-scale-heat-production
[111] https://www.government.nl/topics/environment/contents/roles-and-responsibilities-of-central-government/environmental-management-act

Chapter 18 of the Environmental Management Act regulates the enforcement of legal measures. It denotes which authorities are responsible for enforcement and requires them to designate officials who are charged with monitoring compliance. In the event of violations, authorities have several sanctions at their disposal. For example, they may order that the situation is brought into compliance at the expense of the violator, impose a pecuniary penalty or withdraw a licence. Another option is a criminal sanction. Public prosecutors may bring cases against offenders in the criminal court, which could result in high financial penalties or even imprisonment (maximum of six years).

Environmental Permitting (General Provisions) Act
The Environmental Permitting (General Provisions) Act lays down the rules for granting an All-in-one Permit for Physical Aspects. This Act enables members of the public and companies to use one transparent procedure in order to apply for permits to one competent authority for activities that have an impact on the physical environment. Large companies, such as chemical plants, are required to obtain environmental permits that stipulate limits for the discharge of substances harmful to the environment.[112]

Housing Act and Buildings Decree
Energy performance requirements for new buildings are laid down in the Buildings Decree pursuant to the Housing Act. The Buildings Decree empowers municipal authorities to grant building permits. In the event of violations of building permits, municipal authorities may have recourse to administrative sanctions based on Section 25 of the Municipalities Act and to criminal sanctions based on Section 108 of the Housing Act. In 2015, the stringency of energy performance requirements in the Building Decree was increased (see Section 4.3.9).
In March 2015, the Dutch Senate approved new legislation on housing associations. The Housing Act came into effect on 1 July 2015. It defines the core tasks of housing associations, which is to provide affordable housing to people on a low income. The Housing Act makes a strict distinction between social activities and commercial activities. Housing associations have to focus their future activities on Services of General Economic Interest (SGEI) and have to meet the strict conditions imposed by the national government on activities in the commercial sector (non-SGEI).

Provisions to make arrangements and procedures publicly accessible
After adoption, all laws and underlying legislative arrangements in the Netherlands are published in one of several official government bulletins and/or directly on the National System website, as indicated in Section 3.3. The Freedom of Information Act and the Environmental Management Act also provide for public access to information on the enforcement of environmental rules and regulations. As from 22 December 2005, the Freedom of Information Act has been extended with a provision for the reuse of official government information, in accordance with Directive 2003/98/EC of the European Parliament and the European Council of 17 November 2003.
Since the NC6, there have been no significant changes to the provisions for making arrangements and procedures publicly accessible.

4.3.14 Policies and measures in accordance with Article 2 of the Kyoto Protocol

Article 2 of the Kyoto Protocol asks to specifically address:

- policies and measures to promote sustainable development.
- the steps taken to promote and/or implement decisions by ICAO and IMO to limit or reduce associated emissions.
- how it strives to implement policies and measures in such a way as to minimise adverse effects.

This information is provided in the following paragraph.

Promoting sustainable development
In September 2015, the 17 Sustainable Development Goals (SDGs)[113] of the 2030 Agenda for Sustainable Development were adopted by world leaders at a UN Summit. Countries have committed to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. Many of the goals set, are related to climate issues. The Netherlands is determined to implement the SDGs, and has submitted its first Voluntary National Review to the UN High Level Political Forum in July 2017. One of the main observations is that a multi-stakeholder approach is key to the successful implementation of the SDGs.

[112] http://rwsenvironment.eu/subjects/all-one-permit/
[113] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

The EU has also taken up the implementation of the SDGs. In November 2016, the European Commission launched its Communication “Next Steps for a Sustainable European Future. European Action for Sustainability”. This is a comprehensive document, which integrates and links economic, social and environmental dimensions.
Under the current Commission sustainable development is mainstreamed in key cross-cutting projects as well as in sectoral policies and initiatives. In the past, an EU Sustainable Development Strategy was launched in 2001, revised in 2006 and reviewed in 2009. Since 2010, sustainable development has been mainstreamed into the Europe 2020 strategy, confirmed by the current Commission and built around education and innovation ("smart"), low carbon emissions, climate resilience and environmental impact ("sustainable") and job creation and poverty reduction ("inclusive").

The OECD has reviewed the Environmental Performance Policy of the Netherlands in 2015 with special attention paid to the themes green growth, sustainable mobility management and waste and materials management. The main conclusions of the OECD were:

- The Netherlands is a forerunner in environmental policy but has recently reined in ambitions.
- Environmental policy saw significant streamlining and modernising efforts
- Greening growth at a moderate pace with opportunities for more cost-effective policies
- Dutch policies effective at promoting sustainability in mobility, but at a very high cost in some cases
- A strong track record in waste management, with new challenges to transition to a circular economy

Green growth has been one of the priority themes for the Dutch Government. The government aims to strengthen the competitiveness of the Netherlands while reducing the burden on the environment en the dependence on fossil energy. Combining the innovative strength of industries, knowledge institutes and government is essential to achieve this ambition.
In 2015 the Dutch government sent its mid-term evaluation report on ¨Green Growth¨ to parliament, as a follow-up on the 2013 policy paper. Consumer behaviour had not shown major changes, in spite of relatively high taxes on environmental impact. Progress was recorded however on energy-efficiency, sustainable procurement and inclusion by private enterprise of social costs and returns.

Dutch Green Growth policy focuses on 8 areas: Climate, Energy, Water, Building, Food, Bio-based Economy, from Waste to Resources and Mobility. It promotes the use of 4 instruments to achieve green growth: smart use of market incentives, revision of laws and regulations, innovation and the government acting as a network partner. An international approach and joint EU actions are essential to achieve the objectives and to secure a level international playing field

In September 2016 the Dutch government sent its proposal for ¨A Circular Economy in the Netherlands by 2050¨ to parliament, followed in 2017 bv the ¨National Agreement on
the Circular Economy¨ - a letter of intent to develop transition agendas, together with undersigned private enterprises, trade unions, ngo´s, regional and local government.

Steps relating to greenhouse gas emissions from aviation and marine bunker fuels
In accordance with Article 2.2 of the Kyoto Protocol, the Netherlands is still committed to achieving a limitation or reduction of greenhouse gas emissions not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) respectively.

ICAO
The Netherlands is fully committed to and involved in the challenges caused by climate change and is working towards resource-efficient, competitive and sustainable aviation. A comprehensive approach is considered the best way to reduce aviation emissions, and a number of policy initiatives related to sustainability and climate change are key in Dutch civil aviation policy. Measures apply to all of the four pillars of the so-called ‘4-pillar strategy’ for sustainable aviation, comprising innovative technology, Air Traffic Management (ATM) measures, market-based measures and the use of sustainable biofuels.

With respect to an international sector such as aviation, the Netherlands prefers a global system for CO_2 reduction. At the 39th ICAO Assemblee in 2016, the proposed Carbon Offset and Reduction System for International Aviation (CORSIA) was adopted and agreed to be further developed for implementation aiming at a first phase starting 1st

January 2021. At European level, the debate will start somewhere in 2018 about the way CORSIA will be implemented in Europe.

The Netherlands has been involved in the development and implementation of various measures such as the EU ETS and Single European Sky in ATM.

EU ETS
The EU Environment Council decided to include aviation in the EU ETS Directive (2008/101/EC) in December 2008, starting from 2012. All Dutch airlines complied with the directive and the associated obligations on monitoring, reporting and verification. In the light of the developments within ICAO regarding a global reduction system, the EU decided in 2013 to a temporary derogation from the ETS directive for aviation. This derogation meant that all flights between the EU and third countries would be temporarily exempt from compliance with the monitoring, reporting and verification obligations associated with the EU ETS. For all intra-EU flights, the ETS applied unchanged. This derogation is also known as 'stop-the-clock'. In 2017 the EU decided on a continuation of the 'stop-the-clock' policy until 31 December 2023, so after the start of CORSIA. This will allow time for a follow-up decision on the co-existence of CORSIA and EU ETS for international aviation.

Air traffic management
The Netherlands is strongly committed to the ICAO environmental and sustainability goals for air traffic management. For the larger part, this is organised in a joint European effort – the Single European Sky (SES) –, which is expected to have a potential reduction of CO_2 emissions of up to 10% by 2020. Examples of measures in this project are the simplification and optimisation of the airspace and procedures for its use. A strategy has been laid down in the Dutch Airspace Vision, accompanied by a performance-based navigation roadmap and an aeronautical information management roadmap. Implementation over the next years will ensure an optimised flow of air traffic, which will contribute to the internationally agreed sustainability goals.

The Netherlands is involved in the deployment of sustainable *biofuels* for aviation both at the European and national level. Through initiatives of one of the national air carriers and relevant stakeholders (including supplier, airport and producer), the Netherlands aims to be at the forefront of the implementation of bio-kerosene. With essential elements for a bio-kerosene infrastructure already in existence, the Netherlands is working on a structural supply by the further development of a bio-kerosene market, making public/private arrangements to secure its commitment and future involvement and has nationally implemented the EU Renewable Energy Directive in such manner that aviation biofuels can contribute directly to the Renewable Energy Goals.

IMO
According to decisions of the Marine Environment Protection Committee (MEPC), the IMO focuses on developing technical, operational and market-based measures for reducing CO_2 emissions from shipping. At its 62nd meeting, the MEPC decided on the Energy Efficiency Design Index (EEDI) for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for all ships, which will be in force as of this year. For its deliberations on these matters, the Committee makes use of the Second IMO Study on GHG emissions from ships, which estimated emissions of carbon dioxide (CO_2) from international shipping based on activity data and international fuel statistics. The resulting consensus estimate for 2007 was that CO_2 emissions from international shipping amounts to 843 million tonnes, or 2.7% of global CO_2 emissions compared to the 1.8% estimate in the 2000 IMO study. In the absence of future regulations on CO_2 emissions from ships, in the base scenario these emissions were predicted to increase by a factor of 2.4 to 3.0 by 2050. MEPC has agreed on a GHG Update Study that will become available in 2014.

In June 2013, the European Commission presented a strategy for the inclusion in its climate policy of measures to reduce the maritime GHG emissions, consisting of a step-by-step approach that starts with a proposal for the monitoring, reporting and verification (MRV) of maritime CO_2 emissions, followed by setting the emissions targets and the development of market-based measures. The first step, MRV, is under discussion between the EU member states and the European Commission.
Nationally, the Netherlands is monitoring a voluntary agreement between ship owners, ship operators, the logistic sector, hydraulic engineers, the shipbuilding industry, and the Ministry of Infrastructure and the Environment concerning the reduction of GHG emissions by the maritime sector.

In 2016, the IMO approved a Data Collection System (DCS) for fuel consumption. Since then, it has been developing a reduction strategy for GHG (CO_2), of which the draft version is to be prepared by April 2018 and the formal

ratification will take place in 2023. Among other things, this strategy will comprise reduction targets and measures, focusing on short-term measures for quick fixes. The strategy will conform to the principles defined in the Paris temperature goals of 'well below 2 degrees Celsius' and 'pursuing efforts for 1.5 degrees Celsius'. As a result, the international shipping industry will be making an important and measured contribution to combating global warming. The alignment process to integrate the MRV Regulation into the IMO system began last summer and will take approximately two years.

4.3.15 Minimising adverse effects

The Kyoto Protocol and the Paris Agreement were adopted in pursuit of the ultimate objective of the Convention, and hence its full implementation by the Netherlands is intended to contribute to preventing dangerous anthropogenic interference with the climate system. Ambitious mitigation goals are necessary to ascertain a future for all countries. In striving to develop policies and measures to reduce greenhouse gas emissions, parties subscribed to the Kyoto Protocol and the Paris Agreement should implement those policies and measures in a way that minimises any adverse effects, including the adverse effects of climate change, effects on international trade, and social, environmental and economic impacts on other parties, especially the developing country parties identified in article 4, paragraphs 8 and 9 of the Convention.

Adverse impacts on developing countries are reduced if the global temperature increase is limited to 2 degrees Celsius, if dependence on fossil fuels decreases, and if developed parties are able to develop low-carbon energy systems and reduce fossil fuel consumption. Furthermore, developing countries, especially the poorest and most vulnerable, need assistance to realize a low-carbon development path and to adapt to unavoidable climate change.

The Netherlands has decided to integrate development and climate action budgets, policies and activities for maximum impact and best results, especially for the poorest and most vulnerable. Committed to supporting developing countries in their climate action, we have been scaling up our climate finance. While public climate finance amounted in 2013 to EUR 286 million, it reached EUR 395 million in 2014, EUR 416 million in 2015 and EUR 472 million in 2016. In addition, in 2015 the Netherlands mobilised EUR 73 million private finance in 2015 and EUR 171 million in 2016. We have provided support to multilateral climate funds such as the Least Developed Countries Fund, the Green Climate Fund, the GEF and the Scaling up Renewable Energy Program of the Strategic Climate Fund, one of the Climate Investment Funds. Furthermore, we focus our support on access to renewable energy, halting deforestation, climate-smart agriculture, integrated water resource management and the provision of climate resilient water and sanitation (WASH) services. Disaster risk reduction is an integral part of our integrated water resource management programmes and furthermore receives support through Partners for Resilience. Gender is an important cross-cutting issue, as climate action is most effective when it builds on the capacities of both genders and addresses both their needs and vulnerabilities. Chapter 7 of this report contains more detailed information.

To promote Policy Coherence for Development, the Netherlands has adopted an Action Plan. One of its focus areas is climate change. In addition to integrating climate action into development cooperation, and increasing support for climate change adaptation and mitigation in developing countries, we have taken a number of other actions. We no longer provide public support, including export credits, to coal-fired power plants. In the International Financial Institutions we advocate more investments in renewable energy and support investments in fossil fuels only in exceptional circumstances where no realistic alternatives are available. In climate funds such as the Green Climate Fund and the Climate Investment Funds we seek to ensure that funding benefits the poor. To halt deforestation in highly relevant supply chains such as timber, soy and palm oil, the Netherlands has initiated and promoted the Amsterdam Declarations. The two Declarations−one on stopping deforestation and one on sustainable palm oil−were launched on December 7th 2015 with the intention of achieving fully sustainable and deforestation-free agro-commodity supply chains in Europe by 2020. To date, in addition to the Netherlands, Denmark, Germany, Norway, the United Kingdom and France have signed. The Declarations are intended to stimulate private sector commitment and progress on agricultural commodities associated with deforestation (such as palm oil, soy and cocoa) for which Europe has a significant market share. By expanding market demand for sustainable commodities in the signatory European countries, the Declarations aim to incentivize sustainable production in producer countries.

The Netherlands also strives to accelerate the transition to renewable energy worldwide. The Netherlands is founding member of the International Renewable Energy Agency (IRENA), an intergovernmental

organization that supports countries in their transition to a sustainable energy future. Through the Energy Sector Management Assistance Program (ESMAP) of the World Bank and the Friends of Fossil Fuel subsidy reform, the Netherlands supports countries (mostly) in the MENA region to reform fossil fuel subsidies while maintaining social safety nets.

In the COPs, important focus areas for the Netherlands are attention for adaptation action, the involvement of non-state actors in climate action, transparency and gender equality.

The flexible mechanisms under the Protocol – (1) Emissions Trading (i.e. the European Union Emissions Trading Scheme EU ETS), (2) Joint Implementation and (3) Clean Development – are all tools incorporated into the Protocol in order to share efforts aimed at reducing greenhouse gases, ensuring that investments are made where the money has optimal greenhouse gas reducing effects, and thus ensuring a minimum impact on the world economy. The Netherlands has made use of each of the flexible mechanisms, as was explained earlier in this chapter (par. 4.3.4). It has also signed MoUs regarding CDM projects with several countries worldwide. The Netherlands is supporting the World Bank's "Partnership for Market Readiness", which will help countries use the carbon market. The PMR will promote new market instruments as well as adjustments or expansion of the CDM.
To buy carbon credits under the Clean Development Mechanism, the Dutch Ministry of Infrastructure spent € 151 million between 2005 and 2008 and for the period 2009-2012 € 132,6 million. The Ministry of Economic Affairs purchased carbon credits under Joint Implementation for € 53,4 million between 2005 and 2008 and for the period 2009-2012 € 109,1 million.

In total, the Netherlands contracted 33.2 million tonnes of carbon credits from CDM-projects, 17.1 million tonnes from JI-projects, 3 million tonnes of carbon credits from Latvia (Green Investment Scheme) and 2.2 million tonnes from participation in Carbon Funds (PCF) in order to realise its obligations under the Kyoto Protocol.

Monitoring Policies and Measures
All activities that support climate action in developing countries are monitored on an ongoing basis through the financial and progress reports submitted by the implementing agencies. In many cases, activities are evaluated mid-term and after completion. This helps to redirect activities when needed. Furthermore, the Policy and Evaluations Department of the Ministry of Foreign Affairs regularly carries out thematic impact evaluations and policy reviews. An example is the evaluation of the Dutch contribution to renewable energy and development over the period 2004-2014[114]. Lessons learned from evaluations help to improve policies and their operationalisation.

The Ministry of Foreign Affairs reports on an annual basis to Parliament on the climate finance that the Netherlands provides to developing countries and on the results of development cooperation, including climate action. Parliament also receives an annual report on the Policy Coherence for Development efforts of the Netherlands.

Information on Dutch development and climate activities is furthermore made transparent through ~~the~~ International Aid Transparency Initiative (IATI).

Minimising adverse effects regarding biofuels production
All biofuels on the market in Europe and the Netherlands must be in compliance with the sustainability criteria laid down by the Renewable Energy Directive (2009/28/EG). Only if the biofuels are sustainable, they are allowed to be used for fulfilling the blending target. Compliance with these criteria must be demonstrated through one of the adopted certification systems. These certification systems are controlled by an independent audit. All biofuels produced in the Netherlands fulfil these requirements.

4.4 (C) Policies and measures no longer in place

The following policies have been repealed or have expired since the Second Biennial Report and the Sixth Netherlands National Communication:

- The MEP and earlier SDE schemes have been replaced by the more cost-effective SDE+ scheme. There are still payments taking place for projects with an MEP or earlier SDE grant, as subsidies in the SDE typically run for 12

[114] https://erbs.nl/wp-content/uploads/Renewable-energy-Policy-review-on-the-Dutch-contribution-to-renewable-energy-and-development-2004-2014-Summary-report.pdf

to 15 years. Support for CHP under the SDE/SDE+ scheme was repealed in 2010, as the government prefers generic measures over the financial or fiscal favouring of specific – mature – technologies such as CHP.

- The Benchmarking Covenant has been replaced by a new Long-Term Agreement on energy efficiency for ETS companies (LEE Covenant, see Section 4.3.4).

All these changes have been further explained in the previous sections.

5 PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES

5.1 Introduction

The previous National Communications (6)[115] described the projections made in 2012, also known as the Geactualiseerde Referentieraming (Verdonk and Wetzels, 2012)[116]. The projections in this National Communications 7, as well as those in the Third Biennial Report are based on the report "National Energy Outlook 2017" (Schoots and Hammingh, 2017) .

Section 5.2 presents the main results for greenhouse gases for the years 2020 and 2030. Emission projections for air pollutants are described in Section 5.3, while Section 5.4 is dedicated to the aggregate results and the uncertainty and sensitivity analyses. The methodologies and assumptions underlying the projections are described in more detail within Section 5.5.

5.2 (A) Projections

Scenario used and major changes relative to the previous previous National Communications
The projections described in this chapter are based on the National Energy Outlook 2017 (NEV 2017), which describes the most plausible developments based on the available information about prices, markets, technology and policies. Compared to the 'Geactualiseerde Referentieraming 2012' that was used in the previous National Communications, the present scenarios have taken into account, for example, the policies and measures of the Energy Agreement for Sustainable Growth of 2013 regarding energy policies up to the 2020-2023 period (SER Energieakkoord) and the implementation of the 2006 IPCC Guidelines (e.g. GWPs according to AR4). The NEV 2017 has incorporated new insights into economic and demographic developments, sectoral developments, fossil fuel prices, and CO2 prices and policies. New insights into exogenous modelling assumptions were taken into account up to May 2017, using official national statistics mostly from Statistics Netherlands (CBS)[117] and the Pollutant Release and Transfer Register of RIVM[118] where available. This approach means that the base year for most modelling parameters is 2015 or where possible 2016. Data on greenhouse gas emissions are in line with 2006 IPCC guidelines. Assumptions on policies are also taken into account up to May 2017. New insights after May 2017, such as recent policy developments and statistics, have been updated where relevant up to August 2017 but have not been incorporated in the modelling. Statistics of greenhouse gas emissions for the year 2016 are still provisional. The National Energy Outlook now also projects the emission levels of greenhouse gases up to 2035 (instead of 2030). Emission levels of air pollutants were an integral part of the National Energy Outlook 2015. In the NEV 2017, however, air pollutants were not included. An update to the emission levels of air pollutants in the NEV 2015 scenarios has been published in a separate report by the Netherlands Environmental Assessment Agency (PBL)[119]. Where relevant, the results of this update are included in the present NC7

In the NEV, an uncertainty analysis is included that takes into account uncertainties concerning economic development as well as energy and CO2 prices and policies. Uncertainties with regard to weather influences are not included.

The projections distinguish two different policy variants which are based on the underlying principles of Dutch and European policy, including the measures from the Energy Agreement (see section 4.3.2). They also contain measures made binding by market participants, public organisations and other government bodies on or before 1 May 2015.

Variant "With Existing Measures" (WEM)
This variant encompasses currently implemented and adopted policies and measures as from 1 May 2017. It includes measures that are sufficiently concrete and have been made binding, such as the European Emissions Trading System

[115] NC-5
[116] www.ecn.nl/docs/library/report/2012/e12039.pdf
[117] https://www.cbs.nl/en-gb
[118] http://emissieregistratie.nl/erpubliek/bumper.en.aspx
[119] http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-emissieramingen-luchtverontreinigende-stoffen-nederland-rapportage-2017-2946.pdf

(ETS), subsidies for renewable energy, the abolition of the milk quota and the concrete and binding measures of the Energy Agreement.

Variant "With Additional Measures" (WAM)
In addition to all measures from the WEM variant, this variant also encompasses planned policies and measures which have been published but not yet officially implemented by May 2017. Nevertheless, they were specific enough to incorporate in the calculations; for example, the European CO_2 norms for cars as from 2025, stringent energy performance requirements for existing offices and the intensification of several measures in the Energy Agreement. A complete list of policies and measures that are included in the projections, either as implemented or as planned, is published separately from the NEV 2017 report itself[120].

A variant "Without Measures" is not included in the projections, because climate and energy policies have already been implemented in the Netherlands from the early 1990s onwards. Since then, policies have been elaborated (such as subsidy schemes for sustainable energy production and energy efficiency policies), discontinued (such as the Benchmarking Covenant) or newly created, both nationally (such as the Energy Agreement agreed in 2013) or as a result of European policies (such as ETS and Ecodesign) and their revisions. Many policies are cross-sectoral, but each sector also has its specific policies. This situation has resulted in a complex framework of policies and measures, making the construction of a variant "Without Measures" (for instance, no new policies after 2000) very difficult as well as a highly theoretical and unrealistic.

The impact of (groups of) PAM's on the reduction of greenhouse gases are established using a referencescenario that assumes no policy changes after 2012 (see section 4.10 for more details). This section presents the integrated projection results for the variants "With Existing Measures" and "With Additional Measures".

5.3 Projection results

5.3.1 General trends

National greenhouse gas emissions have fallen since 1990
The total greenhouse gas emissions fell by 11% between 1990 and 2016, from 219 to 197 Mton of CO_2 equivalents (see Figure 5.1). This decrease has been achieved mainly through a sharp fall in non-CO_2 greenhouse gas emissions after 1995 due to reduction measures taken (the "ROB" programme, see Chapter 4). CO_2 emissions increased after 1990 but peaked in 2010 at 183 Mton. In the years after 2010, CO_2 emissions decreased mainly due to lower emissions from the industry and from buildings, although they tend to fluctuate from year to year (partly due to colder and milder winters as well as varying economic activities). In 2016, CO_2 emissions were 3% higher than in 1990 and 1 Mton higher than in 2015. It is expected, however, that the structural trend of future CO_2 emissions will fall as a result of the trend towards decarbonisation of the energy system.

National greenhouse gas emissions will continue to fall until 2020
Based on existing policy (the "With Existing Measures" or WEM variant), greenhouse gas emissions are expected to fall to 171 Mton Mton of CO_2 equivalents by 2020, with an uncertainty range of 163–181 Mton CO_2 eq. This figure is a decrease of almost 23% from 1990 levels (see Figure 5.1).

When the intended policy is taken into account (the "With Additional Measures" or WAM variant), emissions will fall to 170 Mton of CO_2 equivalents by 2020. This figure is a decrease of more than 23% from 1990 levels. There is a higher proportion of renewable energy in this policy variant and more energy savings in buildings. However, the reduction by 2020 in the WAM variant is almost 2% below the level of reduction imposed by the courts on the Dutch State (which is 25% below 1990 levels)[121].

Nevertheless, with the projected emissions for 2020 in both the WEM and the WAM variant, the Netherlands would comfortably meet its 2020 European target for reducing greenhouse gases.

[120] http://www.pbl.nl/sites/default/files/cms/data/pbl-2017-nationale-energieverkenning-2017-overzicht%20beleidsvarianten.ods
[121] The legal process is not yet finalised; see https://www.rijksoverheid.nl/onderwerpen/klimaatverandering/klimaatrechtszaak.

In the European context, the Netherlands only has a national emissions target for greenhouse gases that are not regulated by the European Emissions Trading System (ETS; see Chapter 3). This target relates to cumulative (non-ETS) emissions in the period 2013–2020 and is set at 921 Mton CO_2 equivalents. Annual non-ETS emissions will decrease in the variant "With Existing Measures" (WEM) as well as in the variant "With Additional Measures" (WAM) from 109 Mton CO_2 equivalents in 2013 to 100 Mton in 2020 (see Figure 5.2). Compared to the target of 921 Mton CO_2 equivalents allowed for cumulative emissions, it is expected that actual emissions will amount to 798 Mton CO_2 eq (with existing and additional measures) or 801 Mton CO_2 eq (with existing measures only). These levels are decreasing due to lower emissions from buildings and horticulture (less use of gas), lower fuel consumption by transport and further decreases in non-CO_2 emissions (such as from landfills). As a result, the Netherlands will meet this target by a comfortable margin. In June 2015, the government announced that any surpluses of AEA's will be cancelled and will consequently not be carried over to the period after 2020.

In the same period (2013–2020), the emissions under EU ETS will decrease from 87 Mton in 2013 to 76 Mton by 2020 (both the WEM and the WAM variant) due to the falling consumption of coal and gas in the energy sector and the industry.

Emissions of greenhouse gases are projected to decrease further after 2020

If the WEM variant is followed, the emissions of greenhouse gases will further decrease to 156Mton of CO_2 equivalents by 2030. This figure is almost 30% lower than in 1990. Emissions in both ETS and non-ETS sectors will decline. In ETS sectors, this decrease is mainly due to the falling consumption of coal and gas as well as the increasing production of power and heat using renewable energy. In non-ETS sectors, the decrease in emissions between 2020 and 2030 will mainly be due to the decline of energy consumption in buildings and greenhouse horticulture. Non-ETS emissions from vehicles and industrial sectors are expected to remain more or less stable, whereas emissions of non-CO_2 greenhouse gases will also decrease further.

The WAM variant will lead to a slightly lower energy consumption in the built environment and in transport. As a result of this scenario, greenhouse gas emissions will fall by an additional 2.5 Mton to 154 Mton CO_2 equivalents. This figure is almost 31% lower than in 1990.

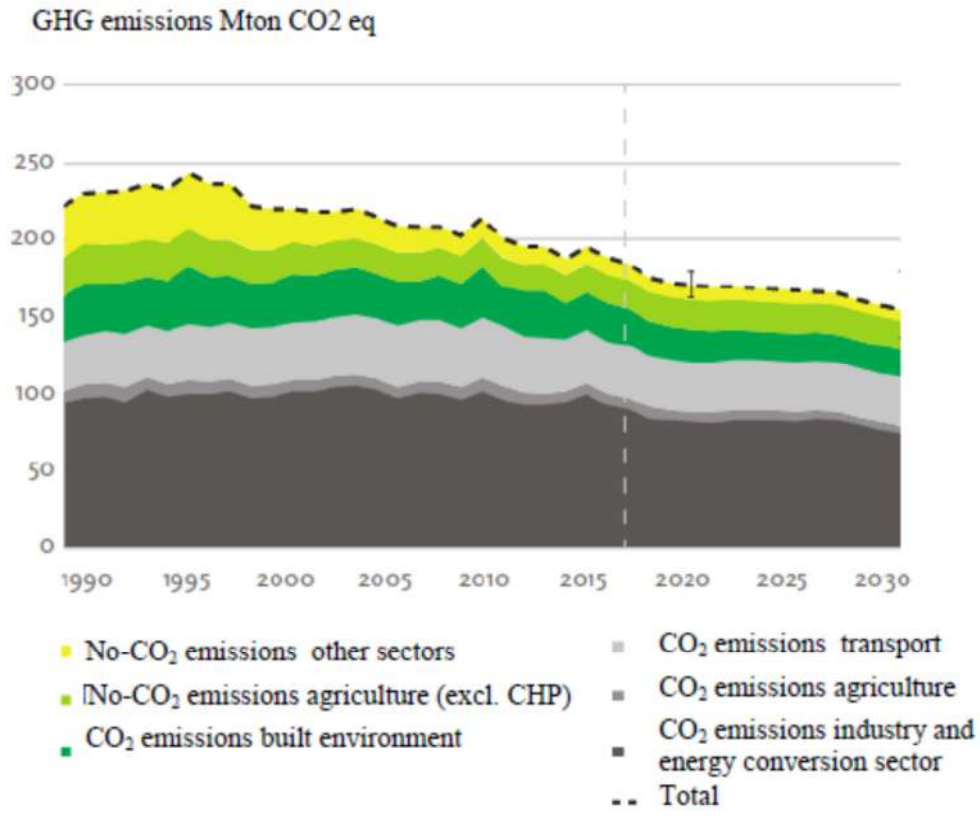


Figure 5.1: Historical emissions and projections for greenhouse gases per gas, 1990–2030, in Mton CO_2 eq

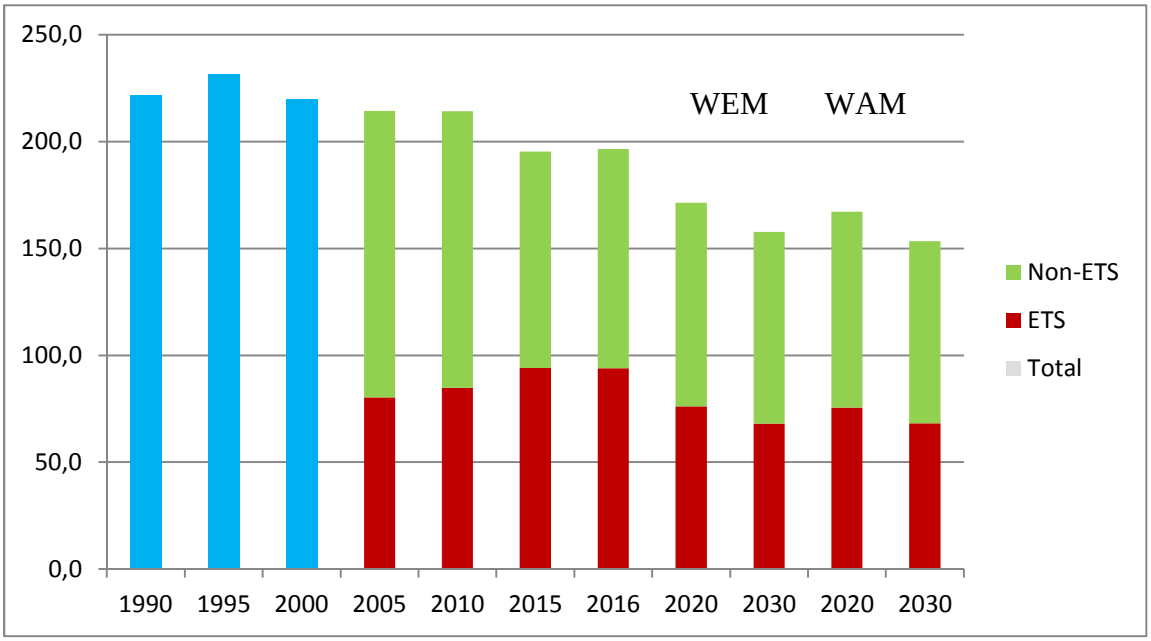
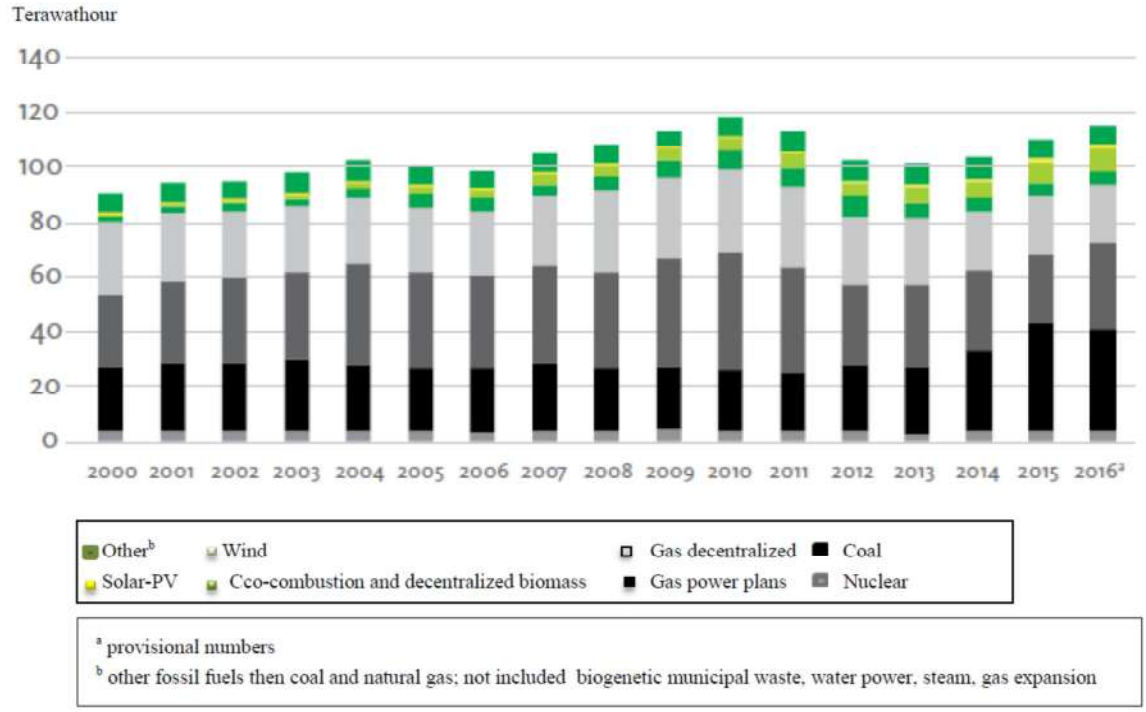


Figure 5.2: Historical emissions and projections (split ETS/non-ETS), 1990–2030, in Mton CO_2 eq

5.3.2 Energy and industry (CO_2)

CO_2 emissions from energy and the industry encompass emissions from power and heat production by the utility and industrial sectors as well as from industrial non-energy processes. By contrast, CO_2 emissions from buildings and horticulture are excluded and described in the sections below. The emissions from this energy and industry sector are largely covered by the European Emission Trading System (for more than 90%). Important measures for these sectors are the Sustainable Energy Production Subsidy Scheme, the 2013 Energy Agreement (which included the closure of coal-fired power plants), Long-Term Agreements on Energy Efficiency (LTA and /LEE) and the Energy Investment Allowance scheme (EIA).

Emissions from energy and the industry increased from 98 Mton in 2000 to 101 Mton in 2016 (according to provisional data). This growth is mainly due to developments in the energy sector, where the use of coal for power production has been increasing. However, this figure is expected to fall again due to the closure of coal-fired power plants in the coming years and the increase of power production from renewable sources (see figure 5.3a and figure 5.3b). In addition, the capacity to interconnect with neighbouring countries (such as Germany) is increasing, which improves the exchange of renewable power between countries. This development also contributes to a reduced need for conventional power production. After 2023, the Netherlands is expected to become a net exporter of electricity. By 2025, more than half of the power production is expected to come from renewable sources. This figure may increase to two thirds by 2030, evn though it is assumed that no new SDE+ subsidies will be granted in future for the co-combustion of biomass in power plants. CO_2 emissions from power production are expected to fall from 69 Mton CO_2 in 2016 to 51 Mton CO_2 by 2020 (both WEM and WAM). Due to the increasing production of renewable energy, most notably from wind and solar, emissions are expected to decline further to 43 Mton CO_2 by 2030 (both WEM and WAM).



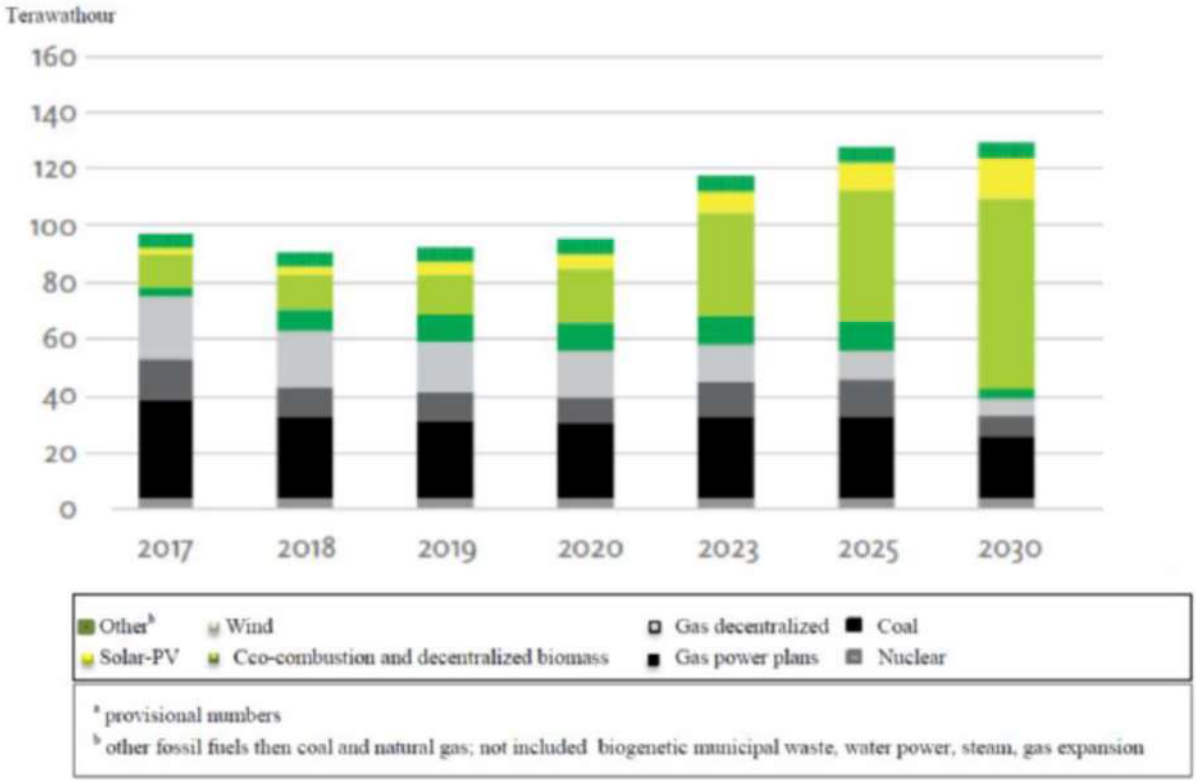


Figure 5.3a and figure 5.3b: Historical and projected power production by energy source (NEV 2017), 2000–2030, in TWh

The energy demand from industrial sectors decreased sharply after 2008 due to the economic crisis and never returned to that level. It is expected that the demand will increase slightly from 1,088 PJ in 2016 to 1,098 PJ (WEM) or 1,091 PJ (WAM) by 2020[122]. This slight increase is the result of economic growth balanced by improvements in energy efficiency. In the WAM scenario, additional energy savings are expected as the result of the intensification of the Energy Agreement. On the one hand, the production of power and heat by industrial CHP has been declining since 2010 and is expected to decline further due to unprofitable market circumstances. On the other hand, the use of

[122] These figures include the final energy demand for power, heat and raw materials.

biomass for heat and steam production is increasing. As a consequence of these developments, CO_2 emissions from the industry are expected to remain stable at around 31 Mton CO_2 (both WEM and WAM) in the coming decade.

Combined CO_2 emissions from the energy and industry sectors are expected to decline to 82 Mton (WEM) or 81 Mton (WAM) by 2020 (see Figure 5.4), decreasing further to 74 Mton CO_2 by 2030.

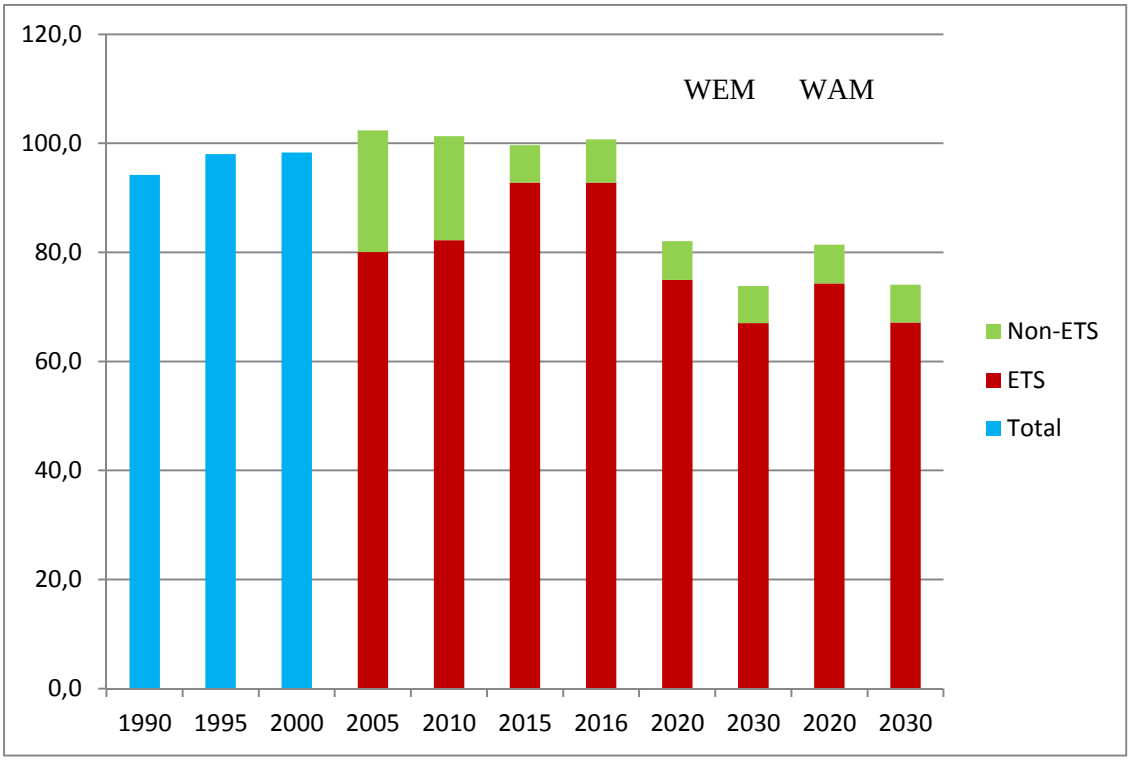


Figure 5.4: Historical emissions and projections for CO_2 from energy and industry, 1990–2030, in Mton

5.3.3 Built environment (CO_2)

The CO_2 emissions from the built environment encompass the emissions from dwellings and utility buildings in the services sector (such as offices, schools, and so on) but exclude emissions from buildings in industrial and agricultural sectors (which are accounted for in those sectors). CO_2 emissions arise from the use of natural gas for spatial heating, cooking and tap water. The CO_2 emissions in the built environment decreased from 29 Mton CO_2 in 1990 to 24.5 Mton CO_2 in 2016, despite a 13% increase in the number of households during the period 2000–2016 and a 25% increase in the floor area of utility buildings. This development is the result of increased insulating measures and the growing use of highly efficient boilers. It is expected that CO_2 emissions will decrease further as a result of declining gas use in the coming decade. With existing measures, the CO_2 emissions are projected to be around 22 Mton CO_2 in 2020 and 19 Mton CO_2 in 2030 (see Figure 5.5). With additional measures, the projected emissions are roughly 1 Mton CO_2 lower. The developments for dwellings and utility buildings are described below.

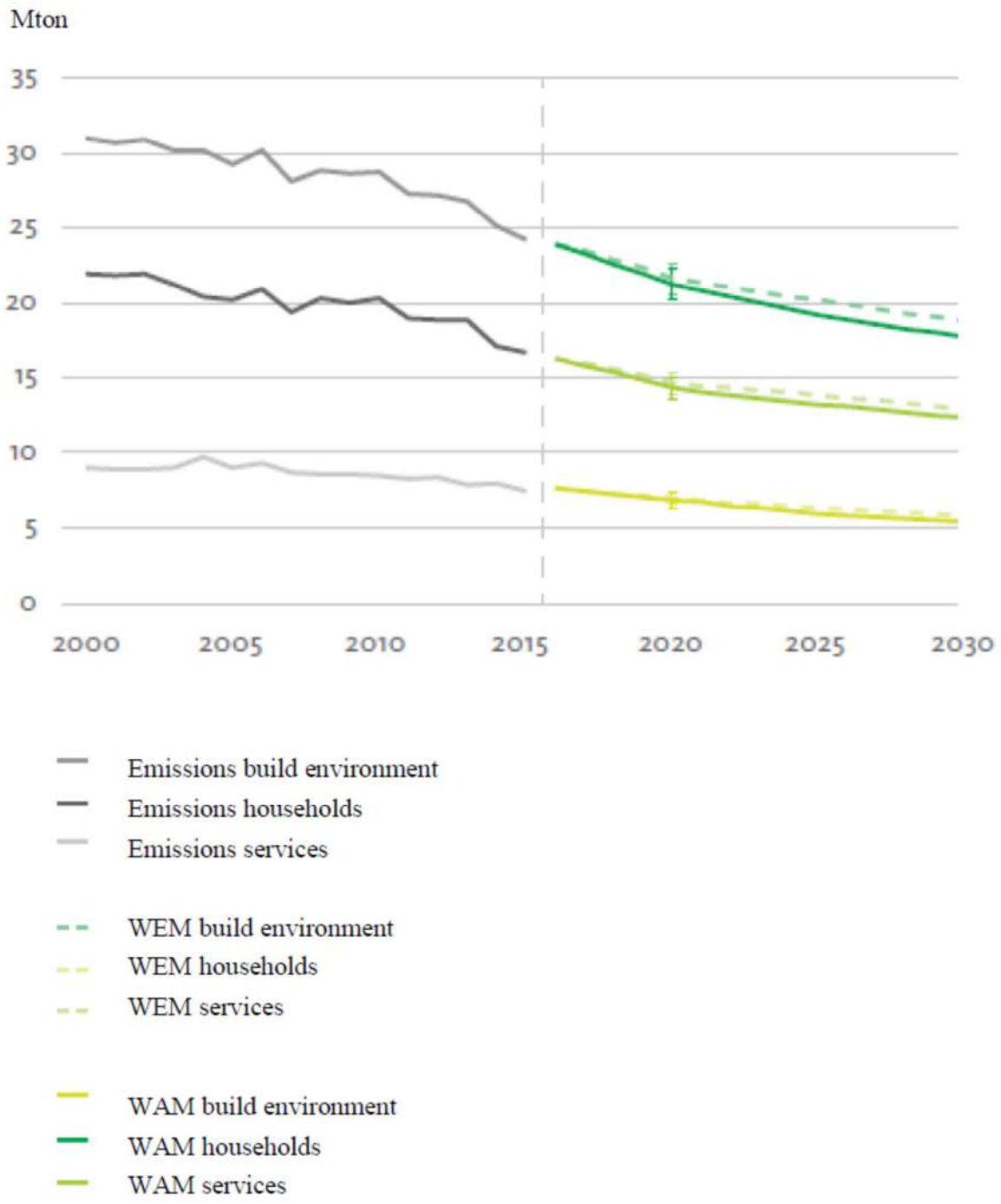


Figure 5.5: Historical emissions and projections for CO_2 from buildings, 2000–2030, in Mton CO_2

Homes

The average gas consumption per house fitted with gas central heating fell from approximately 2,150 Nm^3 in 1995 to approximately 1,300 Nm^3 in 2015 due to energy-saving measures in existing and new homes. It is expected that this figure will fall to 1,150 Nm^3 by 2020 and to 1,050 Nm^3 by 2030, even though the number of households will be growing by 8% between 2016 and 2030. The current requirements for an energy performance certificate (EPC) for new homes and the current requirements for energy efficiency in domestic appliances and lighting under the EU Ecodesign Directive are included in the WEM variant. This situation results in new homes that are nearly energy neutral from 2020 onwards. Such houses use virtually no natural gas. Account has also been taken of measures from the Energy Agreement, such as the arrangements aimed at domestic consumers and the renovation of social dwellings. This development will reduce emissions in homes from 17 Mton in 2015 to a projected 15 Mton in 2020 and to 13 Mton in 2030.

In addition, the intended policy (WAM variant) also takes account of the new covenant to stimulate energy savings by households and of the additional agreements with the social housing sector to realise an average energy label B for social dwellings. These measures will reduce emissions by an additional 1 Mton CO_2.

Services
While the building stock in the services sector almost doubled between 1980 and 2010, there has been a marked decrease in new building after 2010 as a result of the economic recession creating a surplus of office and retail premises. That situation has been a temporary slowdown, as floor area is increasing again, albeit at a lower pace. This development is related to expected demographic trends: an ageing population, a smaller population of professionals and fewer students in education. Trends such as online shopping, new working methods ("Het Nieuwe Werken") and senior citizens staying in their own homes for longer are also playing a role in the decreasing need for space. Vacancy levels remain relatively high despite the economic recovery. At the beginning of 2015, over 17% of office space and over 9% of retail space was empty. A part of this surplus comprises readily marketable offices. Another part consists of buildings that have fallen into disuse due to obsolescence or that are situated in areas with poor prospects (contracting regions).

Since 2010, emissions in the services sector have stabilised at around 8 Mton (2015 level). In the services sector, the current requirements for energy performance in new buildings, the current requirements for energy consumption under the EU Ecodesign Directive, the subsidies for renewable energy (ISDE, sports facilities) and a stricter control of energy requirements under the Environmental Protection Act are included in the WEM variant. This set of requirements will reduce emissions to a projected 7 Mton in 2020 and to 6 Mton in 2030.

The WAM scenario includes a stricter control of the energy-saving requirements from the Environmental Management Act for all branches and a minimum energy label C for existing offices by 2023. In addition, the energy performance of new buildings is required to be almost energy neutral (for normal buildings by the end of 2020, for the central government by the end of 2018). This development will reduce emissions to a projected 7 Mton in 2020 and to 5 Mton in 2030.

5.3.4 Transport (CO_2)

Between 2000 and 2010, emissions from traffic and transport in the Netherlands rose from 37 Mton to 39 Mton CO_2. This increase was mainly due to the growth in traffic on the roads. Goods transport and its associated emissions decreased in 2009 and 2010 due to the economic recession. Following an increase in 2011, emissions fell again in 2012, 2013 and 2014, partly due to weaker growth in traffic, a more economical vehicle fleet under the influence of the European standards for CO_2 and tax incentives to boost fuel economy in vehicles. In recent years, emissions have remained more or less stable due to economic growth.

In 2012, the maximum speed limit on motorways was raised from 100 km/h or 120 km/h to 130 km/h on those stretches where this increase was deemed acceptable in terms of safety, noise, nature and air quality. If 130 km/h is not possible the whole day, a dynamic speed limit applies to part of the day. Based on an ex-ante assessment, it is expected that this action leads to an annual increase in CO_2 emissions of about 0.4 Mton[123].

It is expected that the demand for transport (of both goods and persons) continues to increase as a result of further economic growth. In the WEM variant, although energy consumption in the sector would be stable until 2020, emissions are projected to fall further to 33 Mton in 2020 due to a growing share of biofuels and an increase of electric or semi-electric vehicles. By 2030, the emissions are projected to have increased slightly to 35 Mton as a result of the increasing demand for transport (of both goods and persons).

In the WAM scenario, the decrease in CO_2 emissions is relative to energy consumption, also after 2020. This fact is mainly due to a higher share of electric passenger vehicles that is driven by European CO_2 standards and fiscal policies. In public transport, the share of electric buses is also expected to increase from 2025 due to the ambition of governments to deploy new buses in public transport that have zero emissions. In the WAM variant, emissions are projected to fall to 32 Mton in 2020 and remain stable afterwards.

[123] https://zoek.officielebekendmakingen.nl/blg-142118.pdf

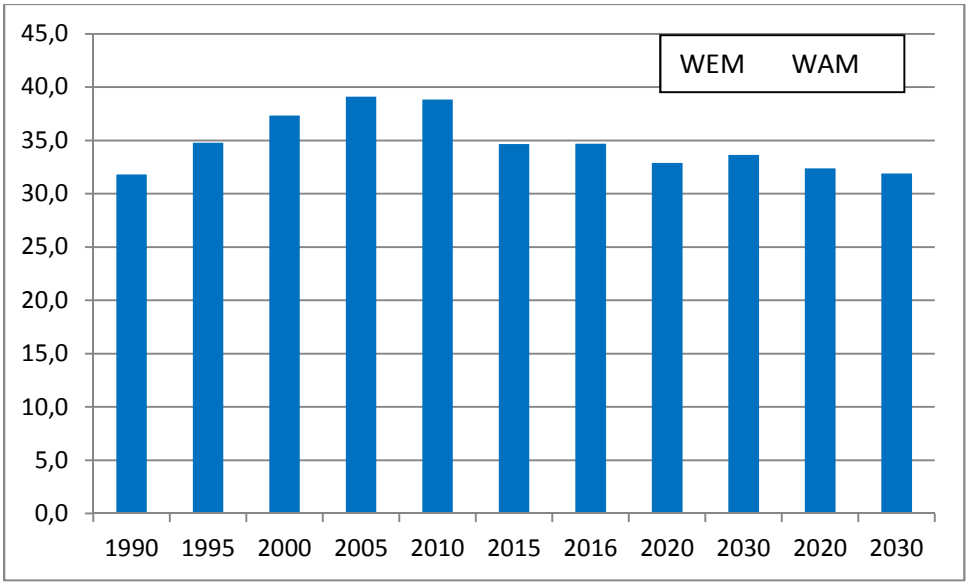


Figure 5.6: Historical emissions and projections for CO2 from transport, 1990–2030, in Mton

5.3.5 Agriculture (CO_2)

In terms of energy consumption, the agricultural sector can be divided into two parts: greenhouse horticulture and other agriculture, with the latter covering arable farming and intensive livestock farming. The majority of energy consumption in agriculture is caused by greenhouse horticulture, mainly for heating greenhouses and for lighting, to grow and develop plants.
Since 2010, the area being cultivated under glass has been decreasing. In 2016, the area was 12% less than in 2000. The number of companies involved fell by 65% in that period due to an increase in scale and clustering. Given the improved economic circumstances, it is expected that the decline in the area being cultivated under glass has ended. The uncertainties about this development are substantial, however. It is assumed that the area will remain stable after 2020 at around 9,390 ha (1% above 2016). Despite the recent decrease in the area being cultivated under glass, the total production in greenhouse horticulture continues to increase due to intensification and optimisation of cultivation. The shift over the last few years from the cultivation of cut flowers and flowering plants in greenhouses to vegetables is also expected to continue in future.

In line with the area, the total energy consumption has been falling since 2010. In 2015, the energy consumption level was 17% below 2010 levels. For the coming years, a small increase in consumption is expected as a result of a small increase in area. However, as the area will remain stable after 2020, energy consumption is expected to fall further due to improved energy efficiency and innovative greenhouses. By 2020, consumption will be about 27% below 2010 levels and continue to fall to more than 50% by 2030.

Combined heat and power systems (CHP) and boilers currently provide the largest part of the necessary heat; the CO_2 released by burning natural gas can then be used for CO_2 supplementation in greenhouses. However, the use of CHP is declining due to unfavourable market conditions (high gas prices relative to electricity prices), which are not expected to change in the near future. The installed capacity in 2015 was 3,000 MW, which is expected to decline to 1,000 MW by 2030. In recent years, the production of renewable energy using biomass boilers and geothermal sources has increased to 8% in 2015. It is expected that this share will increase further to 12% by 2020 and to more than 25% by 2030.

CO_2 emissions in agriculture have been falling from almost 9 Mton in 2010 to 7.3 Mton in 2015, following the trends of declining cultivation area and energy consumption. After a short increase to around 8 Mton in 2016 and 2017, emissions in both policy variants (WEM and WAM) are expected to fall to 6.6 Mton by 2020 and to 4.5 Mton by 2030.

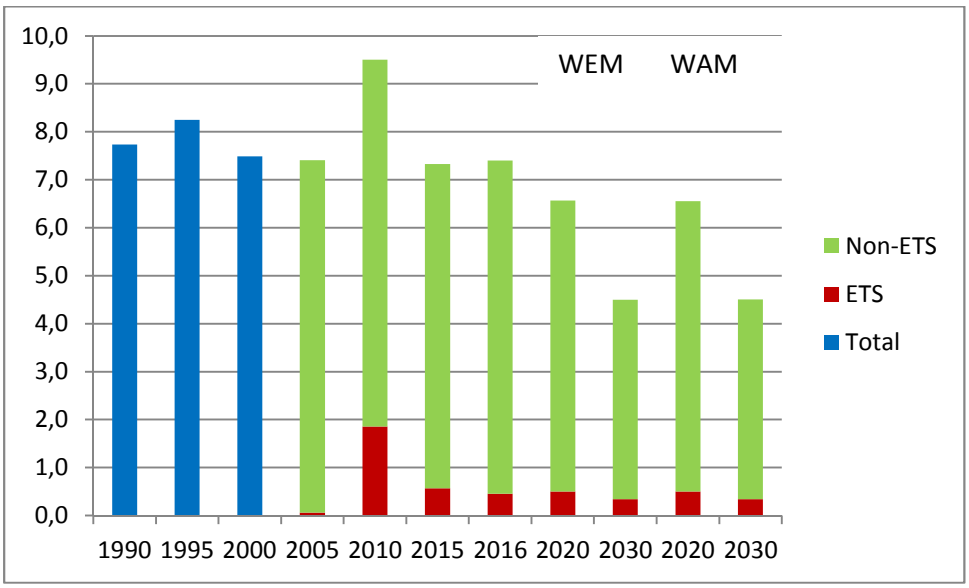


Figure 5.7: Historical emissions and projections for CO_2 from agriculture, 1990–2030, in Mton

5.3.6 Agriculture (non-CO2)

Non-CO_2 emissions from agriculture come from the following sources:

- methane (CH_4) emissions from enteric fermentation and manure management;
- nitrous oxide (N_2O) emissions from manure management as well as direct and indirect emissions from agricultural soils.

The developments and expected trends for methane and nitrous oxide are set out below.

Methane emissions
Methane emissions from agriculture fell by approximately 21% between 1990 and 2005, from 15 Mton to 12 Mton of CO_2 equivalents. After 2005, these emissions rose again to 13 Mton of CO_2 equivalents in 2016. This increase was due to a growth in milk production of around 25% compared to 2015 as a consequence of the abolition of milk quotas. Though most of this increase was achieved by increasing the milk production per cow, the number of dairy cows also increased by almost 5%. The number of dairy cows will fall to 2015 levels again due to new policies introduced in 2017, which were established after European phosphate production levels were exceeded. As a result, measures were implemented in 2017 to reduce phosphate production, encompassing the stimulation of low-phosphate fodder and the reduction in the number of dairy cows. From 2018 onwards, a quota system for phosphate production will be introduced.

The fermentation of manure (with or without co-substrates such as maize) for biogas production reduces emissions from manure storage, as the manure is stored for a short period and produces biogas which can be used to generate heat and/or electricity. Current levels of fermented manure are around 2,5%. Under the SDE+ Sustainable Energy Production Subsidy Scheme, it is expected that this figure will increase to around 8% by 2025. However, recent insights into methane leakage have led to higher methane emissions, especially for co-fermentation installations.

Methane emissions from agriculture are expected to remain at the 2016 levels after 2020. The emissions for 2030 are estimated at 13 Mton in both policy variants (WEM and WAM).

Nitrous oxide emissions
In 1990, agricultural emissions amounted to 10.1 Mton of CO_2 equivalents in the form of nitrous oxide. By 2015, that figure had fallen to 6.1 Mton of CO_2 equivalents. This decrease was mainly achieved through the reduced use of artificial fertiliser under the influence of the manure policy and because fewer dairy cattle were grazing outdoors. Emissions will stabilise at 5.7 Mton of CO_2 equivalents by 2020. After that time, a small reduction to 5.6 Mton of CO_2 equivalents in 2030 is expected as a result of a further decrease in outdoor grazing. These figures apply to both variants.

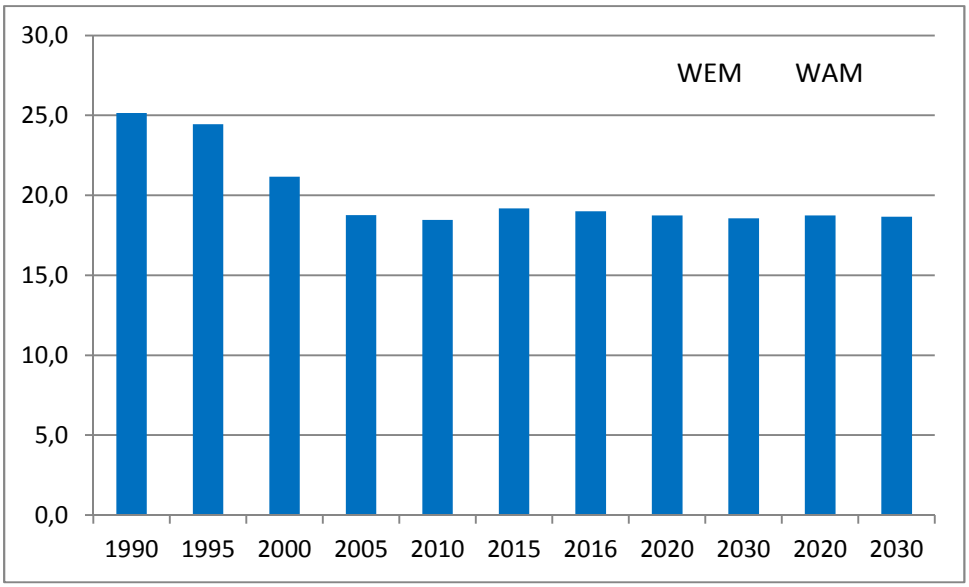


Figure 5.8 Historical emissions and projections for CH_4 and N_2O from agriculture, 1990–2030, in Mton CO_2 eq

5.3.7 Non-CO2 (other sectors)

General matters
Since 1990, there has been a substantial decrease in emissions of non-CO_2 greenhouse gases within the other sectors, from 33.3 Mton-CO_2 eq in 1990 to 26.6 Mton-CO_2 eq in 2000 and to 10.8 Mton-CO_2 eq s in 2015. These emissions will decrease further between 2013 and 2030, but the rate will be lower, as the potential to reduce emissions quickly is declining. The projected emissions in 2020 and 2030 amount to 9.4 Mton-CO_2 eq and 6.9 Mton-CO_2 eq respectively under the existing policy (WEM), or to 9.4 Mton-CO_2 eq and 6.8 Mton-eq Mton-CO_2 eq under the intended policy (WAM). The difference between the WEM and the WAM variant is the methane emissions from combined heat and power plants (CHPs) in horticulture, which are slightly higher in WEM. There is no difference between the two policies with respect to the other sources. The historical developments and estimated future trends for the most important sources are set out below.

Methane from waste disposal
Methane emissions from waste disposal (such as landfill sites) fell substantially in the past, from 13.7 Mton-CO_2 eq in 1990 to 2.9 Mton-CO_2 eq in 2015. The expectation is that these emissions will continue to fall to 1.1 Mton-CO_2 eq in 2030. This decrease is due to reducing emissions from landfills, less waste being landfilled and a decline in the biogenic fraction of landfilled waste.

Methane emissions from combined heat and power plants (CHPs)
A marked increase in the use of CHPs in greenhouse horticulture since 2005 has caused a rise in methane emissions from 0.4 Mton-CO_2 eq in 2005 to 1.3 Mton-CO_2 eq in 2010. Since then, emissions have been declining due to the lower utilisation of CHPs in greenhouse horticulture. It is expected that emissions decline to 0.8 Mton-CO_2 eq by 2020 and to 0.5 Mton-CO_2 eq by 2030 (WEM). In the WAM variant, methane emissions from CHP are expected to be slightly lower by 2030 (less than 0.1 Mton-CO_2 eq).

Nitrous oxide emissions from the industry
Nitrous oxide emissions from the industry are caused by the production of caprolactam (0.9 Mton-CO_2 eq in 2015) and nitric acid (0.4 Mton-CO_2 eq in 2015). The latter emissions have been falling since 2008 under the EU Emissions Trading System (EU ETS). Measures to reduce emissions were taken at nitric acid factories in 2007. This policy achieved a reduction of 5 Mton-CO_2 eq over 2008 as compared to 2006. Since the production of caprolactam and nitric acid is expected to increase slightly in the period 2013–2030 and no further reduction measures are anticipated, there will be a small growth in nitrous oxide emissions from the industry to 1.4 Mton-CO_2 eq in 2030.

Emissions of F-gases
F-gases are produced as a by-product of a number of industrial production processes, especially the production of HCFC-22 (emission of HFC-23) and primary aluminium production (emission of PFCs).
These gases are also released during the use of these substances. Their main uses include HFCs as refrigerants, PFCs in the semiconductor industry and SF_6 in the power current industry.

Emissions of F-gases increased between 1990 and 1998 (from 8.5 Mton-CO_2 eq to 14.0 Mton-CO_2 eq), but have sharply decreased to levels below 3 Mton-CO_2 eq since 2003 (except in 2010, when emissions were 3.1 Mton-CO_2 eq . This development was mainly due to measures taken under the Reduction Programme for non-CO_2 Greenhouse Gases (ROB), which resulted in significant emission reductions from production processes. Emissions from the use of F-gases, however, increased between 1990 and 2015 from 0.2 to 2.4 Mton-CO_2 eq. This increase is mainly due to a large growth in the use of HFCs due to the phasing out of ozone-depleting substances (especially HCFCs) since 1995.

The total emissions (from use and processing) of F-gases are expected to fall to 2.2 Mton-CO_2 eq in 2020 and to 1.0 Mton-CO_2 eq in 2030. This decrease is mainly due to lower emissions from the use of HFCs. Following the new EU Regulation that came into effect on 1 January 2015, the use of HFCs (calculated Mton-CO_2 eq) must be reduced by 79% between 2015 and 2030. The effect of this regulation will be to cut emissions due to the use of HFCs from 2.2 Mton-CO_2 eq in 2015 to 1.6 Mton-CO_2 eq by 2020 and to 0.5 Mton-CO_2 eq by 2030.
Total F-gas emissions from the use of F-gases will decrease from 2.4 Mton-CO_2 eq in 2015 to 1.9 Mton-CO_2 eq by 2020 and 0.7 Mton-CO_2 eq of CO_2-equivalents by 2030.

Total F-gas emissions from production processes in 2020 and 2030 are expected to remain at around the level of 0.3 Mton-CO_2 eq .

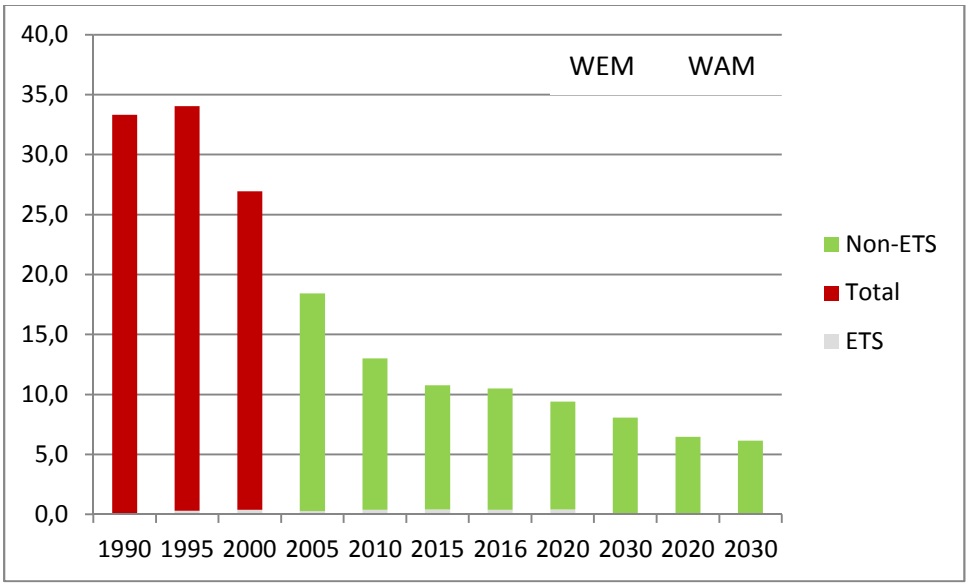


Figure 5.9: Historical emissions and projections for non-CO_2 from other sectors, 1990–2030, in Mton CO_2. eq

5.3.8 LULUCF

In the Netherlands, the historical net CO_2 emissions from LULUCF are around 6 Mton-eq. The main emission sources are grasslands (on peatland), croplands and soils in the built environment. Forests are a net sink of CO_2. The emissions from grassland are declining as a result of its conversion into cropland as well as the establishment of new infrastructure and buildings, which both result in a net release of CO_2 from the soil. Since 2005, more CO_2 is captured by forests due to the growth of existing forests and the creation of new forests.

It is projected that net CO_2 emissions from LULUCF will increase to nearly 6.8 Mton-eq in 2030, assuming no new policies. The expectation is that the rate of converting grassland into buildings will slow as new buildings are increasingly built within the existing built environment. Management practices of grass- and cropland are assumed to

remain unchanged, which results in more or less stable emissions. Forests, however, are expected to take up less CO_2 as they grow older, resulting in slightly increased LULUCF emissions over the coming decade.

The historical emissions and projections from LULUCF have been incorporated into the National Energy Outlook for the first time in 2017. For the collection and establishment of the historical emissions, the underlying methodology complies with 2006 IPCC guidelines and is described in the methodology report of the National System[124].

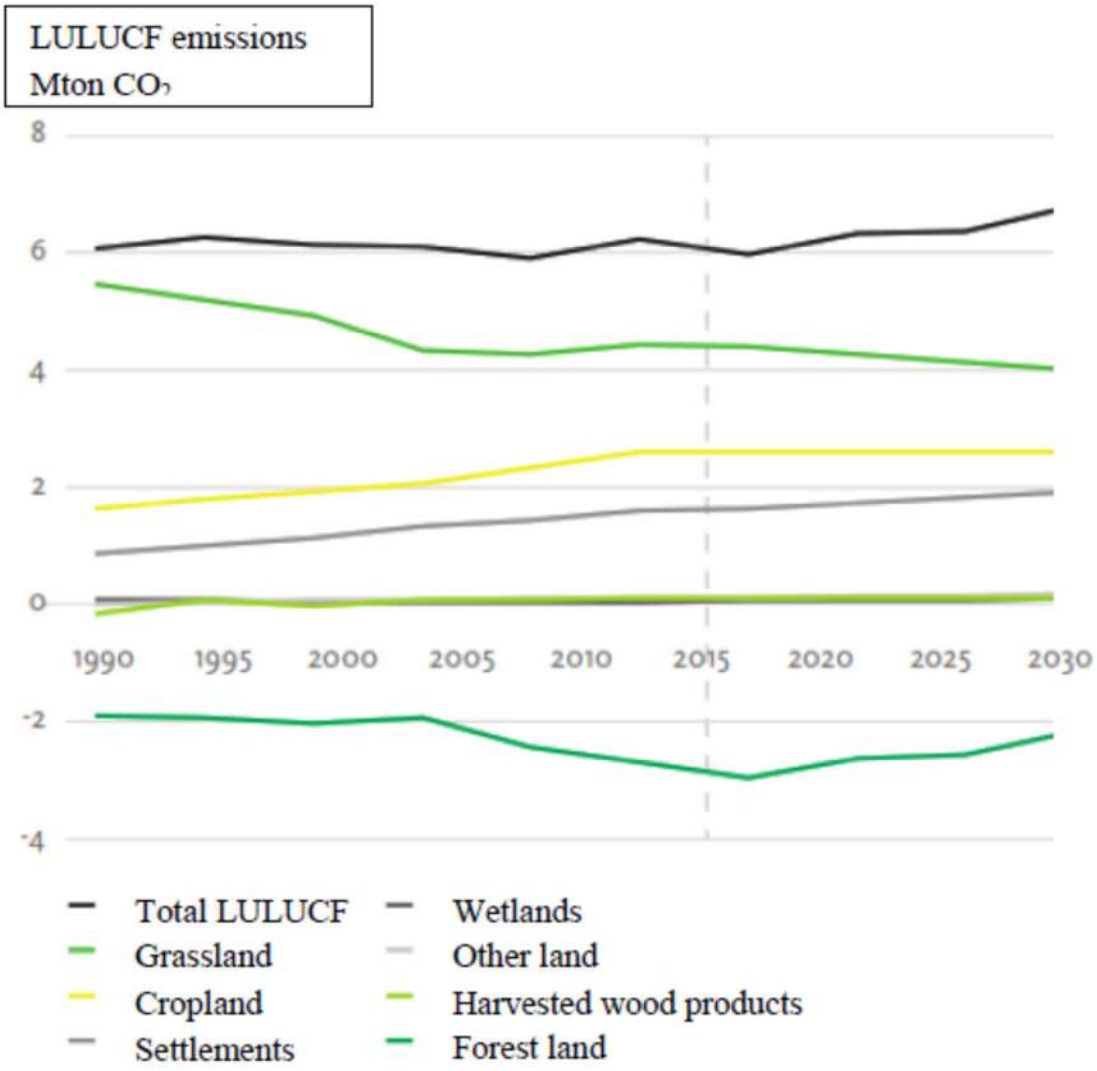


Figure 5.10: Historical emissions and projections from LULUCF, 1990–2030, in Mton-eq CO_2

5.3.9 International bunkers

Although energy consumption (and the related CO_2 emissions) from international transport over water does not count as domestic consumption, it is treated as a form of export not attributed to the Netherlands for policy purposes regarding energy and CO_2. The CO_2 emissions from international aircraft are not attributed to the Netherlands either, but they do count towards the target for the total gross end consumption of renewable energy from the Renewable Energy Directive (RED). A great deal of bunker fuel is sold for international shipping and aviation in the Netherlands and Europe.
In 2015, the CO_2 emissions from international bunkers amounted to 52 Mton in total, of which around 40 Mton-eq for navigation and 11 Mton-eq for aviation. As a result, the bunker emissions exceeded the emissions from domestic transport. In both the WEM and the WAM variant, the total emissions from international bunkers are expected to grow to 55 Mton-eq in 2020 and 58 Mton-eq in 2030 as a consequence of the estimated growth in transport volumes.

[124] https://english.rvo.nl/file/lulucf-methodology-report-2017

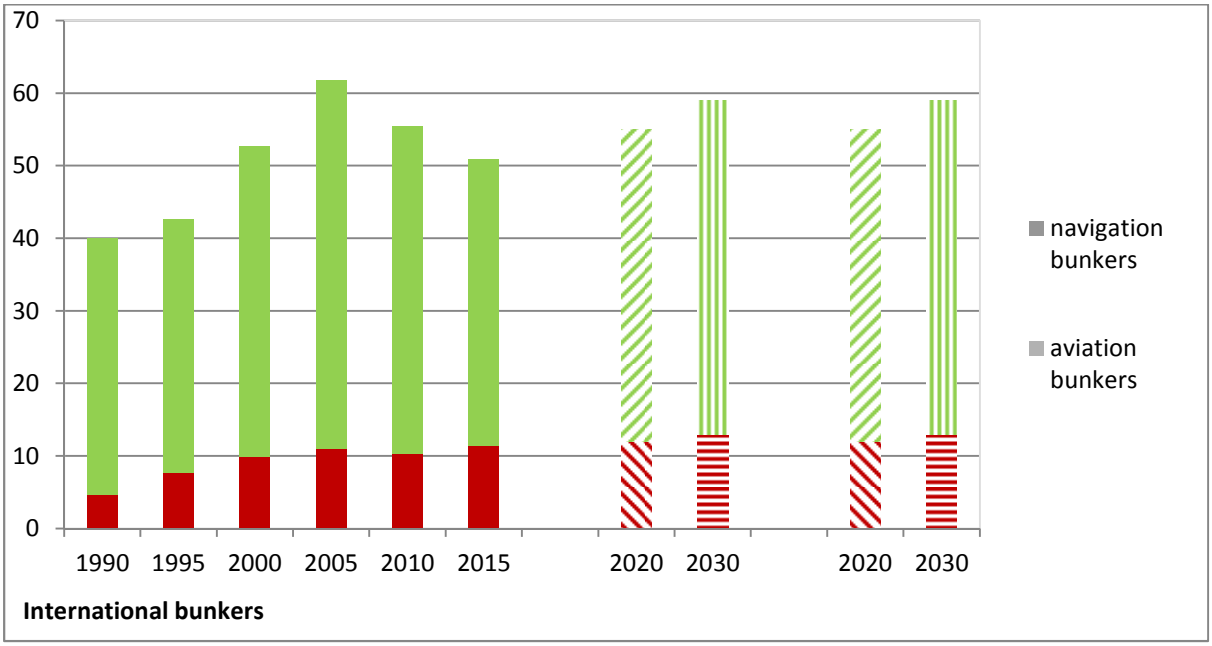


Figure 5.11: Historical emissions and projections for CO_2 from international aviation and navigation, 1990–2030, in Mton-eq CO_2

5.3.10 Emissions of NOx, NMVOCs and SO_2

A significant proportion of the emissions of air-polluting substances are related to energy consumption. Burning fossil fuels and biomass produces both greenhouse gases and air-polluting substances. Combustion processes are the main cause of the release of nitrogen oxides and sulphur dioxide. Non-combustion processes are also major contributors to the emission of non-methane volatile organic compounds (NMVOCs). In addition, NMVOCs are released through the use of paint and cosmetics, among other things. Emissions of air-polluting substances have decreased substantially since 1990 due to the implementation of national and European legislation and regulations. These large decreases have mainly been achieved through policies which have led to the application of scrubbing methods and cleaner processes as well as the use of cleaner fuels, such as gas instead of coal or oil. Since 2000, however, emissions have not been falling as rapidly as in the 1990s.

The projections for air pollutants below are from a 2017 update of projections in the National Energy Outlook 2015[125]. Some inconsistencies with the projections for greenhouse gases may therefore occur.

Sulphur dioxide (SO_2)
Emissions of sulphur dioxide fell by 84% from 193 kton SO_2 in 1990 to 30 kton SO_2 in 2015. Over the coming years, the emissions of sulphur dioxide are expected to remain stable at around 30 kton under both the existing (WEM) and the intended (WAM) policies (see Figure 5.12). Various developments in several sectors are behind this stable situation. On the one hand, the closure of five old coal-fired power stations in 2016 and 2017 as agreed in the Energy Agreement (Energieakkoord) will reduce emissions from coal-fired electricity generation. By 2030, emissions from refineries will be reduced as compared to their average levels over recent years through two developments. First, there will be fewer emissions due to the estimated lower production (oil throughput) in the long term. Second, the expected intensification of the desulphurisation of ships' fuel due to international IMO requirements will decrease emissions. On the other hand, emissions from the industry (including base metals, building materials and chemicals) will increase slightly because of the projected economic growth while the current emissions standards remain in force.

[125] http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-emissieramingen-luchtverontreinigende-stoffen-nederland-rapportage-2017-2946.pdf

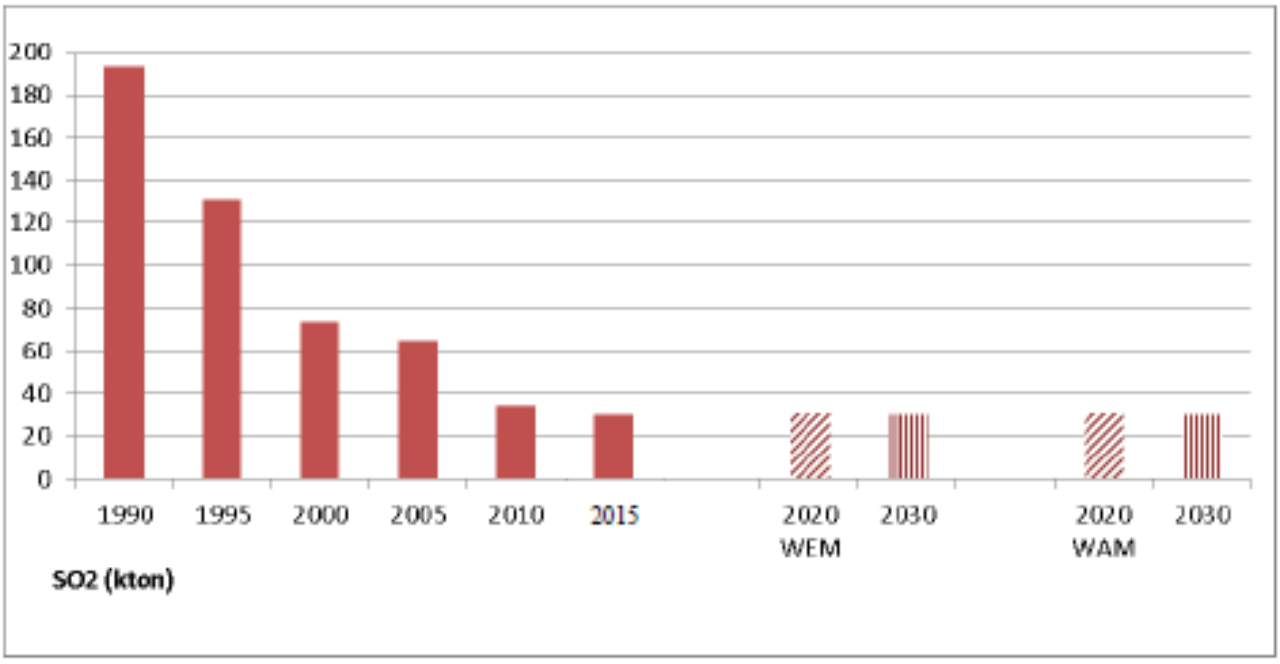


Figure 5.12: Historical emissions and projections for sulphur dioxide (SO_2), 1990–2030, in kton SO_2

Nitrogen oxides (NO_x)

Emissions of nitrogen oxides (NO_x) fell by 62% from 604 kton NO_x in 1990 to 228 kton in 2015. It is expected that emissions will continue to fall through to 2030.

The expected decrease in the national emissions of nitrogen oxides in the WAM variant (see Figure 5.13) can be traced back to reductions in most sectors except the industry, where they remain roughly the same. In absolute terms, the greatest decrease will be in transport. This decrease will be achieved through the existing European standards for road transport, other transport and mobile machinery. Emissions are projected to fall gradually by more than 80 kton between 2015 and 2030 due to the existing standards, despite a slightly increasing energy consumption. Compared to the BR2, the projections now include the effect of the intended toughening of procedures to test emissions from private cars and delivery vans. Tightened emissions standards for mobile machinery and inland waterways vessels are now also included.

In order to improve air quality, the use of catalytic converters was made compulsory for petrol-driven vehicles in the early 1990s. This measure resulted in a substantial decrease of NO_x emissions. However, the use of catalytic converters does result in higher N_2O emissions per kilometre. The average N_2O emission factor also rose during the period 1990–1999 (from 9 mg/km to 15 mg/km), slightly dropping to 12 mg/km in 2003. In the last decade, the emission factor remained stable[126].

Emissions from electricity generation will decrease up to 2030 as old coal-fired power stations are decommissioned (agreed in the Energy Agreement) and because of incentives for renewable energy generation (wind and solar). The emissions from small combustion installations in greenhouse horticulture, utility buildings and homes will be reduced largely due to lower energy consumption and national emissions regulations. In greenhouse horticulture, one of the reasons for this trend is a reduction in the use of CHP in favour of gas boilers. A rise in emissions from the industry is anticipated as a consequence of the assumed economic growth and the continuation of the present emission standards. The projections for air-polluting substances take into account the incentives under the SDE+ scheme for the use of biomass in medium-sized combustion plants (larger than 500 kilowatt, especially in the industry, agriculture and utility buildings). Biomass plants are mostly replacing plants fired by natural gas. Although this measure reduces CO_2 emissions, it does increase emissions of nitrogen oxides, NMVOCs and Particulate Matter (PM2.5). The use of biomass in medium-sized combustion plants will increase by a factor of more than two between 2015 and 2020. After

126 http://www.emissieregistratie.nl/erpubliek/documenten/Lucht%20(Air)/Verkeer%20en%20Vervoer%20(Transport)/Wegverkeer/TNO%20(2012)%20N2O%20emissies%20van%20wegverkeer.pdf

2020, the combustion of biomass is expected to decline sharply, as it is assumed that no new subsidies will be granted after 2020[127]. The nitrogen oxide emissions per petajoule of biomass fuel used are more than a factor of two higher than for natural gas plants.

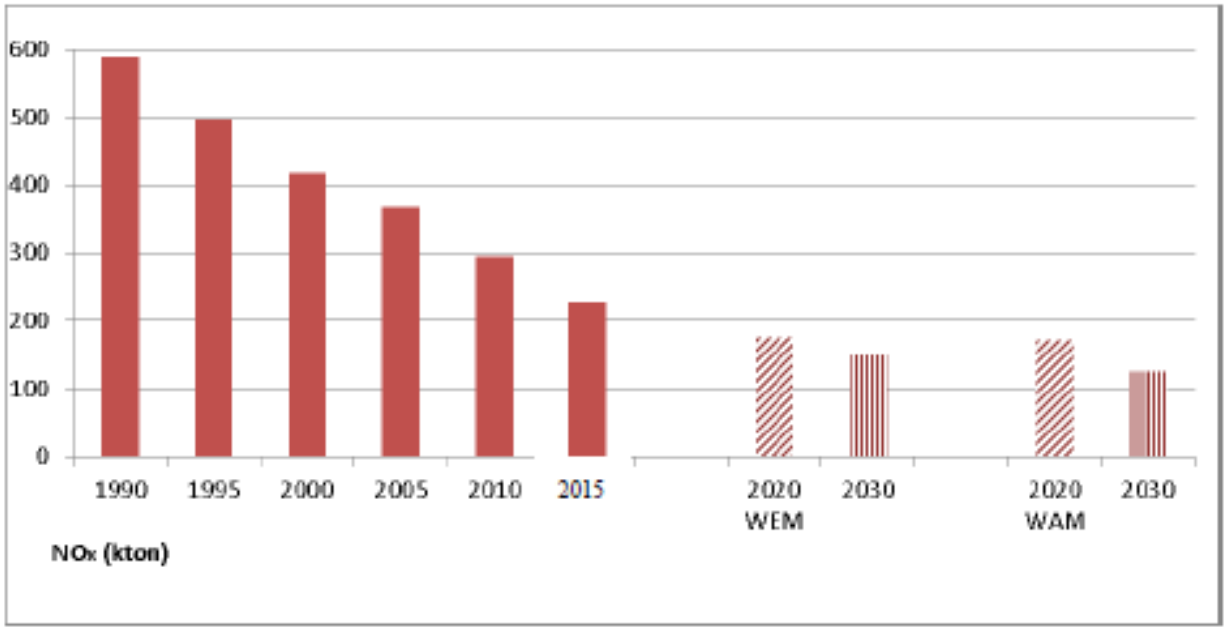


Figure 5.13: Historical emissions and projections for nitrogen oxides (NO_x), 1990–2030, in kton NO_x

NMVOCs
Emissions of non-methane volatile organic compounds (NMVOCs) decreased by 69% from 489 kton in 1990 to 139 kton in 2015. It is expected that emissions will remain stable in the period up to 2030. Though the total NMVOC emissions seem to have been stabilising since 2013, a number of relevant developments are projected in the underlying sectors. Both the WEM and the WAM anticipate a decrease of emissions in road transport up to 2030 as a consequence of the European emissions standards for road vehicles and mobile machinery (see Figure 5.14). Emissions from onshore and offshore gas and oil production will also fall in the short term due to reduced production on Dutch territory. A small reduction in emissions from wood-burning stoves is expected, partly due to a small increase in certified – and therefore cleaner – stoves, on the assumption that the amount of wood used by households will not change from now to 2030.

By contrast, the emissions from the industry, the storage and the trans-shipment of chemical products and fuels, as well as from consumer products such as cosmetics (deodorant sprays and hairsprays), car products and cleaning products, will increase. These increases are associated with the expected growth in these activities as well as a continuation of the current product and emission standards.

[127] This policy assumption was not taken into account in the projections for air pollutants.

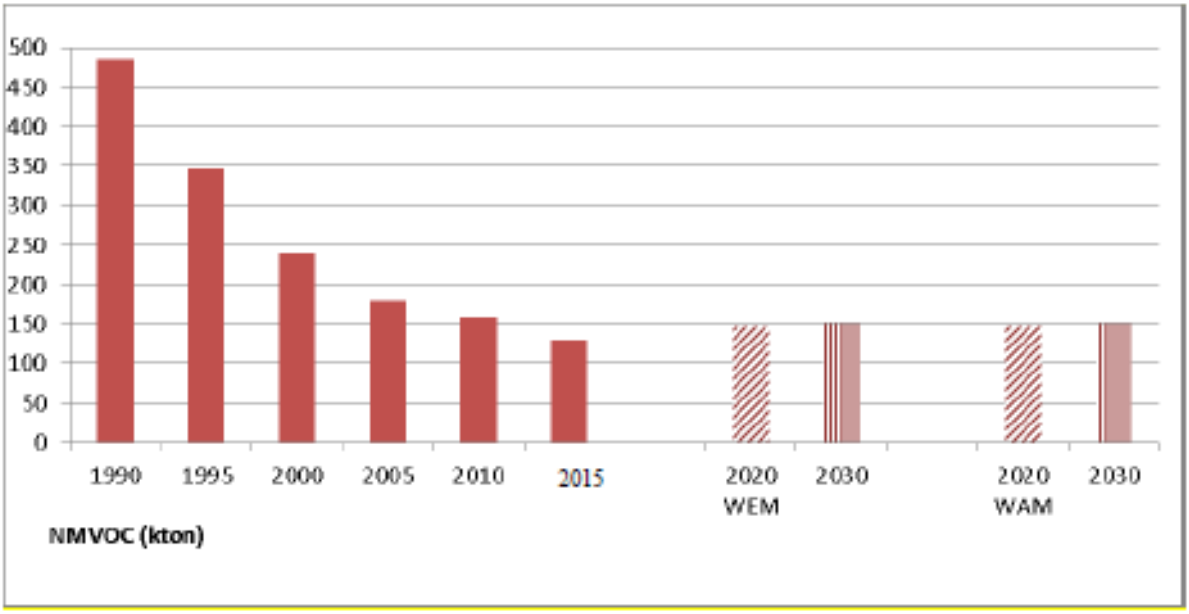


Figure 5.14: Historical emissions and projections for non-methane volatile organic compounds (NMVOC), 1990–2030, in kton of CO_2 eq

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5.4 (B) Assessment of the aggregate effects of policies and measures and uncertainty analysis

5.4.1 Effects on emissions of greenhouse gases

All measures taken together will bring about a reduction of the total greenhouse gas emissions in the period 2016–2020 of 25 Mton-eq. (13%) under the existing policy (WEM variant) or 26.9 Mton-eq. (14%) under the intended policy (WAM variant; see Figures 5.1 and 5.2 as well as Table 5.1).
The greatest reduction will be achieved in CO_2 (24 and 25.7 Mton-eq respectively). Under both policy variants, reductions of 0.5 Mton-CO_2 eq for methane, 0.3 Mton-CO_2 eq for nitrous oxide and 0.4 Mton-CO_2 eq for fluorinated or F-gases are expected.
Additional emissions reductions of 15 Mton-CO_2 eq under the existing policy (WEM) or 16 Mton-CO_2 eq under the intended policy (WAM) are expected for the period 2020–2030. CO_2 emissions will fall by 12.4 Mton-CO_2 eq or 13.4 Mton-CO_2 eq respectively. Under both policy variants, methane emissions will fall by 1.4 Mton-CO_2 eq, nitrous oxide emissions by 0.1 Mton-CO_2 eq and F-gases by 1.2 Mton-eq Mton-CO_2 eq

Around 45% of the Dutch emissions (excluding LULUCF and international aviation and navigation) are covered by EU ETS. The emissions under EU ETS are projected to fall by 17.8 Mton-CO_2 eq (WEM) or 18.4 Mton-CO_2 eq (WAM) in the period 2013–2020. Non-ETS emissions are projected to fall by 7.5 Mton-CO_2 eq (WEM) or 8.5 Mton-CO_2 eq (WAM) in the same period. The emissions under ETS will decrease by a further 7 Mton-CO_2 eq (WEM) or 8 Mton-CO_2 eq (WAM) in the period 2020–2030, while non-ETS emissions will decrease by an additional 7 Mton-CO_2 eq (WEM) or 8.6 Mton-CO_2 eq (WAM).

(Mton CO_2 -eq)	Historical emissions							Projections			
	1990	1995	2000	2005	2010	2015	2016*	2020 WEM	2020 WAM	2030 WEM	2030 WAM
Total emissions	221,4	231,5	219,7	214,4	214,2	195,2	196,6	171,3	169,7	156,2	153,7
Breakdown by gas											
Carbon dioxide	162,9	173,3	172,0	177,4	182,8	165,3	167,2				
Methane	32,3	30,3	25,1	20,5	20,1	19,0	18,6	143,1	141,5	130,7	128,2
Nitrous oxide	17,7	17,7	15,7	14,2	8,1	8,3	8,2	18,1	18,1	16,7	16,7
Fluorinated	8,5	10,1	6,9	2,3	3,1	2,6	2,6	7,9	7,9	7,8	7,8
Breakdown ETS/non-ETS	221,4	231,5	219,7	214,4	214,2	195,2	196,6	2,2	2,2	1,0	1,0
ETS				80,4	84,7	94,1	93,9	76,1	75,5	68,0	68,1
Non-ETS				134,0	129,4	101,2	102,7	95,1	94,2	88,2	85,5

* provisional data

Table 5.1 Projections by gas and broken down into ETS/non-ETS, 1990–2030, in Mton CO_2 eq.

5.4.2 Uncertainty analysis

The Netherlands uses the National Energy Outlook (NEV) 2017 for the projections. Although developments in factors which are largely exogenous – such as the economy, demography, fuel prices, technology and human behaviour – can only be predicted to a limited extent, they do have a major influence on the trends in emissions. The effects of policy measures can also be uncertain, because it is usually difficult to predict how the market will behave.

As a consequence, there is inevitably a large degree of uncertainty in the projections. Based on the most up-to-date information about these factors, NEV 2017 presents a picture of the most plausible scenario for the future. The projections present one estimation of future trends in these factors. One scenario is produced that constitutes the conditional point of departure for the projections; if the trends proceed as expected, the consequences for the emissions will be as described. The varying degrees of uncertainty surrounding the exogenous and other factors are shown by means of uncertainty ranges with a 90% reliability interval, which means that an outcome outside the given ranges is very improbable but still conceivable.
The uncertainty calculations produce ranges in the total emissions of 10% for 2020 and 28% for 2030 (see Table 5.2).

(Mton-eq of CO_2 –eq)	2020 (WEM)	2020 (WAM)	2030 (WEM)	2030 (WAM)
Total emissions	171	170	156	154
Uncertainty range	163–181 (±5%)	161–179 (±5%)	140–182 (±14%)	136–179 (±14%)

Table 5.2 Projected national emissions with uncertainty ranges, 2020–2030, in Mton CO_2 eq

5.5 (C) Description of methodology

Much of the information below is based on the Dutch National System for projections and reporting on policies and measures, which was established in 2015 (RVO.nl, 2015).

5.5.1 Models and methods used

The NEV 2017 uses a combination of models to construct an energy balance sheet of energy consumption in the Netherlands that reflects on the past and projects the future (for results, see annex 4). This outlook analyses the developments in different socioeconomic sectors with regard to energy demands and energy production. An overview of energy flows is provided on the basis of these analyses. The quantitative developments in the activities themselves form the basis for this outlook and include the production of electricity and goods, the use of devices, the heating of buildings and the number of kilometres travelled. Statistics Netherlands (CBS) collects information from questionnaires completed by businesses as well as information registered by network companies and government institutions to construct a historical overview. For future projections, the expected changes to these activities are calculated on the basis of assumptions about developments in the economy, demographics and the energy market. These particular projections are calculated using confirmed and announced projects as well as the intended policy measures of government institutions and other social players. The expected levels of activity are converted into the relevant energy usage and the necessary energy production. Expected developments in technology are an important aspect of these calculations, especially those relating to improved energy efficiency and those leading to a change in the fuels needed for the production of electricity. Finally, the energy usage is converted into CO_2 emissions. The emissions created by non-CO_2 greenhouse gases and air pollutants are determined on the basis of the levels of relevant activities that produce these emissions. A brief description of the models used to create the overview is included in Annex 2.

5.5.2 Key variables and assumptions

The key variables used in the projections are listed in Table 5.3 below.

Summary of key variables and assumptions used in the projections analysis

Key underlying assumptions						Projected		
Assumption	*Unit*	2000	2005	2010	2015	2020	2025	2030
GDP growth rate		100.00	106.00	114.00	117.00	128.00		152.00
Population	millions	15.8	16.3	16.6	16.9	17.2	17.5	17.7
Population growth	%	0.80	0.20	0.50	0.40	0.40	0.30	0.20
Number of households	millions	6.8.1	7.1	7.4	7.7	8.0	8.3	8.4
International oil price	US$ per barrel	39.00	66.00	87.00	55.00	89.00	114.00	140.00
Exchange rate	US$/Euro	0.90	1.24	1,33	1,11	1,16	1,11	1,11
International coal price	€ per ton	52.00	75.00	89.00	70.00	81.00	85.00	88.00
International gas price	€ per m3	0.16	0.18	0.20	0.24	0.28	0.31	0.33
Electricity (commodity baseload price) (WEM)	€ per MWh	58.38	51.50	52.96	40.81	32.28	47.62	44.41
Electricity (commodity baseload price) (WAM)	€ per MWh	58.38	51.50	52.96	40.81	32.38	47.42	43.51
European Emission Allowance (EU ETS)	€ per ton	N.A.	12.12	15.40	7.70	6.60	10.90	16.40
habited dwellings	millions	6.45	6.71	7.00	7.30	7.48	7.73	7.91
floor area utility building (services sector)	millions of m2	370.27	405.11	440.76	463.08	485.46	502.18	519.59
mobility passengers (WEM)	billions of km's	186.60	194.00	193.60	192.50	207.16	219.16	230.33
mobility passengers (WAM)	billions of km's	186.60	194.00	193.60	192.50	207.33	217.90	227.56

transport (WEM)	billions of tons freight * km's	Not available	122.3	118.50	126.70	144.72	150.60	156.47
transport (WAM)	billions of tons freight * km's	Not available	122.3	118.50	126.70	144.72	150.60	156.47
Livestock								
- Dairy young stock	millions of animals	1.34	1.15	1.25	1.34	1.25	1.14	1.03
- Dairy cows	millions of animals	1.50	1.43	1.48	1.62	1.62	1.62	1.62
- Cattle for meat production	millions of animals	1.23	1.21	1.25	1.17	1.18	1.16	1.14
- Breeding swine (incl. piglets)	millions of animals	6.61	5.81	6.35	6.80	6.58	6.58	6.58
- Fattening pigs	millions of animals	6.50	5.50	5.90	5.80	5.78	5.78	5.78
- Laying hens including broiler parents	millions of animals	53.08	48.42	56.50	57.66	54.08	52.67	51.26
- Broilers including ducks and turkeys	millions of animals	53.44	46.77	46.87	50.90	47.14	46.08	45.01
- Sheep	millions of animals	1.31	1.36	1.13	0.95	1.03	1.03	1.03

Table 5.3 Key variables used in the projections, 2000–2030

5.6 (D) Supplementarity relating to mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol.

Both companies and the government acquired credits as defined in articles 6 and 12 in order to meet their reduction commitments for the Kyoto Protocol in the period 2008-2012. Companies also acquired such credits because European Member States like the Netherlands have implemented a European emission trading system, which covers the activities of mostly large, industrialised companies (about 40% of total European emissions). The EU ETS requires these companies to compensate for their emissions through sufficient emission allowances and/or credits . For the emissions that fall outside the scope of ETS, not so-called non-ETS emissions, the government was responsible for acquiring enough emission allowances and/or credits (see also section 4.2).

During the first commitment period of the Kyoto Protocol, the Netherlands contracted a total of 33.2 Mton in carbon credits from CDM projects, 17.1 Mton from JI projects and 2.2 Mton from participation in Carbon Funds (PCF).

In the True-up Period Report (Report upon expiration of the additional period for fulfilling commitments by the Netherlands) in section IV (Other information) the total quantity of units in the retirement account as well as the total quantity of units requested to be carried over to the second commitment period was reported

The Dutch registry only contained CER’s at the end of the year 2016. There were 7,562,197 CERs in the registry at the end of 2016: 465,289 CERs were held in the Party holding accounts, 7,015,968 CERs were held in entity holding accounts and 80,940 CERs were held in the voluntary cancellation account.
The total amount of the units in the registry corresponded to 7,562,197 tonnes CO2 eq.

6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS, AND ADAPTATION MEASURES

The climate in the Netherlands is projected to undergo significant changes over the coming decades, which will have multiple consequences. The most pressing consequences are increasing heat stress in urban areas, increasing flood risks due to both more extreme river discharge and sea level rise, more frequent failure of vital infrastructure such as electricity and IT, more frequent damage to crops or production resources, an increased health burden and productivity loss, and changes in biodiversity. These conditions, in a country such as the Netherlands – a low-lying delta area with four large rivers and a high population density – give rise to climate change impacts that require risk assessments and decisions on timely and smart interventions.

The Sixth National Communication (2013) described the National Programme for Spatial Adaptation to Climate Change (ARK), which started in 2006 and ran until 2011, as the central programme for adaptation in the Netherlands. The Dutch Delta Programme, which started in 2010, has been the main vehicle for climate change adaptation planning in the Netherlands (see Box 6.1). The report by the Netherlands Court of Audit (Roenhorst and van der Geest 2012) recommended broadening the scope beyond the water domain. This challenge was taken up, resulting in the National Climate Adaptation Strategy "Adapting with ambition" (2016). The strategy broadened the scope of adaptation planning to include the effects of climate change within nine sectors: water and spatial management; nature; agriculture, horticulture and fisheries; health and welfare; recreation and tourism; infrastructure (road, rail, water and aviation); energy; IT and telecommunications; and public safety and security. Table 6.1 provides an overview of milestones in addressing climate adaptation over the past ten years (2006–2017).

Annum	Action
2006	The Royal Netherlands Meteorological Institute (KNMI) publishes climate scenarios for the Netherlands for 2050 and 2100
2006–2011	National Programme for Spatial Adaptation to Climate Change (Adaptatieprogramma Ruimte voor Klimaat, ARK)
2007	National Adaptation Strategy "Climate changes Spatial Planning" (Maak ruimte voor klimaat), with a focus on spatial adaptation
2008–2014	National Research Programme on Climate Change and Adaptation (Onderzoeksprogramma Kennis voor Klimaat)
2009	The Royal Netherlands Meteorological Institute (KNMI) updates its climate scenarios for the Netherlands for 2050 and 2100; scenarios from 2006 remain unchanged
2010–2014	Start of the Delta Programme, preparation phase: preparation of decisions on the protection against flooding, on climate-resilient urban areas and on adequate freshwater supply
2012	EU Climate Adaptation Strategy
2012	The Netherlands Court of Audit advises in its report "Adapting to climate change: strategy and policy" to broaden the scope to climate risks that have so far been insufficiently explored and mentions the sectors of health, energy, transport and recreation
2012	The Netherlands Environmental Assessment Agency (PBL) publishes the policy study "Effects of Climate Change in the Netherlands" (Effecten van Klimaatverandering in NL), a study requested by the Dutch government and an important input for the National Climate Adaptation Strategy 2016. It contains among other things an inventory of effects on the sectors of water management, nature conservation, arable and livestock farming, human health and tourism
2013	The Netherlands Environmental Assessment Agency (PBL) publishes "Adapting with tact, building blocks for an integrated vision on climate adaptation" (Aanpassen met beleid, bouwstenen voor een integrale visie op klimaatadaptatie), in which the inventory is extended with the sectors of fisheries, transport and infrastructure, energy, and information and communication technology, also including the consequences of climate effects abroad
2013	The National Climate Agenda (Klimaatagenda) integrates the advice from the Netherlands Court of Audit, covering both climate mitigation and climate adaptation
2014	Ratification of the five Delta Decisions including those on flood safety, freshwater supply and climate-resilient urban areas. One of these is the Delta Decision on Spatial Adaptation, which includes the ambition for the Netherlands to be flood resilient and climate robust in 2050. Start of the implementation phase of the Delta Programme

Annum	Action
2014	The Royal Netherlands Meteorological Institute (KNMI) updates its climate scenarios for the Netherlands for 2050 and 2100
2015	The Netherlands Environmental Assessment Agency (PBL) synthesises the results of the National Research Programme on Climate Change and Adaptation in its report “Adapting to climate change: recognising risks, seizing opportunities” (Aanpassen aan klimaatverandering: kwetsbaarheden zien, kansen grijpen), an important input for the National Climate Adaptation Strategy 2016
2016	National Climate Adaptation Strategy “Adapting with ambition”, a result of the National Climate Agenda and the EU Climate Adaptation Strategy
2017	Delta Plan on Spatial Adaptation presented as part of the Delta Programme to enhance the implementation of the Delta Decision on Spatial Adaptation

Table 6.1: Milestones in addressing climate adaptation over the past ten years

Box 6.1 The Delta Programme and Adaptive Delta Management

The Delta Programme is aimed at guaranteeing that the Netherlands remains safe and attractive, now and in the future, and that the fresh water supply is adequate. The Delta Programme is a nationwide programme, and has an advisory role towards the national government. The national government, provinces, municipalities, and regional water boards work together with input from social organizations, the business community, and knowledge institutes (Delta Commissioner 2013, www.deltacommissaris.nl). The Minister of Infrastructure and the Environment bears the responsibility. A Delta Commissioner was appointed to prepare and oversee the implementation of the Delta Programme. His main responsibility is to prepare an annual report that outlines progress and the steps that will be taken in the year ahead. Each year, the Minister of Infrastructure and the Environment presents the Delta Programme report to the House of Representatives as part of next year's national budget. The legal framework for the implementation of the current national adaptation strategy in the Netherlands is 'the Delta Act on flood safety and fresh water supply' (hereinafter: the Delta Act).The Delta Act is formally an amendment of the Water Act and anchors the Delta Programme, the Delta Fund, and the role of the Delta Commissioner. The Delta Act entered into force on 1 January 2012.

The Delta Programme is currently being developed in nine sub-programmes (See also Delta Commissioner 2013). Three sub-programmes apply to the whole of the Netherlands:
- Safety;
- Fresh water;
- New Urban Development and Restructuring.

The other six sub-programmes are regional:
- Rhine Estuary-Drechtsteden;
- South-western delta;
- IJsselmeer Region;
- Rivers;
- Coast;
- Wadden Region.

Administrative consultations regarding the three national sub-programmes take place within the so-called Administrative Umbrella Consultations. The six regional sub-programmes are discussed in regional high-level steering groups and administrative consultation bodies.

The Delta Programme uses an integrated approach when tackling the issues of safety, water supply, and the role that spatial planning can play in resolving those issues. Key decisions regarding flood risk management, fresh water supply, and spatial adaption, as well as regional strategies will be proposed to Parliament in September 2014. After approval, the implementation of the proposed policy and strategies can start. This will take several decades. E.g. new flood risk management standards have to be accomplished in 2050. The Delta Programme will take account of uncertainties about the future impact of climate change as well as spatial and socio-economic development (See the next section for the use of scenarios). For the Delta Programme, a new planning approach was developed, called 'adaptive delta management'. Key elements of adaptive delta management are:
- Linking short-term decisions with long-term tasking around flood risk management and fresh water;
- Incorporating flexibility in possible solution strategies (where effective);
- Working with multiple strategies and moments to switch between them (i.e. adaptation paths);
- Linking different investment agendas.

Preparing for future changes requires short-term measures that tie in with the long term, i.e. measures that expand our adaptability and increase the ability to withstand extreme situations. Finalising measures for impacts fifty to a hundred years ahead is difficult and in most cases not advisable. After all, solutions must be able to grow along with new insights and circumstances. On the other hand, it is essential that measures are taken now, considering that it took several decades to complete the Delta Works. Implementing adaptive delta management involves three steps:
- What short-term developments in other policy areas might interfere with water safety and fresh water supply measures?
- Insight into the flexibility of the possible solutions. For example, can the solutions be easily implemented on a step-by-step basis and adapted in case circumstances change?
- What decisions must be taken now in order to make the adaptive approach possible?

These three steps ensure that necessary measures are taken early, while at the same time keeping sufficient options open for additional measures required in the future to protect the Netherlands against flooding and to ensure a sufficient supply of fresh water. To enable this approach, monitoring, reporting, and evaluating schemes for refining adaptation are developed.

In the process, all relevant material, like results of research and knowledge programmes (Knowledge for Climate), experiences from international cooperation (International Water Programme, Delta Alliance, Connecting Delta Cities), and assessments by the Netherlands Environmental Assessment Agency (PBL 2011) are taken into account.

This chapter reports on climate change and its effect on multiple sectors (Section 6.1), on assessments of the impacts and the way that urgencies are defined (Section 6.2), and on the resulting policies and measures (Section 6.3) in the Netherlands. For a more detailed description of national climate effects and implications, the reader is referred to the assessments by the Netherlands Environmental Assessment Agency (PBL 2011; PBL 2012; PBL 2015). Details on international cooperation and capacity-building can be found in Chapter 7 (and in PBL 2016), while details of research activities and programmes are described in Chapter 8.

6.1 (A) Climate effects

This section summarises observed and projected changes in the climate (Subsection 6.1.1) and their effects on multiple sectors in the Netherlands (Subsections 6.1.2–6.1.9). It elaborates on the work coordinated by the Netherlands Environmental Assessment Agency (PBL 2013; PBL 2015). The sectoral assessments that have been performed in 2014-2015 were part of this work. All results form the basis of the National Climate Adaptation Strategy. The Delta Programme is based on research that has been executed by the same organisations.
Figure 6.1 visualises the greater picture of climate effects and some of its sectoral implications in the Netherlands.

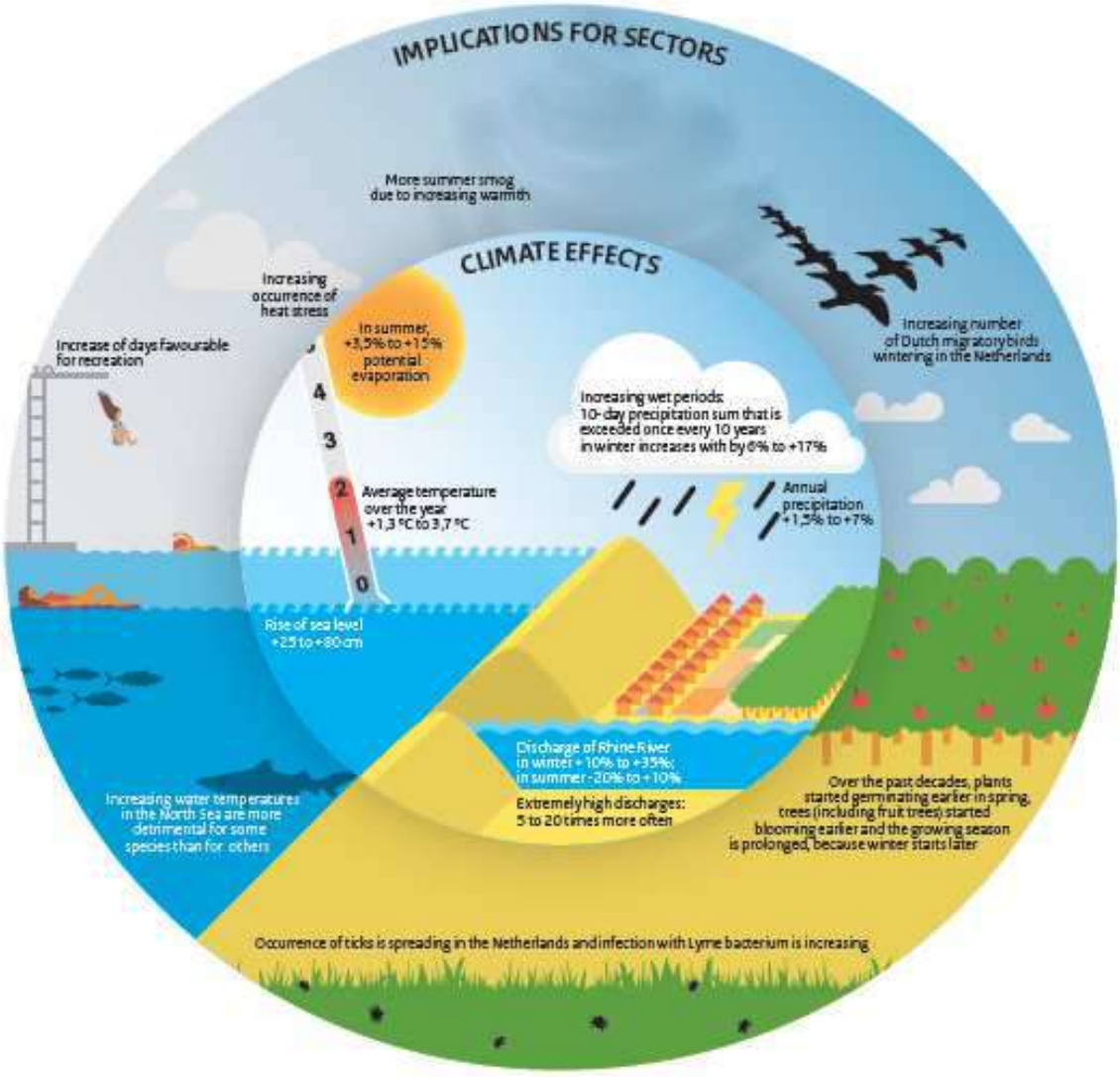


Figure 6.1 Overview of some climate effects and implications for sectors

Sources figure:

- Sperna Weiland, F., Hegnauer, M., Bouaziz, L. & Beersma, J.J. 2015. Implications of the KNMI'14 climate scenarios for the discharge of the Rhine and Meuse; comparison with earlier scenario studies. Report no. 1220042-000-ZWS-004, Deltares, Delft, the Netherlands. http://publications.deltares.nl/1220042_000.pdf.
- The brochure "KNMI'14 climate scenarios for the Netherlands" is a guide for professionals in climate adaptation. Revised 2015 edition of the brochure (34 pp.) https://www.knmi.nl/kennis-en-datacentrum/publicatie/knmi-14-climate-scenarios-for-the-netherlands; http://www.climatescenarios.nl/.

6.1.1 Effects of climate change

The Netherlands has become warmer. Average temperatures in De Bilt increased by 1.7 °C between 1906 and 2015. In all four scenarios that KNMI developed for the Netherlands, the temperature will increase further. The mean temperature increase in 2050 is the largest for winter (December, January, February) and the smallest for spring (March, April, May). Extreme precipitation in the Netherlands has increased as well and it is likely that it will further increase in future. This trend includes higher frequencies and intensities of extreme precipitation. There are indications that higher humidity of the air from a warmer climate will result in larger clusters of showers, including “supercells” that may cause both squalls – sudden sharp increases in wind speed – and hailstorms.

In 2014, the Royal Netherlands Meteorological Institute (KNMI) published its update of four climate scenarios for the Netherlands for around 2050 and 2085 (the first scenarios were published in 2006; see KNMI’14 scenarios). These scenarios are based on a whole range of advanced global and regional climate models combined with information from time series of measured data, which allowed them to incorporate changes in air circulation patterns in their models. Each scenario provides a consistent picture of the changes in many climate variables, including temperature, precipitation, sea level and wind. Not only the changes in the mean climate are depicted, but also the changes in the extremes such as the coldest winter day and the maximum hourly precipitation per year. The changes are provided for two different time horizons: around 2050 and around 2085 (Table 6.2), relative to the reference period of 1981–2010. The KNMI’14 scenarios are the four combinations of two possible values for the global temperature increase – “Moderate” or “Warm” – and two possible changes in air circulation patterns, “Low value” (L) and “High value” (H) (Figure 6.2). Together, they span the likely changes in the climate of the Netherlands according to the latest insights. In the H scenarios, more frequent westerly winds occur in winter. This change leads to mild and more humid weather compared to the L scenarios. In summer, high-pressure systems have a greater influence on the weather in the H scenarios. Compared to the L scenarios, these high-pressure systems cause more easterly winds, which implies warmer and drier weather for the Netherlands.

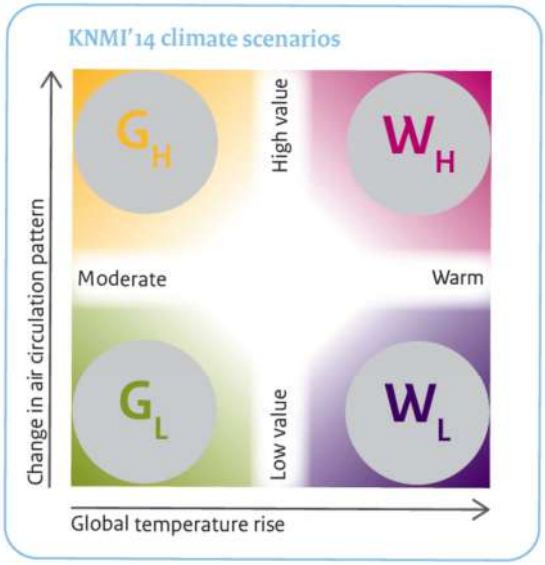


Figure 6.2 The four KNMI’14 scenarios (KNMI 2015)

	Climate reference (1981–2010)	Climate around 2050			
		G_L	G_H	W_L	W_H
Annual average temperature	10.1 °C	+1.0 °C	+1.4 °C	+2.0 °C	+2.3 °C
Annual average precipitation	851 mm	+4%	+2.5%	+5.5%	+5%
Potential evaporation (annual)	559 mm	+3%	+5%	+4%	+7%
Sea level absolute rise	+3 cm	+15 to +30 cm	+15 to +30 cm	+20 to +40 cm	+20 to +40 cm
Winter average temperature	3.4 °C	+1.1 °C	+1.6 °C	+2.1 °C	+2.7 °C
Coldest winter day per year	-5.9 °C	+2.0 °C	+3.6 °C	+3.9 °C	+5.1 °C
Average precipitation winter	211 mm	+3%	+8%	+8%	+17%
10-day amount exceeded once in 10 years	89 mm	+6%	+10%	+12%	+17%
Mean wind speed in winter	6.9 m/s	-1.1%	+0.5%	-2.5%	+0.9%
Highest average daily wind speed per year	15 m/s	-3%	-1.4%	-3%	+0%
Summer average temperature	17.0 °C	+1.0 °C	+1.4 °C	+1.7 °C	+2.3 °C
Warmest summer day per year	24.7 °C	+1.4 °C	+1.9 °C	+2.3 °C	+3.3 °C
Average precipitation summer	224 mm	+1.2%	-8%	+1.4%	-13%
Daily amount exceeded once in 10 years	44 mm	+1.7 to +10%	+2.0 to 13%	+3 to +21%	+2.5 to +22%
Maximum hourly precipitation in a year	15.1 mm/h	+5.5 to +11%	+7.0 to 14%	+12 to +23%	+13 to +25%
Potential evaporation (summer)	266 mm	+4%	+7%	+4%	+11%
Highest moisture deficit exceeded once in 10 years	230 mm	+5%	+17%	+4.5%	+25%

	Climate reference (1981–2010)	Climate around 2085			
		G_L	G_H	W_L	W_H
Annual average temperature	10.1 °C	+1.3 °C	+1.7 °C	+3.3 °C	+3.7 °C
Annual average precipitation	851 mm	+5%	+5%	+7%	+7%
Potential evaporation (annual)	559 mm	+2.5%	+5.5%	+6%	+10%
Sea level absolute rise	+3 cm	+25 to +60 cm	+25 to +60 cm	+45 to +80 cm	+45 to +80 cm
Winter average temperature	3.4 °C	+1.3 °C	+2.0 °C	+3.2 °C	+4.1 °C
Coldest winter day per year	-5.9 °C	+2.7 °C	+4.1 °C	+5.6 °C	+7.3 °C
Average precipitation winter	211 mm	+4.5%	+12%	+13%	+30%
10-day amount exceeded once in 10 years	89 mm	+8%	+12%	+18%	+25%
Mean wind speed in winter	6.9 m/s	-2.0%	+0.5%	-2.5%	+2.2%
Highest average daily wind speed per year	15 m/s	-2%	-0.9%	-1.8%	+2%
Summer average temperature	17.0 °C	+1.2 °C	+1.7 °C	+3.2 °C	+3.7 °C
Warmest summer day per year	24.7 °C	+2.0 °C	+2.6 °C	+4.2 °C	+4.9 °C
Average precipitation summer	224 mm	+1.0%	-8%	-5.0%	-23%
Daily amount exceeded once in 10 years	44 mm	+2.5 to +15%	+2.5 to 17%	+5.5 to +40%	+5 to +40%
Maximum hourly precipitation in a year	15.1 mm/h	+8 to +16%	+9 to 19%	+22 to +45%	+22 to +45%
Potential evaporation (summer)	266 mm	+3.5%	+8.5%	+9%	+15%
Highest moisture deficit exceeded once in 10 years	230 mm	+3.5%	+17%	+15%	+40%

Table 6.2: Climate scenarios for the Netherlands, predicted values for 2050 and 2085 (KNMI 2015)

Looking at the differences between the KNMI'06 and KNMI'14 scenarios, the scientific evidence (as assessed in the latest IPCC report on which KNMI'14 was based) does not differ substantially from the evidence in the previous IPCC report on which KNMI'06 was based. Consequently, the overall trends in KNMI'14 are similar to those in KNMI'06. This fact indicates that the general characteristics of the scenarios are robust. KNMI'14 adds more details and provides a richer picture of the future climate of the Netherlands than KNMI'06. The KNMI'14 scenarios include more climate variables and indicators than the KNMI'06 scenarios.

The KNMI scenarios describe the most likely range of future climate changes in the Netherlands. These scenarios have also been combined with socioeconomic scenarios (so-called WLO, Welvaart en Leefomgeving "Prosperity and Environment") to form the Delta Scenarios[128]. These scenarios combine plausible views of future climate trends (slow/rapid) and socioeconomic developments (limited versus strong changes), looking ahead to 2050 and 2100. The first set of Delta Scenarios was drawn up in 2012 and launched in 2013[129]. Its hydrological conditions were based on the KNMI'06 scenarios, while its socioeconomic trends derived from WLO 2006 (Janssen *et al.* 2006). The Delta Scenarios are the basis for the risk and vulnerability assessments that are developed in the Netherlands at the national and subnational level. A substantial part of the impacts relate to the issues addressed in the Delta Programme: protection against flooding, the supply of fresh water and spatial adaptation to flooding, and heat stress in the built environment.

The new KNMI'14 climate scenarios were launched in 2014 and the socioeconomic scenarios received an update in 2015. Also in 2015, global agreements were set down in Paris on the restriction of global warming to a maximum of 2 degrees Celsius by 2100. An assessment of these new scenarios and agreements for the Delta Scenarios concluded that the new insights fall within the bandwidth of the Delta Scenarios; as such, the Delta Scenarios are still a proper basis for the selection of measures. Nevertheless, the Delta Scenarios will be updated in 2017. Table 6.3 summarises the most important risks and opportunities for various sectors as derived from the KNMI'14 scenarios.

Coastal impacts	Storm surges will show little change, but the sea level rise will continue; until now, the process of sea level rise is relatively slow. Coastal protection measures require continuous monitoring to detect a potential acceleration of the sea level rise in time
Flooding	Increased winter rainfall will increase peak discharge and flooding risks of the Rhine, Meuse and smaller rivers
Water resources	In two of the four scenarios, drought will increase in summer and lead to water shortages, water quality issues and salinisation; sea level rise will contribute to salt water intrusion
Health	Temperature rise will lead to reduced mortality during winter and increased mortality in summer; during hot summers, air quality will deteriorate; there is great uncertainty about possible trends in infectious diseases; a further increase in the number of "allergy days" due to the extension of the growing and flowering season
Mobility	Traffic disruption due to heavy showers may increase; slippery roads under icy conditions and damage to roads become less likely, but rutting will increase during summer heat waves
Energy	The energy demand for heating houses, factories and offices will decrease, but more energy will be required for air conditioning; the demand for inland cooling water for electricity production will reduce
Agriculture	Potential crop yields will increase with a longer growing season and higher CO_2 concentrations, but changes in precipitation and the prevalence of extreme events could threaten harvests; dry years will present a particular challenge; pests and diseases may increase
Nature	The risks are the greatest for ecosystems that depend on precipitation, e.g. heathlands, dry grasslands, rain-fed moorland pools and raised bogs; fens in nature reserves surrounded by deeply drained polders that depend on the inlet of surface water are also highly susceptible; increased risk of natural fires; climate zones are shifting and biodiversity will change
Recreation	The number of attractive recreation days increases

Table 6.3: Sectoral implications for the Netherlands (KNMI 2015)

The National Adaptation Strategy (2016) has its basis in the KNMI scenarios and elaborates on the four climate trends ("Hotter", "Wetter", "Drier" and "Rising Sea Level") to characterise the implications of climate change for nine

[128] http://www.pbl.nl/sites/default/files/cms/publicaties/Deltascenario%27s%20voor%202050%20en%2 02100.pdf
[129] http://www.pbl.nl/sites/default/files/cms/publicaties/Deltascenario%27s%20voor%202050%20en%202100.pdf

sectors: water and spatial management; nature; agriculture, horticulture and fisheries; health and welfare; recreation and tourism; infrastructure (road, rail, water and aviation); energy; IT and telecommunications; and public safety and security.

6.1.2 Implications for water and spatial adaptation

The main impacts of climate change on water are:

- a raised likelihood of coastal erosion and flooding;
- an increase in peak discharges from the rivers in winter, raising the likelihood of flooding, especially in coastal areas;
- more frequent flooding in urban areas after extreme rainfall events;
- a decrease of river discharges in summer, affecting transport capacities and freshwater availability (e.g. for irrigation);
- an increased chance of water quality deterioration caused by drought – combined with decreasing water volumes and dropping water levels – or by higher water temperatures;
- an increase in salt water intrusion into surface water bodies, impacting freshwater availability;
- an increase in concentrations of substances in water such as nutrients due to the evaporation of water.

Over the past 100 years, the sea level rose by about 20 cm and is projected to increase further (Table 6.2). This rising sea level leads to coastal erosion and reduces safety along the coast. The climate scenarios also predict higher wind speeds, although this increase is small and lies within the current variability in wind speed from year to year. The expected higher precipitation in winter and reduced snowfall will make discharges in the Rhine and Meuse catchment more extreme. It is important to note that the actual discharges will also depend on factors such as water management of the upstream river basin, in addition to climate change. A critical flood situation can occur if spring tide, storm conditions and high river discharge coincide. As the sewage systems were designed to cope with less violent downpours, heavier summer storms will also mean more pluvial flooding in urban areas.

A national monitoring programme to assess the strength of the dykes has been implemented after it became clear that a number of dykes does not meet the safety standards (ILT 2013).
This third extended assessment round has generated the current picture of tasking for flood risk management. Flood protection projects have been prioritised on the basis of data from the National Flood Risk Analysis for the Netherlands (2015), including new safety standards. The new standards entered into use in 2017. In 2050, when the flood defence system will meet these new standards, every citizen will have a level of protection against flooding equivalent to a fatality rate of 10^{-5} per year. In addition, a higher protection level may apply for areas in which flooding could lead to large groups of casualties or significant losses. A higher level of protection may also apply if so-called “vital functions” are present.

Furthermore, the Delta Programme scenarios (see Box 6.1) have been used to assess the regional vulnerability of the freshwater supply in 2050. Specific vulnerabilities included the following:

- Freshwater may become increasingly scarce in our country as water consumption increases while the climate changes.
- In the coastal provinces, where salinisation can occur, a dry year means that no water of the desired quality can be withdrawn for long periods.
- On the higher, sandy part of the Netherlands, where there is no water supply from the rivers, bottlenecks can occur in an average year due to a lack of moisture in the soil and a drop in the groundwater level.
- The increase in periods of drought can cause irreversible damage to nature and can damage the infrastructure. Prioritisation of water use, for which a ranking is already in use, can diminish the possibilities to solve drought stress in agriculture through the water supply.
- In 2016, the Rhine-Meuse Estuary System Analysis study and the study of the salt tolerance of agricultural crops generated more insight into salinisation and its impact.

6.1.3 Implications for nature and biodiversity

Nature in the Netherlands is under pressure. Biodiversity has been declining for the past decades due to e.g. habitat loss and fragmentation as well as nitrogen deposition. Climate change may exacerbate these problems. Significant effects of climate change on ecosystems and biodiversity are:

- an earlier start of the growing season as well as the breeding season;
- a decrease in species with the core area of distribution north of the Netherlands (cold-loving species);
- an increase in species with the core area of distribution south of the Netherlands (heat-loving species);
- changes in composition of species;
- changing bird migration patterns;
- loss of native species, while new species will establish themselves.

Climate change can have multiple impacts on nature and biodiversity in the Netherlands.
First, climate change will allow some plant and animal species from warmer, more southerly regions to become established in the Netherlands. This process has been observed already (Figure 6.3) and constitutes a natural process. However, some of these new species may pose a threat to biodiversity, economic activity, or human and veterinary health, as they also involve pest species or nuisance species. Examples include the oak processionary caterpillar and the western corn rootworm. This process of changing species abundance could be amplified by low spatial cohesion between the nature areas in the Netherlands and those of our neighbouring countries (species cannot follow shifting climate zones due to habitat fragmentation).
Second, climate change can also have an effect on the growing and flowering periods of plants as well as on the breeding season of birds. When some of these changes fail to coincide, food chains can become disrupted. If this situation occurs, the change in climate rises above the adaptive capacity of nature.
Third and finally, hydrological changes in groundwater and surface water – as well as temperature changes – are also putting increasing direct pressure on ecosystems such as forests, coasts and peat areas. Our aquatic and wet terrestrial ecosystems, such as the smaller and larger river systems, wetlands, wet heath and raised bog, are particularly sensitive to extremes in the weather.

Climate change will be advantageous for some plants and animals but disadvantageous for others. The actual impact will be co-determined by non-climate factors such as the dispersal and adaptive capacity of species, or management issues such as an improvement in water quality and more robust ecological networks (PBL 2010).

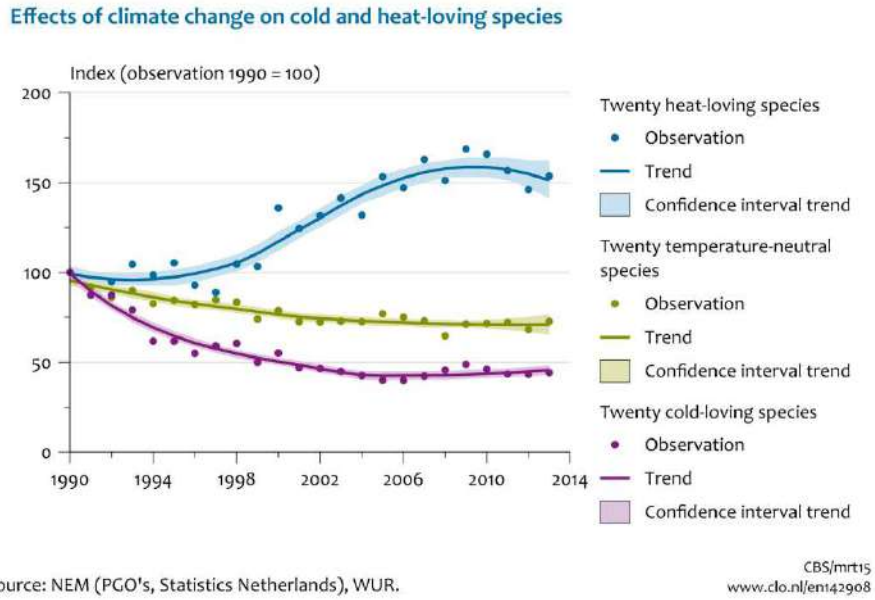


Figure 6.3: Climate change impacts on species in the Netherlands (Environmental Data Compendium 2015)

6.1.4 Implications for agriculture, horticulture and fisheries

The main effects of climate change on agriculture are:

- an increase in crop productivity due to higher temperatures and CO_2 concentrations, e.g. for sugar beet;
- an extension of the growing season;
- crop damage and production constraints as a result of waterlogging due to the increase in rainfall (intensity and/or duration);
- crop damage from soil water deficits and/or brackish groundwater seepage;
- changes in the distribution, frequency and intensity of fungal diseases, insect pests and weed growth, especially for crops such as potatoes and onions as well as for livestock;
- increased frequency and intensity of weather extremes (on the one hand, storms, heavy rain and hailstorms causing damage to e.g. greenhouses and saturated soils; on the other hand, extended dry periods throughout the growing season and during harvest);
- salinisation as a result of the rising sea level and/or extended dry periods;
- heat stress, which may affect the well-being of livestock.

Changes in the climate will generally improve the average climatic conditions for farming in the Netherlands. Higher temperatures mean longer growing seasons and thus higher potential crop yields. Dutch agriculture can often react flexibly to changing climatic conditions. Losses due to smaller yields in dry years may often be counterbalanced by higher product prices, which are often a result of scarcity throughout Europe. Potatoes and dairy production are examples of agricultural commodities where the competitiveness of the Netherlands is high (Hermans *et al.* 2010).

On the downside, too much water (flooding and waterlogging) as well as too little water (drought) can result in yield loss and economic damage. The drought risk is the highest in areas that have little or no access to water from rivers or ditches and in areas where the water table is low. In addition, new pests and diseases may occur. The agricultural sector regards extreme weather events as one of the greatest challenges posed by climate change.

It is expected that higher water temperatures will result in shifts within the fish population of the North Sea. Southern (Lusitanian) species have increased in recent decades (sprat, anchovy and horse mackerel), especially at the northern limit of their distribution areas, while northern (Boreal) species have decreased at the southern limit of their distribution range (cod) but increased at the northern limit (cod). The yield of southern species is expected to increase, whereas the yield of northern species is expected to decrease in the Dutch part of the North Sea. This situation will affect the specialised fisheries in particular[130]. It is as yet unclear whether these shifts will lead to a change in the total yield. Possible increases in the North Sea area will be limited.
Ocean acidification as a result of higher CO_2 levels could have a population-scale impact on fish and shellfish, but this process is currently very difficult to predict. However, the present evidence suggests possible effects in the food web such as an enhanced sensitivity of calcifying plankton as well as effects on fish sensory systems, which may change behavioural patterns[131].
In freshwater systems, mortality during summer could increase. There is a higher probability of diseases, pest algae and damage from storms, especially for shellfish. Overall, the implications of climate change for fisheries are still considered to be limited.

6.1.5 Implications for health and welfare

The direct implications of climate change for public health are:

- an increase in morbidity and mortality during summer due to heat stress;
- an increase in mortality from flooding[132;]
- an increase in mental stress caused by increased pluvial flooding and flood threats[133.]

[130] Rijnsdorp, A.D., Peck, M.A., Engelhard, G.H., Möllmann, C., Pinnegar, J.K. (2009) Resolving the effect of climate change on fish populations. ICES Journal of Marine Science 66, 1570-1583

[131] Heath, M.R., Neat, F.C., Pinnegar, J.K., Reid, D.G., Sims, D.W., Wright, P.J. (2012) Review of climate change impacts on marine fish and shellfish around the UK and Ireland. Aquatic Conservation: Marine and Freshwater Ecosystems 22, 337-367

[132] Within the Delta Programme, measures are taken to keep the level of flood risk within the legal norms. With the adequate implementation of the Dutch flood protection programmes, flood risks will not increase.

Indirect health consequences are:
- an increase of vector-transmitted diseases such as Lyme disease;
- an increase of diseases linked to air quality (ozone and particulates);
- an increase of allergies such as hay fever and house dust mite allergy;
- an increase of water-related diseases;
- a change in the occurrence of food-related diseases, due to the changing occurrence of pathogens;
- an increase of exposure to UV-related disorders.

Climate change is only one contributing factor which impacts human health and well-being. However, its consequences could potentially be severe, placing public health among the priorities of climate change policies in the Netherlands (see Sections 6.2 & 6.3). Senior citizens and people who suffer from respiratory or cardiovascular conditions are particularly susceptible to extreme temperatures. During a heatwave, mortality rises by approximately 13 per cent, largely due to the aggravation of pre-existing conditions (RIVM 2014). The frequency with which extreme temperatures occur in urban areas is higher than in rural areas. Urban areas retain more heat by day and lose less heat at night. Heat stress is exacerbated by atmospheric pollution (high levels of ozone and summer smog) and it is this combination that can trigger various respiratory diseases. It is not yet clear whether milder winters will reduce mortality.

With higher average temperatures, the hay fever season may become longer in duration. An increasing length of droughts may render the season more intense. Exotic allergenic plant species such as ragweed (*Ambrosia artemisiifolia*) may establish themselves. At present, over two million people in the Netherlands take medication to relieve the symptoms of hay fever. This figure is expected to double.

The influence of climate change on public health must be considered alongside that of demographic developments such as population growth, population ageing, migration and urbanisation[134]. Warm and wet conditions will lead to problems with mosquitoes and other arthropods as well as the diseases that they spread (emerging zoonoses such as West Nile Virus or malaria), which also result from more frequent travel abroad. In addition, people are projected to spend more time outside (more often and for longer periods) because it will become warmer on average, while they will also spend more time on outdoor leisure and recreation activities. Exposure to UV radiation, air pollution and pollen, water-borne diseases (e.g. cyanobacteria) and Lyme disease may increase as a result. The ozone layer above the Netherlands will probably recover more quickly from climate change, counteracting the exposure to UV radiation.

6.1.6 Implications for recreation and tourism

The implications of climate change for the recreation sector are:
- a longer tourist season due to higher temperatures in spring and summer;
- restrictions on water-based recreation, such as reduced navigability and more delays at bridges or locks, due to a higher frequency of falling water levels in summer;
- a decline in bathing water quality;
- an increase in the number of day trips;
- a rise in the number of foreign tourists;
- an increase in the erosion of beaches and dunes due to higher mean sea levels.

Depending on the climate scenario, the net spending in the recreation sector may rise by between 1% and 6%. However, no account has been taken of any changes in leisure and recreation behaviour. European studies show that, in the months of June, July and August, the temperature in the traditional holiday regions around the Mediterranean could become too high for many tourists. In the more temperate climates, by contrast, conditions will become more favourable. The Netherlands will have a more distinguished reputation as “the Netherlands Waterland” (since the popularity of water sports is growing). Numbers of foreign tourists coming to the Netherlands may rise and more people may remain in the Netherlands for their holidays.

[133] Idem.
[134] Also see Braks et al. 2013, https://www.ncbi.nlm.nih.gov/pubmed/24452252, for a substantiation of this fact.

The increasing popularity of recreation on and in the water means that more people will be exposed to water and the associated health problems.

6.1.7 Implications for infrastructure (road, rail, water and aviation)

The implications of climate change for infrastructure are:
- an increase in corrosion due to higher precipitation and higher temperatures;
- an increase in damage to oil rigs, high-voltage transmission lines, roads, bridges and vehicles from extreme storms;
- fewer problems due to extreme winter conditions; e.g. fewer occasions when roads need to be gritted or salted, reduction in damage to rail tracks and roads by frost and salt/grit, fewer constraints on water transport from ice cover and fewer travel delays;
- an increasing occurrence of rutting on melting road surfaces and deformation of rail tracks, as well as failure of technical installations, due to extreme high temperatures;
- more obstruction of traffic by roadside fires due to drought and heat;
- a reduced navigability of rivers in periods when water levels are too high or too low;
- more erosion of road infrastructure by heavy rain and flooding, which results in more maintenance;
- increased flooding and obstruction of roads caused by excessive rain, insufficient drainage capacity of culverts and road surfaces, changing groundwater levels or failure of flood defences;
- an increase in the probability of surface water pollution caused by sewerage overflow after heavy precipitation;
- increased vulnerability to extreme weather due to socioeconomic developments and new technologies such as smarter vehicles;
- increased vulnerability of transport to extreme weather due to increasing dependence on other sectors such as energy and IT.

The Stern Review Report (2006) states that the economic costs of storms and floods could be very high. Increasing precipitation combined with higher temperatures may accelerate the corrosion and deterioration of viaducts, bridges and other infrastructure, while inspections and maintenance work will be needed more often. The relatively short depreciation periods for investments in the road haulage sector allow it to react flexibly to climate change. Compared to the change in the levels of use (increased traffic, heavier vehicles), climate change contributes little to wear and tear, proceeding as it does at a slow pace compared to the frequency of regular maintenance work of dry infrastructure. The impact on the availability of infrastructure due to extreme weather, and consequently on user costs, could be much higher. Furthermore, the effects of low river discharges could become an important factor in water transport. Investments in transport by rail and waterways require more time and the replacement periods of materials are much longer, thus making them more vulnerable.
Infrastructure is also dependent on other sectors, e.g. electricity and telecom, whereas managing water risks requires cooperation between water managers. Awareness and knowledge of all possible climate effects is essential for critical infrastructure to become more climate-resilient. A specific effect, which will demand action in the long run, is the constraints that shipping will suffer due to extreme high or low water. This development may push up prices for transport. On the long run, this situation may lead to a shift in transport modality.

Opportunities resulting from climate change arise because costs are avoided (e.g. less winter maintenance), because future developments can accommodate known causes of climate change (e.g. integrated planning, smart vehicles suitable to adapt to climatic conditions), and because innovation and thus economic potential is required.

6.1.8 Implications for energy, IT and telecommunications

The implications of climate change for energy are:
- a decline in natural gas consumption in winter;
- an increase in electricity consumption during summer;
- an increase in the frequency of cooling water constraints for facilities such as power plants. This issue is a European problem, as the Dutch power plants have been moved to the sea;
- a reduction in the ice accretion on wind turbines;
- an increase in the damage to critical infrastructure from extreme storms.

An important trend is the increasing “electrification” of society. Socioeconomic developments and new technologies continuously increase the demand for energy, while the dependence of other critical sectors on the energy and IT network increases the vulnerability of society. Moreover, these networks are becoming increasingly interwoven, not only in the Netherlands but also on the international scale. Finally, due to the increasing contribution of renewable energy sources such as solar and wind, the energy system in Europe – including the Netherlands – is becoming more vulnerable to climate and weather extremes as well (PBL 2017)[135].
As a result of these factors, a disruption of the energy supply due to climate change can have direct effects on all critical infrastructure such as IT and transport, leading to numerous cascading effects in other sectors as well. For example, if heavy rains or heatwaves cause a disruption in the power grid at a certain location, the consequences of this interrupted supply may be felt far beyond national borders. In the end, a failing energy grid due to the effects of climate change can result in a high societal and economic impact.
The cost to repair physical damage to infrastructure is several factors lower than the costs of not being able to add value through energy in all depending sectors of society, such as information and communication (IT), the industrial and transport sectors, and civil society at large.

In addition, the fuel mix used in power generation is changing in the decades to come; the share of renewable energy such as wind and solar power will grow (Figure 6.4). These resources may reduce the power supply’s vulnerability, but they may also increase it; for example, in the case of wind energy, which is sensitive to weather extremes – specifically prolonged periods of windlessness.

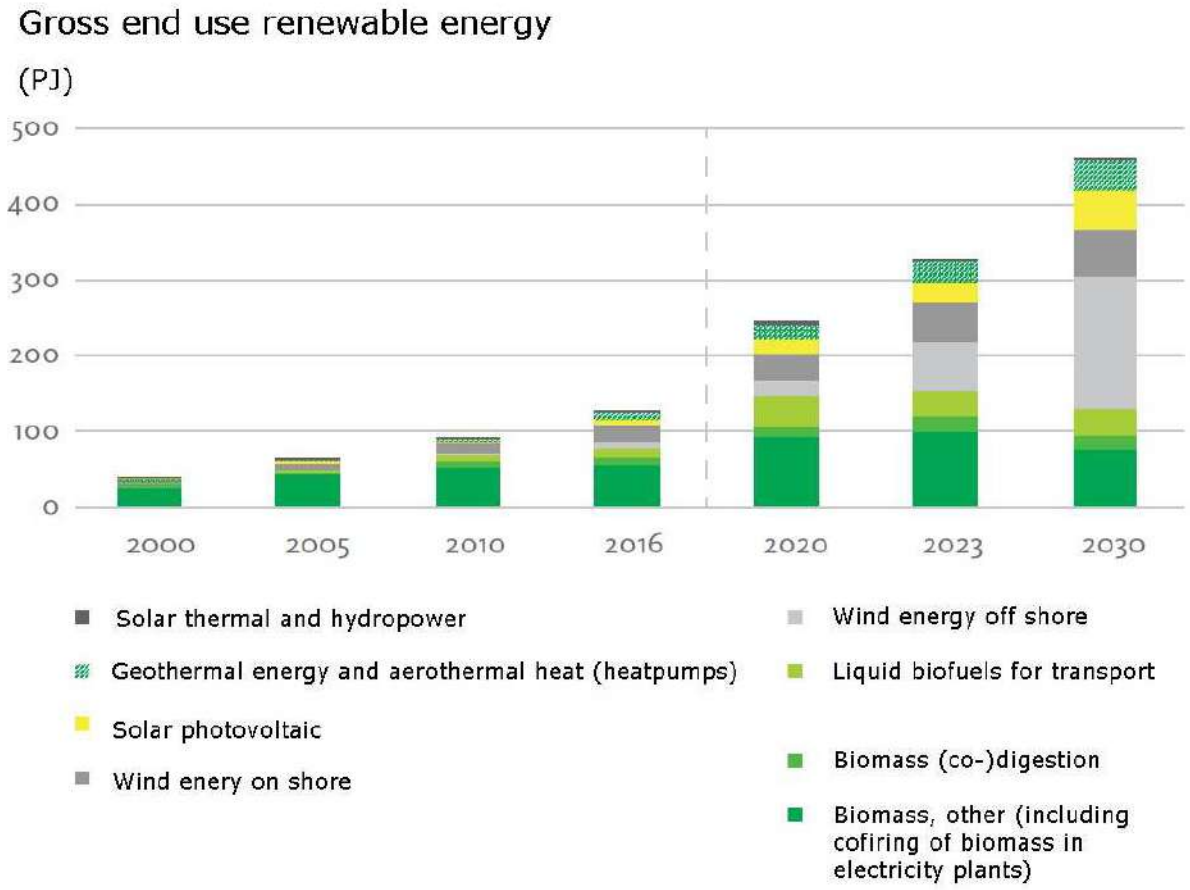


Figure 6.4 Gross end use renewable energy

[135] PBL (2017). Impact klimaat op robuustheid elektriciteitsvoorziening 2050 (Impact of climate on robustness of power supply 2050), eds. M. Vonk and H. Eerens. 41 pp., in press.

6.1.9 International context

Climate change does not respect national boundaries (see Figure 6.5. Climate change in the world has multiple consequences for the Netherlands in terms of how the country functions. This fact is because the Netherlands has an open economy and is connected with the rest of the world in many different ways; for example, through its economy and production chains as well as the power grid, IT, transport networks and vital infrastructure. Many Dutch businesses also have branches outside the Netherlands and many Dutch citizens travel abroad for their work or holidays. Furthermore, climate change could also undermine development results and affect international stability. As such, the Netherlands and the Dutch are at risk due to climate change effects elsewhere, but this situation may also provide opportunities.

The 2015 PBL report[136] on the risks and opportunities of international climate effects for the Netherlands shows that the main risks for the Netherlands arise from weather extremes such as cyclones, extreme precipitation events, heatwaves and drought. It is expected that the probability and intensity of such weather extremes worldwide will increase due to climate change. The more gradual changes in the global climate will also affect the Netherlands on the longer term. These changes could include the melting of the polar ice, the shifting of climate zones and the related effects on the growing conditions for crops, and the warming of the oceans leading to the migration of fish stocks.

The 2015 PBL report distinguishes between climate risks and opportunities in an European context on the one hand and the global dimensions on the other hand. In Europe, the climate risks with the greatest impact for the Netherlands are related to (1) the international power grid and IT networks, (2) the water levels in the rivers and (3) public health. The Netherlands is already preparing to deal with two of these risks: the risk of flooding has been addressed in the Delta Programme, and there is already a monitoring and screening system in place for infectious diseases. As such, a large challenge lies in the power supply and IT services. As grids and networks are becoming increasingly closely connected with one another internationally, a disruption in just one of these networks and/or regions could trigger cascade effects. The probability that the Netherlands will be faced with a failure of the power grid or a collapse of IT networks due to weather extremes is small at the moment, but should it occur, the impact could be huge. At the same time, climate adaptation efforts on the part of the Netherlands to make the power supply and IT networks more robust will be most fruitful if they are undertaken in close cooperation with the other countries in Europe; for example, by doing climate stress tests.

The most relevant risks of climate change impact on the Netherlands from a global perspective are related to (i) disruptions of economic chains and (ii) international stability. Regarding the economic chain, if weather extremes somewhere in the world lead to temporary shortages in and disruptions to the supply of raw materials, products and services, this situation can lead to increasing prices. As a result, the World Economic Forum recognises that climate change is posing a major risk to the functioning of the world economy. Although the impact of these disruptions per event would likely be small for the Dutch economy as a whole, this notion does not preclude the fact that it could be serious for individual companies or private citizens. For example, Dutch businesses and citizens in a disaster area could become directly affected.

Indirectly, the Netherlands could also become affected, as climate change/extremes could affect international stability as well. Simmering conflicts, such as those surrounding the availability of agricultural land and water, could flare up as a result of climate change and lead to political instability. For example, higher food prices due to harvest failures after drought could have considerable consequences for the local population in the affected areas, eventually leading to increased tensions. The possible increase in tensions and natural disasters will lead to a greater demand for relief in other regions and a need for more humanitarian aid. In the Arctic region, tensions could mount concerning the rights to natural resources which would become extractable due to the melting polar ice. Although it is unlikely that this situation will lead to conflict, the impact could be major should it occur.

[136] PBL (2015) Worldwide climate effects. Risks and opportunities for the Netherlands. Eds. M. Vonk, A. Bouwman, R. van Dorland & H. Eerens; report no 1412, 60p, http://www.pbl.nl/en/publications/worldwide-climate-effects-risks-and-opportunities-for-the-netherlands

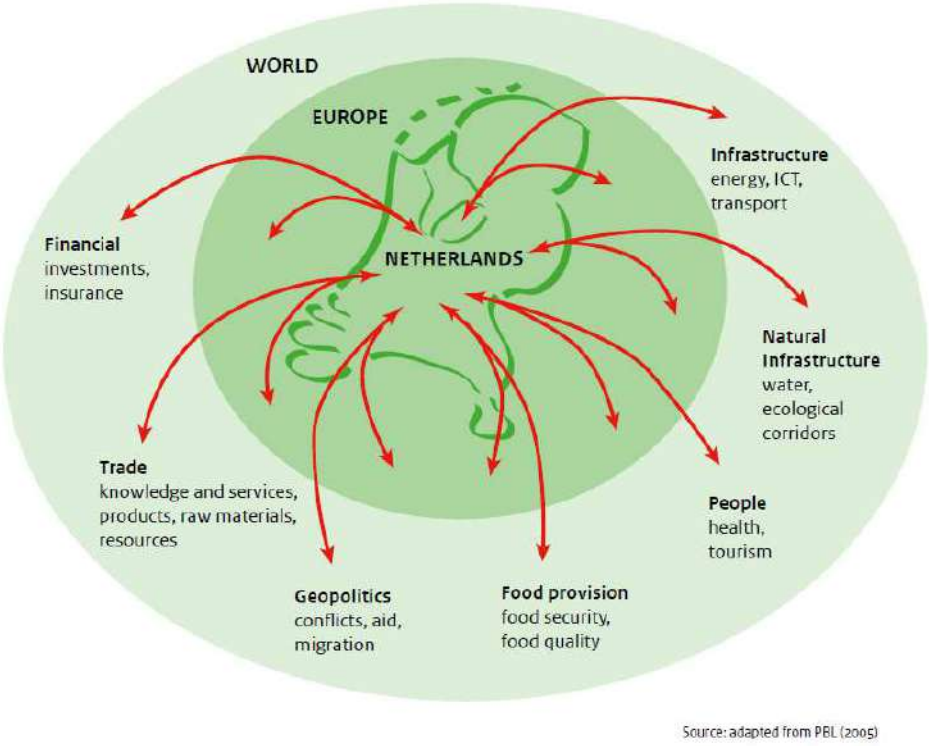


Figure 6.5 International relations

Explanatory note to Figure 6.5: There are several ways in which the Netherlands may come to experience the consequences of global climate change; disruption of the business chains or the supply of raw materials, financial damage to Dutch investments abroad, damage to vital infrastructure such as energy or IT, damage to people travelling to countries with increased public health risks, or even geopolitical consequences such as conflict and migration.

6.1.10 Opportunities of climate change

Climate change may also have positive effects for the Netherlands. Most of them have already been mentioned in previous sections. The increase in the greenhouse gas CO_2 and the rise in temperatures both have a positive impact on the production levels of most agricultural crops grown in the Netherlands. With other regions being hit harder by climate change, this situation may result in a relative competitive advantage for Dutch agriculture.

Milder winters will result in cost savings on energy use and road maintenance, although the savings on energy use may be compensated by a higher energy use in summer. Another positive effect is that the change in climate will make the Netherlands more attractive for tourism and recreation. Although weather extremes will increase, the summer season will be longer; spring and autumn are both expected to have longer periods of pleasant weather.

Internationally, the demand for Dutch expertise may increase, particularly in water management, flood safety, water distribution systems, renewable energy and innovative climate-smart agriculture.

6.2 (B) Impacts and urgencies

Section 6.1 comprised an inventory of climate change – observed and projected – and its implications for the Netherlands. This inventory has been gathered over the years, especially in the Knowledge for Climate (Kennis voor Klimaat) Research Programme. A wide range of implications have been identified. As a next step after these initial inventories, a risk assessment has been carried out in order to assess the risk of especially the negative implications (PBL 2015).

6.2.1 Understanding risk: likelihood and impact

The negative implications of climate change may have a serious effect on the way that the country functions. They are varied, affect various levels and scales, and have an enormously varied impact as well. To picture the main risks that the Netherlands is likely to face, a distinction has been made between risks affecting the economy, those affecting people, and those affecting nature and the environment. The risks were subsequently ranked according to impact and likelihood[137]:

The impact of an occurrence of climate change was classified into three categories using semi-quantitative scoring, with different category boundaries per type of impact (i.e. economy, people, and nature and the environment).
The likelihood of an occurrence of climate change was also classified into three categories: unlikely to increase within this century, likely to increase within this century and likely to increase within this decade.
Three impact tables resulted from this analysis. In these tables, the negative implications of climate change were classified ranging from a low risk (low impact and low likelihood) to a high risk (high impact and high likelihood); see PBL 2015 or Appendix 1 of NAS 2016.

[137] In many publications the term 'probability' is used in stead of 'likelihood'

Box 6.2. Risk assessment method (PBL 2015):

Climate change may cause the events that we are currently already facing to become more frequent and more intense. The gradual changes in climate (e.g. the rise in temperatures and sea levels) as well as the expected increase in weather extremes (drought, heavy rainfall in combination with wind gusts) will both lead to changes in the level of risk for people and nature. In collaboration with many other knowledge institutes, PBL constructed an overview of the range of climate risks to the Netherlands. In doing so, a distinction was made between three risk dimensions: economic risk (damage), human risk (deaths, casualties), and nature and environmental risks (the disappearance of certain species and habitats). These risks were subsequently ranked according to *probability* (likelihood) and *projected magnitude* (impact). The magnitude and probability for each risk dimension were classified into three categories. The resulting tables can be found in PBL 2015.

The level of probability is related to the frequency at which already occurring events are likely to occur (more often, similar, less often), the reference being the occurrences over the past century. Assuming the most unfavourable KNMI'14 scenario for the Netherlands, we estimated the likelihood of the country experiencing more – and more severe – climate change impacts in the coming decades or century. For the risk assessment, we assumed the current spatial layout as well as the current size and composition of the Dutch population, combining these factors with the climate change projected for 2050. As a result, this assessment is effectively an estimation "in case of inaction".

The magnitude of the economic risks is indicated by the projected damage in euros as well as the personal risks in terms of the number of deaths and/or casualties. Casualties are people who have somehow been exposed to the consequences of climate change. This group may vary from people whose home has been flooded as a result of extreme rainfall to people who experience power cuts or disruptions to communication services and those suffering from hay fever. The magnitude of nature risks is indicated on a local, regional or national scale, in combination with the degree of irreversibility of the consequences.

The likelihood and magnitude of water-related risks were derived from studies carried out for the Delta Programme. For the other risks, the magnitude and likelihood were based on other studies of i) transport and infrastructure, ii) the power supply system, iii) IT networks, iv) public health, v) nature, vi) agriculture and vii) fishery. For each category, this estimate concerns the magnitude of the consequences within a certain sector. The related background reports can be downloaded from http://www.ruimtelijkeadaptatie.nl/nl/bouwstenen-nas. International risks for the Netherlands were derived from PBL (2015d).

6.2.2 Visualising consequences of climate change and risk

When writing the National Climate Adaptation Strategy, it was decided to visualise all inventoried implications or consequences of climate change in four diagrams visualising each of the four major climate trends:

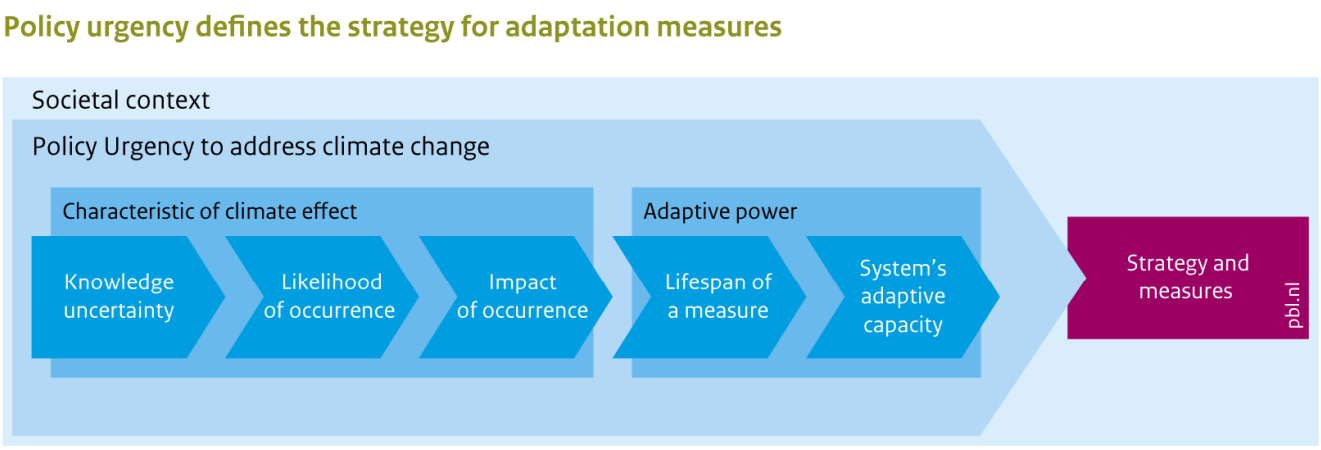
1. Temperatures are rising (it becomes warmer, see figure 6.7a).
2. Precipitation is increasing (it becomes wetter, see figure 6.7b).
3. Periods of drought are increasing in summer (it becomes drier, see figure 6.7c).
4. The sea level is rising (see figure 6.7d).

The results of the risk assessment described above have been included in these diagrams, adding bold uninterrupted and bold interrupted outer lines to indicate that the risk for sectors and systems is high.

6.2.3 From risk assessment to adaptation strategy

The next step to be taken is to formulate an adaptation strategy counteracting the negative sectoral implications. In order to do so, we need to know where to start. Which one of the risks needs our attention? Which sector or system has already studied the implications of climate change and is addressing them already? Where could adaptation measures best be taken? Which should these measures be? And when should these measures be taken? Such questions need to be answered in order to determine where to start.

To determine the issues that need to be addressed urgently, the Netherlands Environmental Assessment Agency (PBL) developed five criteria. Three of them define the character of climate change or a climate effect and two of them define the ability of an affected sector or system to adapt to the changing climate (see figure 6.6).



Source: PBL

Whether or not a climate effect is considered to be urgent depends not only on the character of the particular climate effect but also on the adaptive capacity of society and the societal context.

Figure 6.6 : Criterea to determine urgency.

First, three criteria that determine the character of a climate effect (the first two have already been explained above when defining different risks):

1. the likelihood of an effect;
2. the impact of an effect;
3. the knowledge uncertainty about the effect. Is it a gradual change which is often linear and as such relatively easy to predict, are we confronted with increasing extremes which is much more difficult to predict, or are we facing a system change?

Second, two criteria to define the ability of a sector or system to adapt:

1. the lifespan of a measure, depending among other things on the lifetime or replacement time of parts;
2. the capacity to adapt within a sector or a system, depending among other things on the culture.

Within PBL's standard methodology, these five criteria are used to identify the sectoral implications or consequences of climate change to which extra attention should be devoted, over and above those designated under the Delta Programme. As a result, the National Climate Adaptation Strategy focuses not only on issues suffering from a marked climate impact but also on vulnerable sectors and/or sectors with limited adaptive capacity. This approach has lead to the following six issues demanding urgent action:

1. more heat stress leading to increased morbidity, hospital admissions and mortality, as well as reduced productivity;
2. more frequent failure of vital systems in energy, telecommunications, IT and transport infrastructures;
3. more frequent crop failures or other problems in the agricultural sector, such as decreased yields or damage to production resources;
4. shifting climate zones, whereby some flora and fauna species will be unable to migrate or adapt, leading to changes in biodiversity;
5. greater health burden and loss of productivity due to a possible increase in infectious diseases or allergic respiratory conditions such as hay fever;
6. cumulative effects, whereby a system failure in one sector or at one location triggers further problems elsewhere.

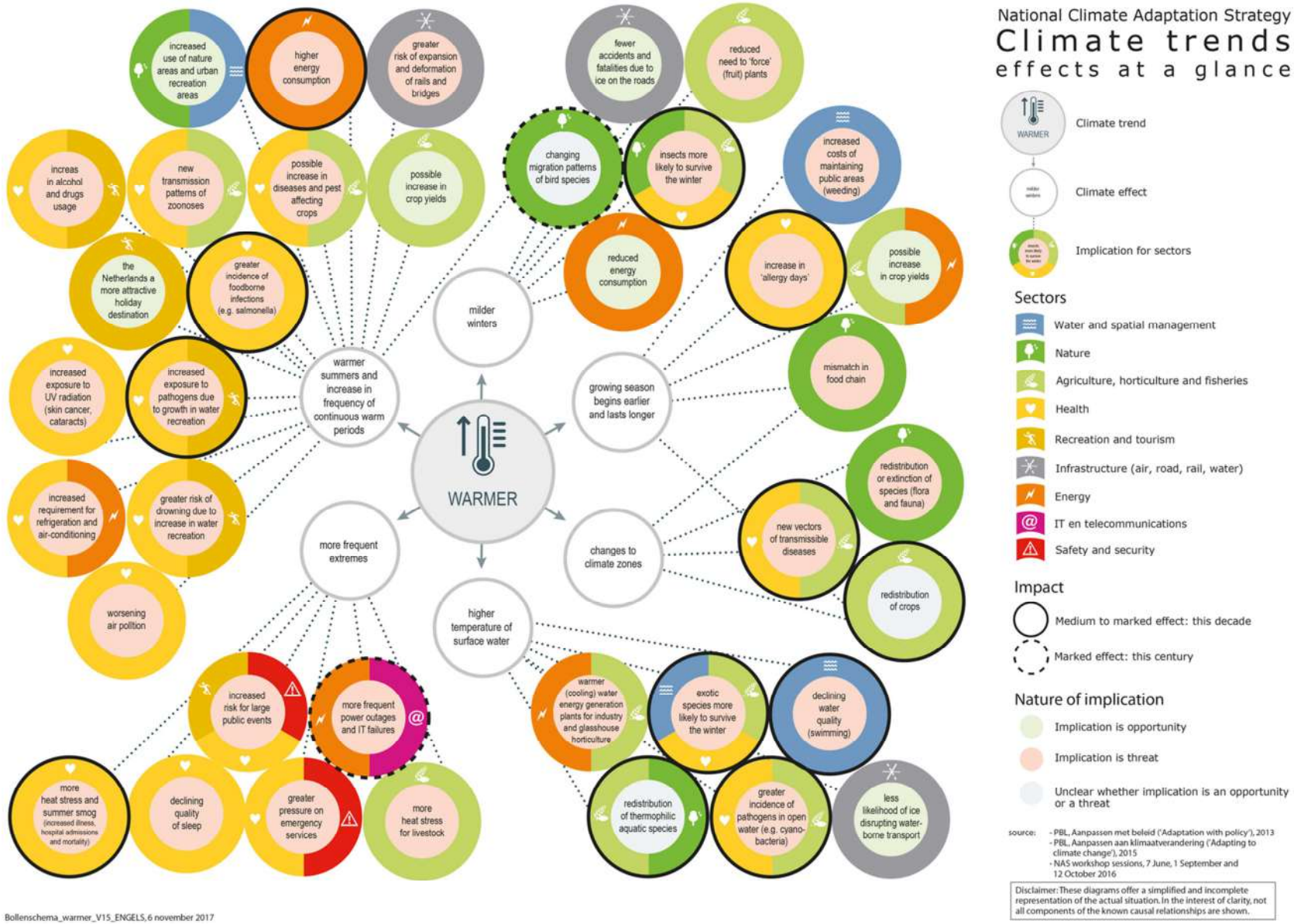


Figure 6.7a: Overview of climate trends in the Netherlands: Temperatures are rising (see annex 5 for diagram on A3 format)

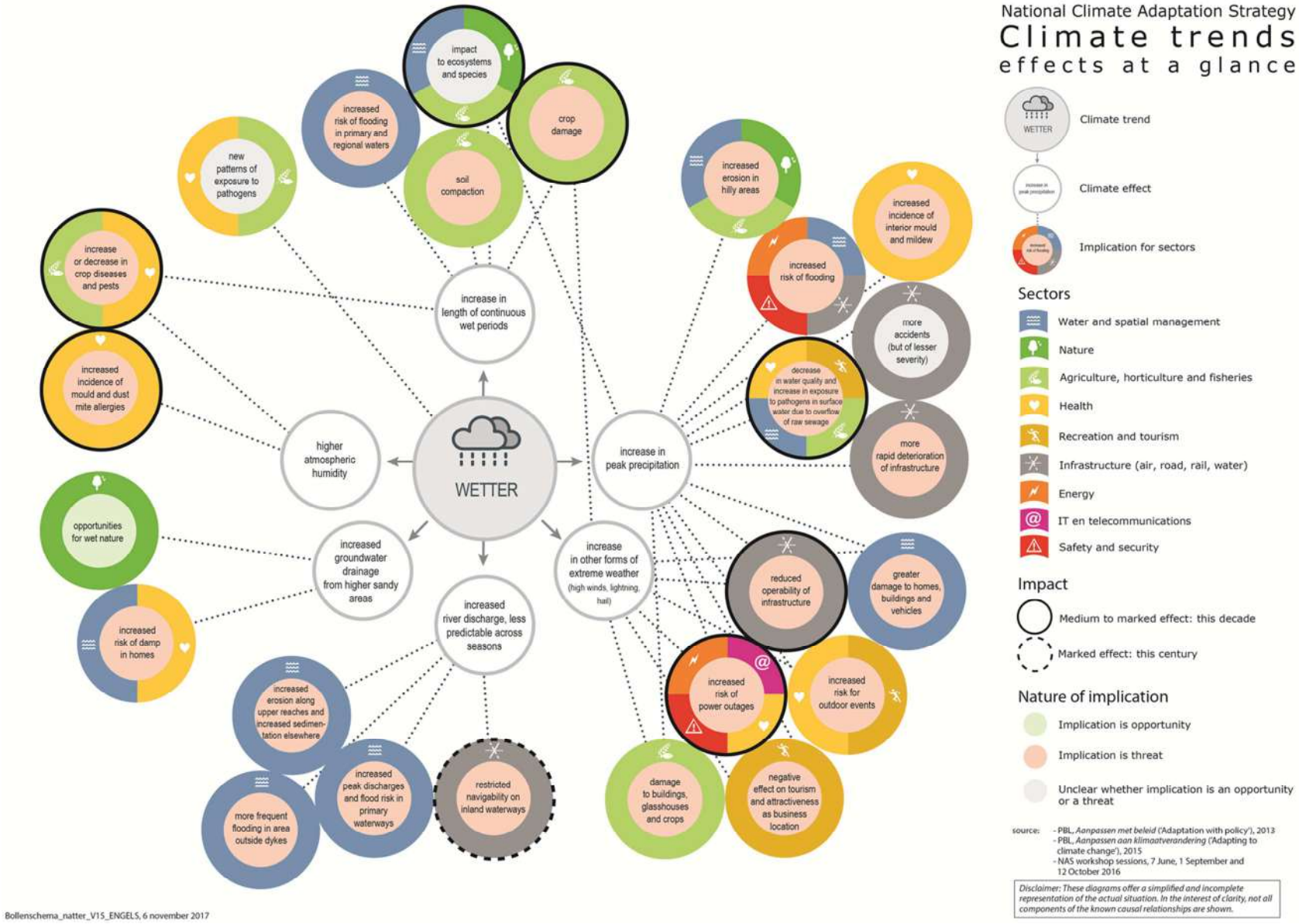


Figure 6.7b: Overview of climate trends in the Netherlands: precipitation is increasing (see annex 5 for diagram on A3 format)

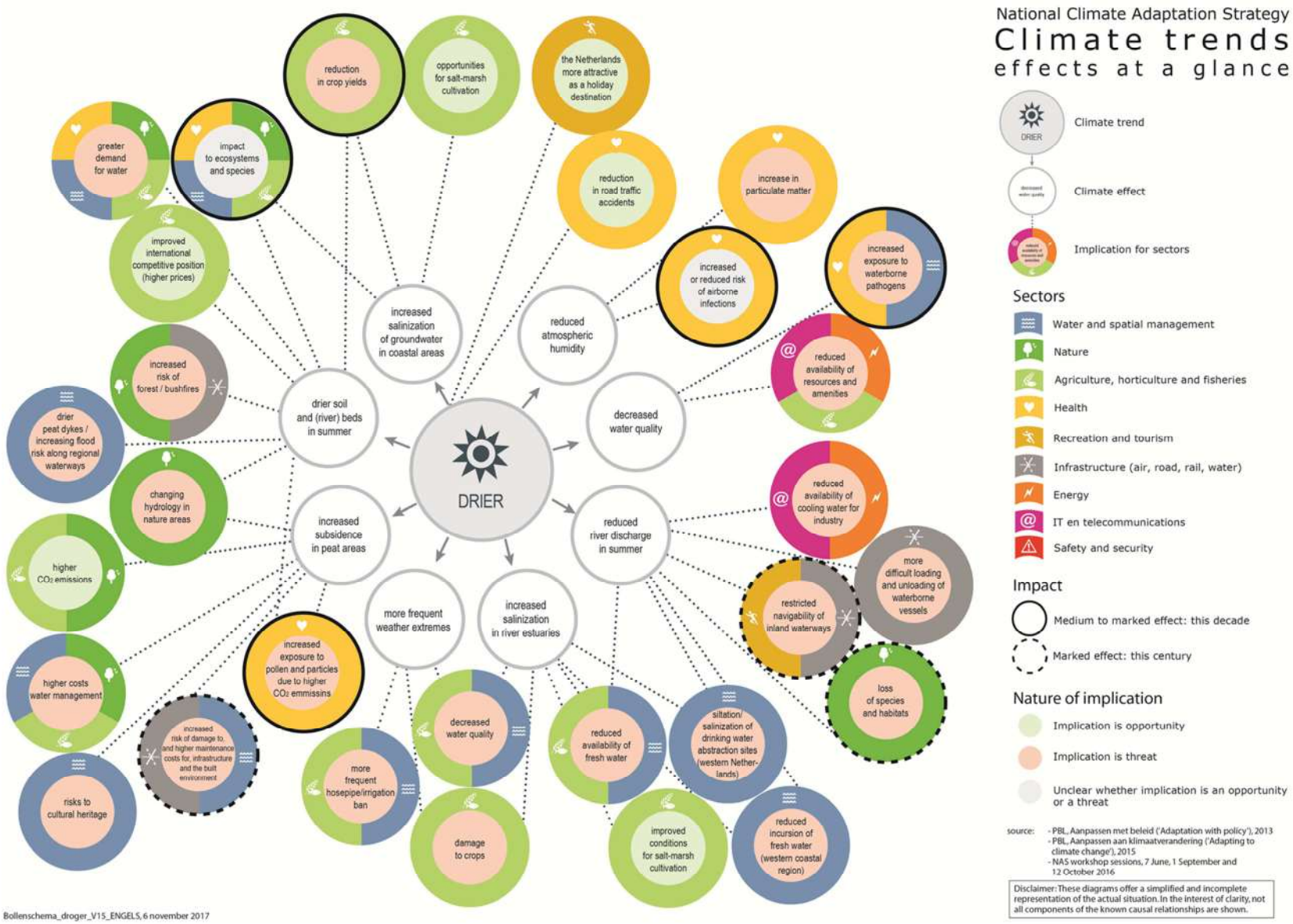


Figure 6.7c: Overview of climate trends in the Netherlands: periods of drought are increasing in summer (see annex 5 for diagram on A3 format)

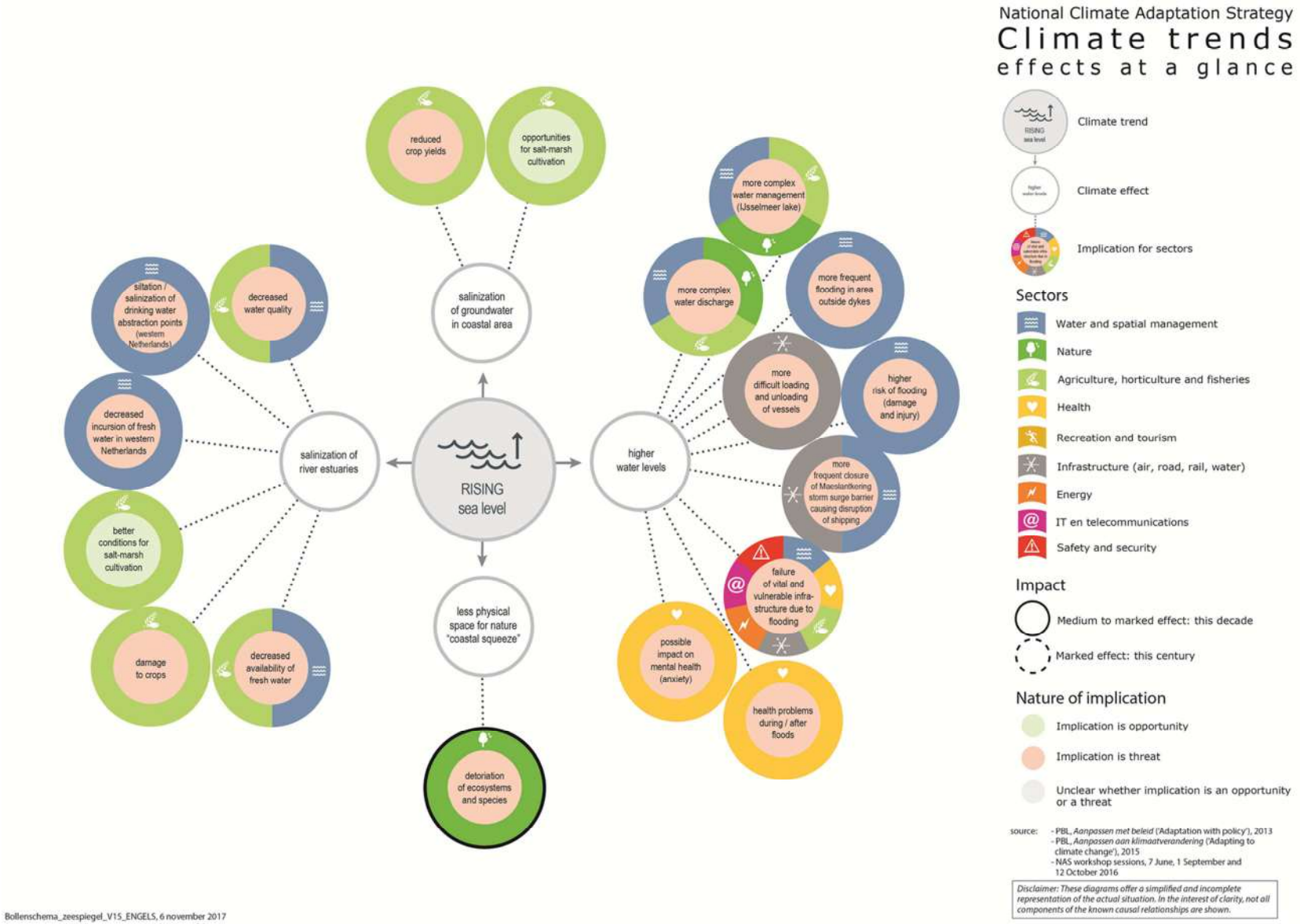


Figure 6.7d: Overview of climate trends in the Netherlands: the sea level is rising (see annex 5 for diagram on A3 format)

6.3 (C) Policies and measures

We start this section with the general outline of climate adaptation policy and implementation. In the following subsections, we elaborate on sector-specific policies and measures.

The most important milestones in policy and measures for climate adaptation have been described in the introduction to this chapter. To summarise, the first National Adaptation Strategy (NAS) was published in 2007. The Delta Programme (DP) started in 2010 and its preparation phase ended with the ratification of the Delta Decisions by the Dutch Government in 2014. In 2016, the second NAS was published.
The DP focuses on issues in the field of water and spatial adaptation. By contrast, the NAS has a wider approach to climate adaptation, focusing on sectors and systems other than water and spatial adaptation (see Box 6.1 for general information about the Delta Programme; see Box 6.3 for general information about the NAS).

Box 6.3. National Climate Adaptation Strategy

Policy

The Netherlands was one of the first countries to develop a National Adaptation Strategy in 2007. In 2016, the Netherlands finalised a new National Climate Adaptation Strategy. This second NAS introduces various new initiatives and intends to accelerate the progress of ongoing initiatives. It encompasses the national Delta Programme, in which all authorities work together on the adaptation to sea level rise, more intensive rainfall, increased peak discharges of rivers, droughts and heat, though it focuses on the issues not dealt with in the Delta Programme. The formulation of the National Climate Adaptation Strategy 2016 was guided by the integral climate policy agenda for mitigation and adaptation, "the Climate Agenda" (2014), and it is based on recent insights into climate risks and vulnerabilities as well as socioeconomic developments. The National Climate Adaptation Strategy 2016 has been presented to the House of Representatives. It also meets the European Commission's request for Member States to produce a climate adaptation strategy no later than 2017.

The National Climate Adaptation Strategy 2016 builds on the analysis elaborated in the previous section, highlighting the six climate effects which call for immediate action (see 6.2). Notwithstanding the importance to address these six climate effects, the NAS underlines that action is needed on a wide variety of climate effects.

The NAS ascertains that "climate-proofing" is a joint undertaking for which not only the government but every member of Dutch society is responsible. For this reason, the NAS intends to set out the course. The government will stimulate and initiate projects and programmes in order to:

1. increase awareness of the necessity of climate adaptation;
2. encourage the implementation of climate adaptation measures;
3. develop and exploit the knowledge base;
4. address the six climate effects which call for immediate action;
5. embed climate adaptation within policy and legislation;
6. monitor the progress and effectiveness of the adaptation strategy.

The NAS also ascertains that the urgency of climate adaptation will only increase in the years ahead. Since it is impossible to plan everything in advance due to many unknown factors, the practice of "learning by doing" will underpin the activities set out on account of the NAS.

Measures

The National Climate Adaptation Strategy 2016 is the precursor to a Climate Adaptation Implementation Programme which is being developed at the moment. Its goal is mainstreaming climate adaptation in all policies, in all policy implementation and in all relevant activities of civil society, citizens and companies. Projects already confirmed in the NAS are also included, such as a study to determine the current status of government buildings and sites, the organisation of a dialogue on the insurability of climate risks, and the production of a climate adaptation guide to accompany the Multi-Year Programme for Infrastructure, Spatial Planning and Transport (MIRT).

In order to implement the National Climate Adaptation Strategy 2016, topical dialogues on climate adaptation have been initiated for the most pressing issues. Stakeholders are gathered around these issues to discuss and analyse the relevant elements, to define the role and responsibility of each of the stakeholders, and to formulate an action plan in which each stakeholder assumes certain responsibilities.

Coordinating role

National and international coordination of climate adaptation lies with the Ministry of Infrastructure and the Environment[138]. The ministry also oversees the design of a monitoring system which is intended to enable the central government, regional and local authorities, water management authorities and other stakeholders to monitor the progress of the NAS implementation programme as well as their own contribution. The National

[138] In October 2017, a new cabinet was established. As a result, the ministry is now called the Ministry of Infrastructure and Water Management. The mandates for the climate adaptation issues remain with this Ministry.

Adaptation Strategy explicitly calls for broad participation of government departments, the business community and individual households. Figure 6.8 illustrates the approach taken in the National Climate Adaptation Strategy 2016 to climate-proof the Netherlands.

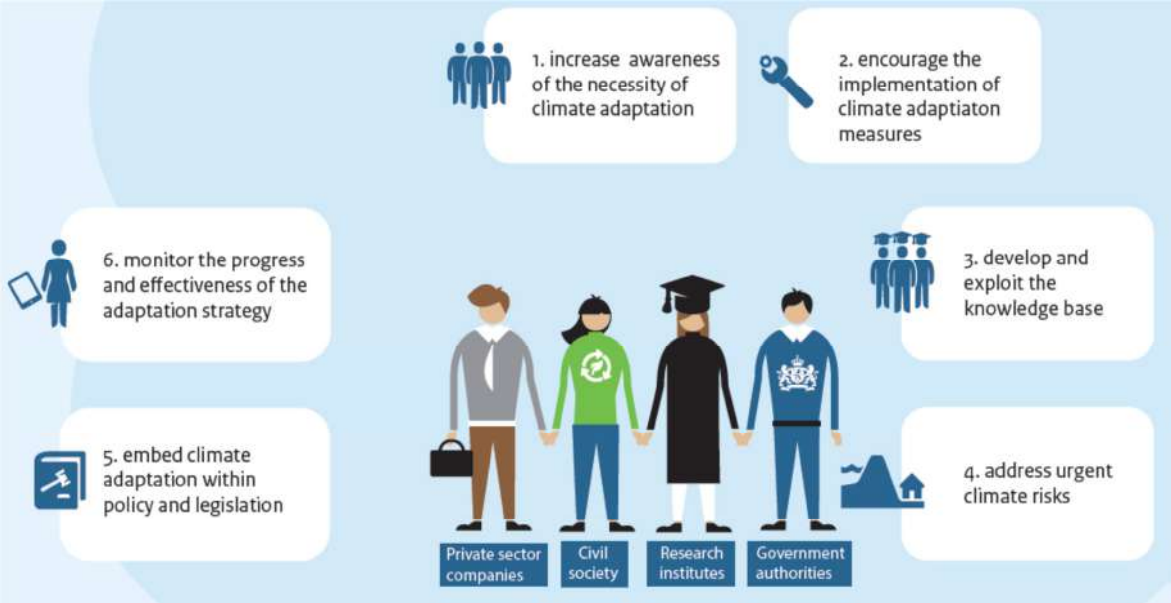


Figure 6.8: The approach of the National Adaptation Strategy to climate-proof the Netherlands

As mentioned in the second National Climate Adaptation Strategy (2016), it has been recognised that climate change adaptation is not only something for the central government, but that regional and local authorities, water management authorities and other stakeholders need to be involved as well. Taking up this challenge, the Association of Provinces of the Netherlands (IPO), the Association of Netherlands Municipalities (VNG) and the Association of Regional Water Authorities (UvW) published on march 10 2017 their "Investment Agenda Energy and Climate"[139]. This agenda contains goals and concrete objectives as well as actions with regard to climate adaptation.
The new cabinet intends to respond to this agenda with a national agreement or covenant on climate adaptation.

The following subsections summarise how the most affected policy sectors deal with climate adaptation, both in recent national policy plans and in implementation. Subsection 6.3.1 mainly falls within the scope of the Delta Programme, while the other subsections mainly fall within the scope of the NAS.

6.3.1 Water and spatial adaptation

In this subsection, we discuss the three components of the Delta Programme: water safety, freshwater supply and spatial climate adaptation. In Box 6.1, the general outline of the programme has been given. Complementary to the Delta Programme components, we discuss the international cooperation in preparing for adaptation.

[139] https://vng.nl/files/vng/20170310_investeringsagenda_voor_kabinetsformatie_2017_def.pdf

Water safety

Overall national policy outline
Climate change and adaptation measures are strongly integrated into the water policy agenda. Increasingly extreme river discharges and the rise in sea levels are addressed in the Delta Plan on Water Safety.

New standards in flood risk management
From 1 January 2017, the new standards for flood risk management have entered into force. These new standards are based on flood probabilities, whereas the old standards were based on probabilities of exceeding water levels. These new standards signify a major leap in flood risk management policy. New knowledge accompanies these new standards as well as new forms of organisation.

Dyke reinforcement continues to play an important part in keeping the Netherlands safe from flooding. The Third Safety Assessment (2014) of the existing primary flood defence system acknowledges the importance of the considerable effort devoted to compliance with old, statutory flood protection standards. The implementation of reinforcement projects has been reprioritised on the basis of the new standard. Some of these projects will also be re-evaluated through the new standard.

In addition to the reinforcement of dykes, other more integrated solutions are taken into consideration. An example is the Room for the River programme[140] (Ruimte voor de Rivier), where the river manager has cooperated closely with provinces and municipalities to find solutions not just for water safety but for multiple goals.

The Delta Programme has adopted a risk-based approach. Not only the probability of flooding but also the consequences of flooding, such as fatalities, damage and disruption, are included in this approach. A tolerable individual risk level (i.e. a basic safety level for the individual loss of life due to flooding) of 1/100,000 or 10^{-5} per year is set for everyone living or working in an area that is protected by dykes, dunes or dams (2013)[141]. This risk-based approach results in differentiated levels of protection as an economically efficient method to reduce the risk. A risk-based approach also recognises opportunities offered by so-called multi-layered safety. In accordance with the European Flood Directive, the Delta Programme from 2013 onwards propagates a three-layer safety model:

1. The first level of safety is protection against flooding (dykes, dunes, barriers and dams), minimising the probability of a flood. This measure is and remains the basis of our safety during high water.
2. Spatial planning is the second layer of multi-layered safety and can limit the effects of flooding in the areas behind the dykes, thus contributing to water safety. A good spatial structure will provide physical protection of vital or vulnerable functions, which is an important component of the Delta Programme for Spatial Adaptation.
3. The third layer is emergency management. Adequate crisis management will limit the impact of a flood in terms of casualties and fatalities. This responsibility has been assigned to the Water Crisis and Flood Management Task Force (*Stuurgroep Management Watercrises en Overstromingen*), which includes representatives of all relevant parties, including ministries, water authorities, regional disaster management authorities and highway authorities. The Ministry of Justice and Security and the Security Council are working alongside partners in the water sector on the "Water and Evacuation" project. This project recently produced guidelines for the regional disaster management authorities on the ways to integrate water safety into their practices and procedures.

[140] https://www.ruimtevoorderivier.nl/english/
[141] Delta Commissioner 2013. Delta Programme 2014. Working on the Delta. Promising solutions for tasking and ambitions. https://english.deltacommissaris.nl/binaries/delta-commissioner/documents/publications/2013/09/17/delta-programme-2014/Delta+Programme+2014_English_tcm310-345435.pdf.

Adaptation measures

Over the past decades, enormous investments have been made to improve the water safety of the Netherlands.

- Coastal zone*:* through "The coast is growing", the Netherlands has opted for sand replenishment as the key solution for coastal defence. It enables the coastal foundation zone to grow concurrently with the rise in sea level. Where possible, this process occurs by distributing and transferring sand naturally along the coast (see Box 6.4). In addition, the cabinet is opting for a cohesive approach to spatial development of the coastal zone which allows for a balanced development of nature, economy and accessibility in the existing coastal areas.

Box 6.4. Sand Engine (Building with Nature)

Between Ter Heijde and Kijkduin along the western coast, 21.5 million cubic meters of sand have been deposited as a kind of sandy reservoir spanning 128 hectares. The width of the beach is about 2 kilometres. This artificial peninsula extends approximately one kilometre into the sea. Wind, waves and currents are to spread the sand. In this way, the coast grows naturally, making it safer and creating new nature. In addition, it is no longer required to bring sand on the shore every five years, which saves costs and is less disruptive to the beaches and the coastal ecosystem. It is expected that the Sand Engine will have produced 35 acres of new beach and dune in 10 to 20 years. The public can walk on the Sand Engine within safety restrictions and the natural developments are closely monitored. After a few months, for example, it had already become clear that the location of the Sand Engine was growing more rapidly in the direction of the coast than expected. Wind and currents started to change the Sand Engine as soon as it was created. The alterations in its shape have largely matched expectations so far. The Sand Engine has been eroded on the western side, with the sand being deposited to the north and south. As a whole, it has become narrower and longer. On the basis of the initial observations, the researchers involved have noticed that more habitats have been created for flora and fauna as a result of the arrival of the Sand Engine. The Sand Engine has proven appealing for a range of outdoor activities, especially kite surfing. Signs have been placed at the entrances to the beach that provide visitors with information about the tides around the Sand Engine and how they can navigate them to avoid being cut off from the beach at high tide.

Even as the Sand Engine is taking shape, it is generating considerable foreign interest. Study requests have come in from the south of Sweden, Peru, South Africa, Vietnam, the United States, Indonesia and the United Kingdom.

- rivers: within the Flood Protection Programme (Hoogwaterbeschermingsprogramma) as well as the programmes for river widening under the Room for the River (Ruimte voor de Rivier) and the Meuse projects (Maaswerken), over 30 projects have been completed along the major rivers. Since 2015, the Rhine is able to handle a peak discharge level of 16,000 m^3/s and the Meuse a discharge level of 3,800 m^3/s. Where possible and cost-effective, measures are already being implemented to enable discharges of 18,000 m^3/s by the Rhine and 4,600 m^3/s by the Meuse. To anticipate these higher discharges, reservation zones for future flood protection or peak storage have been designated.

Regional Water Authorities contribute on a structural basis to the current Flood Protection Programme. As part of an Administrative Agreement on Water Affairs (concluded on 23 May 2011), regional Water Authorities became co-financers of the investments needed to improve the primary flood defence systems which are operated and maintained by these authorities, since they fall within their jurisdiction. The co-financing is equally distributed between the water authorities and the Delta Fund. This agreement also mentions the need to cooperate in water management issues so as to increase effectivity.

Freshwater supply

Overall national policy outline
The Delta Decision on Freshwater Supply[142] and the associated Delta Plan on Freshwater Supply[143] are fostering a sufficient freshwater supply in the Netherlands now and in future, an attractive living environment and a strong economic position. All over the Netherlands, measures aimed at the efficient use, retention, storage and supply of fresh water are in progress[144].

Adaptation measures
The innovative approach in this domain is the so-called Smart Water Management, which aims at efficient operational water management by using IT and reaching across water management boundaries. New applications to this end, such as information screens, have proven their value in recent calamities. Tools to effect a cultural change, such as serious games, also prove effective. The use of a risk-based approach to freshwater availability in operational water management looks promising. Freshwater supply measures are increasingly linked to spatial adaptation measures, especially the ones involving drought issues.
The measures set out in the Delta Plan on Freshwater Supply are being implemented according to schedule. For some measures, an integrated approach has been adopted.

To improve the water quality in the Netherlands, responsible parties such as the national government, regional water authorities and other interested parties cooperate in the Delta Approach. Recently, this cooperation resulted in the Delta Approach Water Quality and Fresh Water, which intends to improve the water quality and to avoid water quality problems in future.

Spatial climate adaptation

Overall national policy outline
The Delta Plan on Spatial Adaptation, launched in 2017, has been mentioned before. It focuses on spatial adaptation to more intense rainfall, drought and heat, as well as on measures to reduce the impact of flooding through spatial planning should a flood occur. The realisation of a water-resilient and climate-proof design will be achieved by working on seven ambitions (Figure 6.9):
1. mapping out vulnerabilities;
2. conducting a risk dialogue and drawing up a strategy;
3. drawing up an implementation agenda;
4. capitalising on opportunities for linkage;
5. encouraging and facilitating;

[142] https://english.deltacommissaris.nl/delta-programme/delta-decisions/freshwater-strategy-delta-decision
[143] https://deltaprogramma2018.deltacommissaris.nl/viewer/chapter/1/2-delta-programme-/chapter/1-delta-plan-on-freshwater-supply
[144] https://english.deltacommissaris.nl/delta-programme/documents/publications/2017/09/19/dp2018-en-printversie

6. regulating and embedding;
7. responding to calamities.

Figure 6.9: The seven ambitions for water-resilient and climate-proof spatial planning (Delta Plan on Spatial Adaptation 2018)

Regional policy outline
In urban areas, municipal authorities and regional water authorities are jointly responsible for reducing the risk of pluvial flooding. The https://www.government.nl/topics/water-management/administrative-agreement-on-water-affairs" flooding as a result of heavy precipitation. Government authorities decide how they address water challenges. So-called Water Plans are developed at different scales and with different legal status; for example, a Water Plan at the level of municipalities, a Municipal Sewerage Plan (including rainwater collection), a Provincial Water Plan, a Water Management Plan of the Water Authorities and a country-wide National Water Plan. These different water plans together offer opportunities for water-inclusive planning.

Measures coordinated by the Delta Programme
Concrete projects for climate change adaptation presently focus on mainstreaming and "no regret" options. Implementation is often realised by regional and local authorities, especially where spatial developments are concerned. Coalitions of the willing for regional and local initiatives are on the increase (for example, see Box 6.5). The most important results continue be the Climate Agreements between the national government, the Association of Provinces of the Netherlands (IPO) and the Association of Netherlands Municipalities (VNG); the development and use of the National Climate Portal[145]; the *Climate Impact Atlas*; the execution of a climate stress test by municipalities before 2020, to which authorities have agreed; and national and international cooperation between the business community and the international Delta Alliance (2013).

[145] http://ruimtelijkeadaptatie.nl/english/

A number of municipalities have started to develop adaptation policies and even released local adaptation strategies; for example, the cities of Rotterdam (with its Rotterdam climate initiative) and Amsterdam (Amsterdam Rainproof). Many more examples exist, as can be seen on the map showing examples of climate adaptation measures which is available on the portal mentioned above. Several studies advise on the embedding of adaptive capacity in planning instruments such as the strategic socio-environmental assessment (planMER), Cost-Benefit Assessment, Water Assessment (in Dutch: Watertoets) and Building Act (in Dutch: Bouwbesluit).

Box 6.5. Adaptation to climate change in the city of Amsterdam – Amsterdam Rainproof makes the most of rainwater

Amsterdam Rainproof is a partnership which aims to reduce the negative impact of the increasingly frequent heavy rainfall in the city. Rainwater represents a free resource. Rather than allowing it to simply run off into the drainage system, Amsterdam Rainproof wants to put it to good use.
In some places, the drainage system is simply not up to the task. Within the urban environment, much of the surface area is covered by buildings, asphalt or concrete where water accumulates and can cause significant damage. Amsterdam Rainproof collates information, initiatives and ideas. Everyone can help to achieve its aims. While installing a water butt in the garden may not seem to make much of a difference, the "rainproofing" of Amsterdam will be the combined result of all efforts large and small. Every drop counts! The project involves close cooperation between various partners, from water management authorities and research institutes to small companies and individual households.
https://amsterdamsmartcity.com/projects/amsterdam-rainproof | https://www.rainproof.nl/

Regional and local measures
Provinces and Regional Water Authorities are implementing adaptation measures in the regional water system. Most of the measures consist of creating "space for water" in order to store precipitation water. In many cases, the parties involved prefer integrated solutions, combining water issues with other space-consuming issues (housing, leisure, biodiversity, farming, and so on) in order to create more value for society as a whole (see also Section 6.3.2).

The Association of Netherlands Municipalities (VNG) is monitoring its members' response to increasingly severe and protracted rainfall. Approximately one third of the investments in water management tasks at this level are intended to improve rainwater drainage. Measures focus on separating the precipitation run-off from sewage water. They include increased infiltration of precipitation, retaining groundwater at levels beneficial to the ecosystem and increased capacity to remove excess water. Municipalities are required to compensate for lost infiltration capacity. Large projects are subjected to a water assessment process.

International cooperation in preparing for adaptation

In addition to the cooperative actions at the national and regional levels, the Netherlands actively cooperates with other countries in low-lying delta areas that also face a challenging climate adaptation. The aim is to learn from each other, to help others protect themselves against floods and to help them ensure sufficient amounts of clean water. In doing so, the Netherlands enters into long-term cooperation agreements. These partnerships will be based on the existing Partners for Water (Partners voor Water) programme. Box 6.6 gives an example. Chapter 7 provides more extensive information on the Dutch support for climate action in developing countries.

Giving adaptation to climate change a more prominent place in foreign policy will also create international opportunities for the Netherlands; for example, in the fields of international stability, agriculture, and urban planning and development. The Netherlands is world-renowned for its experience and expertise in the field of water management. From New York to Vietnam, Dutch companies, academics and public officials are asked for advice. The growing demand for knowledge and experience on the subject of climate adaptation provides opportunities for Dutch expertise as an export product.

Box 6.6. The Banger Polder pilot in Semarang, Indonesia

The Banger Polder project in Semarang originates from the long-term cooperation between Indonesia and the Netherlands in the field of water management, laid down in an agreement between two Indonesian and two Dutch ministries. The project's aim is to stop the flooding caused by soil subsidence, major cause among other things, like climate change. Soil subsidence has lead to increasing severity of the daily sea intrusion and severe limitations on the drainage capacity of low-lying urban territories.

The poor district around the Banger drainage canal in Semarang on Central Java, Indonesia was selected to test the Dutch polder system as a solution to stop the flooding from the Java Sea as well as the flooding during heavy rainfall. The project started in 2006 and comprises two components: 1. the design and construction of polder facilities such as polder dykes, a pumping station, retention basins and dams in the drainage canal, and 2. the implementation and training by the Dutch Regional Water Authority Hoogheemraadschap van Schieland en de Krimpenerwaard (HHSK) of an organisation to operate and maintain the polder facilities.

In October 2016, the polder facilities were – in part provisionally – realised and operationalised. Since that time, the Community-Based Organisation SIMA was activated, previously founded to shape public involvement and responsibility in the water management of the district. The main objective of this CBO is to be an intermediate between the inhabitants and businesses of the district on the one hand and the municipality on the other hand, which operates and maintains the polder facilities. SIMA will also collect water retribution, which will cover approximately 50 per cent of the daily cost for the water management in the district. The retribution adds up to about one to one-and-a-half euro per person per year.

Since the pumping station has been in operation after the completion of the polder dykes, the daily flooding from the Java Sea has stopped and the neighbourhood has grown in prosperity. The project formally terminates at the end of 2017, but the friendly relations between the Dutch Regional Water Authority HHSK, the CBO SIMA and the municipality of Semarang will continue.

Banger Pumping Station in action

No more flooding from Banger drainage canal

6.3.2 Implications for nature

Overall national policy outline
Climate change is likely to have a considerable impact on the realisation of the current conservation goals for biodiversity. This development requires a reassessment of aspects such as the foreseen extension and localisation of the Dutch National Ecological Network (now called "Nature Network Netherlands") to meet climate change challenges. Solutions will often have a strong spatial impact on the already intensively used Dutch landscape.

Examples of innovative strategies in this domain are the following broad types of adaptation:
- assessment of nature policy and biodiversity conservation goals in response to climate change (2013)[146];
- scenarios for nature-inclusive agriculture and a new "collective" approach to agro-environmental schemes;
- integration of nature objectives in water management and infrastructure.

The resilience of the natural environment throughout these innovations is expected to increase by creating larger interconnected nature areas and corridors, as well as a sufficient variety of favourable environmental conditions (High-Low Netherlands, green infrastructure, wet-dry and fresh-salt gradients, and so on). Increasing the adaptive capacity of nature calls for a fuller use of the possibilities within the existing framework of nature and biodiversity legislation and policy, with a view to a more development-oriented policy focused on natural dynamics. This policy should still respect global agreements on the protection and sustainable use of biodiversity as agreed in the Convention on Biological Diversity and the Sustainable Developments Goals. An important instrument in this respect is the creation of the "Nature Network Netherlands" under the responsibility of the provinces.

Provincial policy outline
In 2012, many nature management tasks were devolved to the provincial level, with the existing budgetary reserves transferred to the Provinces Fund. The provincial authorities are now responsible for the management of existing nature areas as well as the realisation of the ecological network, for which 80,000 hectares are to be acquired. Within the physical domain, the central government has limited its own responsibility to the large bodies of water and to certain aspects of agricultural nature management, the latter being undertaken in association with the provinces.

Adaptation measures
In 1990, the government introduced the National Ecological Network, a concept intended to offset the impact of climate change by allowing more space for natural processes. It was hoped that the proposed infrastructure of interconnected nature areas would encourage vulnerable species to migrate; a form of "managed relocation". This principle has been retained and now forms the basis of the policy document "Natuurlijk verder" ("The Natural Way Forward"; Ministry of Economic Affairs, 2014).

The climate buffer programme[147] was initiated in 2006 by collaborating nature organisations, later united in the Climate Buffer Coalition (CNK) in response to the consequences of climate change. Climate buffers are nature-based solutions that serve to reduce the risk of flooding and the effects of prolonged

[146] MinEZ 2013. Natuurambitie Grote Wateren 2050 en verder (*Ambition for nature in large water bodies 2050 and beyond*). https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/publicaties/2013/10/31/beleidsverkenning-natuurambitie-grote-wateren-2050-2010/natuurambitie-grote-wateren-2050-en-verder-dec-2014.pdf.
[147] www.klimaatbuffers.nl

drought, while creating positive effects for living and housing, the landscape, cultural heritage and recreation. These climate buffers contribute to the climate-proofing of the Netherlands.
This initiative found a ready ear in politics. The Dutch House of Representative awarded it a subsidy amounting to € 15 million, which was meant to build climate buffers as an example for climate adaptation. Nature organisations were to be responsible for the implementation of the projects. The government included the provision in the subsidy conditions that attention must be paid to public support and the dissemination of results.
These climate buffer projects were used as best practices by the Delta Programme, which in turn led to further knowledge development and publicity.
The Climate Buffer programme ran until 2014, but a large part of the projects were completed later. These projects are permanent sources of inspiration. In 2017, a restart was made when the CNK received subsidies from the EU (LIFE IP Delta Programme) in order to link nature development and management to future water management and water safety plans.
Altogether, 20 climate buffers were built up to 2014. They were designed in four different types:

- In the river landscape, the deepening of the floodplains (for example, with beds parallel to the main river bed) reduces the occurrence of high water and the risk of flooding and dyke breaches. Climate buffers of this type have been realised in Onlanden, Ooijen Wanssum, Regge, IJsselpoort, Weert and Kemperbroek, for example.
- In the dune areas, broadening makes them more resilient and improves their protection capacity against floods, so artificial breaches can be allowed in order to develop high-quality ecological habitats. One example of such a climate buffer is Voorne-Putten.
- In the tidal landscape of the Wadden Sea and Zeeland, the growth of flats, meadows, silts and salt marshes can be promoted as a way to keep pace with the sea level rise and the land subsidence. One of the projects involved the reintroduction of sea grass.
- In the peat grassland areas, raising groundwater levels will slow down the subsidence process.

Fig 6.10 : Climate buffers in the Netherlands

6.3.3 Agriculture, horticulture and fisheries

Overall national policy outline
Dutch agriculture is likely to benefit from climate change more than agriculture in countries farther to the south or east. Higher temperatures may allow for the introduction of new crops. If the effects of climate change elsewhere in Europe prove less propitious, the Netherlands will gain a competitive advantage. The increased frequency and intensity of weather extremes will nevertheless result in greater damage to crops and production resources.

Examples of innovative strategies in this domain are the following broad types of adaptation:
- innovation at the level of whole areas (vital countryside) by capitalising on the large coupled transitions in energy, water and land use[148];
- renewal of agriculture and horticulture in view of the globally increasing salinity of delta areas as well as innovations at the production level (2012)[149].

Adaptation measures
The Ministry of Agriculture, Nature and Food Security indicates that most adaptation measures need to be implemented at the farm level, although a higher level of planning is required for some. For example, farmers can adapt to high-intensity rainfall by improving drainage, but the impact on crop yields also depends on regional water management. In 2016, high-intensity rainfall caused crop failure on many potato fields in South Brabant. The ministry indicates that measures at the sector level are also required, specifically for the development of heat-resistant or pest- and disease-resistant varieties.

6.3.4 Health and welfare

Overall national policy outline
The Ministry of Health, Welfare and Sport is mindful of the possible effects of climate change, which it addresses within its regular policy. In 2007, a National Heat Plan[150] was prepared as a preventive measure in a cooperative project between the Ministry of Health, RIVM, the Dutch Red Cross, ActiZ and the Regional Health Services GGD (VWS 2007). This plan was updated in 2015. It now offers a range of specific measures that can be taken locally by institutions and care providers to ensure that they are ready and act appropriately in periods of sustained heat. The National Heat Plan focuses on the residential care sector and the action to be taken when a formal heat wave warning is issued. In addition, the Delta Decision on Spatial Adaptation asks local authorities to pay attention to heat stress[151]. The *Climate Impact Atlas* has recently been updated. It disseminates knowledge and best practices.

[148] http://www.klimaatlandschappen.nl
[149] Province of South Holland 2012. Glastuinbouw en klimaatverandering (*Greenhouses and climate change*). http://www.veenweidegebieden-oras.nl/Upload/Glastuinbouw%20en%20klimaatverandering.pdf.
[150] http://www.rivm.nl/en/Documents_and_publications/Common_and_Present/Newsmessages/2015/ National_Heat_Plan_active
[151] https://english.deltacommissaris.nl/delta-programme/regions-and-generic-topics/spatial-adaptation

Fig 6.11 Example of communicating what to do during heat waves

Monitoring of vectors and vector-borne diseases is undertaken by the National Institute for Public Health and the Environment (RIVM) as well as the Netherlands Food and Consumer Product Safety Authority (NVWA). Government policy seeks to prevent the establishment of exotic (i.e. non-indigenous) mosquito populations in the Netherlands and the diseases that they carry (e.g. West Nile Virus). If monitoring reveals the presence of exotic mosquitoes, they will be exterminated. Policy on indigenous mosquitoes (and other culcidae) is currently being prepared. In addition, environmentally related diseases – especially ones associated with exposure to water of poor quality – are under surveillance.

Adaptation measures

Municipal health departments provide various forms of support to prevent climate-related infectious diseases and exposure to allergens. They are responsible for monitoring risks in and around open water that is used for recreational purposes (in association with the water management authorities) as well as for public information about these risks. In addition, they are responsible for pest control and arrange for the extermination of rats or other vermin, among other things. For example, they also respond to outbreaks of the oak processionary (*Thaumetopoea processionea*), whose caterpillars provoke an extreme allergic skin reaction. The municipal health departments also provide advice on other allergens, including pollen,

spores and mites, to members of the public as well as to the departments responsible for parks and recreation.
As part of the *Knowledge for Climate* Research Programme, a number of provincial and municipal authorities have studied the "urban heat island" effect. Measures entail extensive modifications to physical structures. In addition, heat stress may be controlled with proper and timely information or extra care to vulnerable groups.

6.3.5 Recreation and tourism

Overall national policy outline
The general policy is to make the Netherlands more attractive for tourists, give more room to entrepreneurship and aim for sustainability[152]. The Dutch weather might become more attractive – or less uncomfortable – than that elsewhere in Europe, which could have a positive effect on tourism. An attractive environment that invites outdoor recreational activity has a positive health effect. However, recreation also increases the change of exposure to pathogens and vectors (such as ticks and Lyme disease or cyanobacteria, also known as blue-green algae).

Adaptation measures
No specific adaptation measures for recreation and tourism are formulated.

6.3.6 Infrastructure (road, rail, water and aviation)

Overall national policy outline
The Delta Programme addresses the question of how to develop and maintain vital infrastructure in view of its resilience to climate change and extreme weather. The Delta Decision on Spatial Adaptation asks local authorities to pay attention to heat stress as part of the stress test to be performed by the municipalities. The *Climate Impact Atlas* has been updated accordingly and a National Climate Portal has been built to disseminate both knowledge and best practices. The most recent monitoring results suggest that the topic has so far been given little attention by municipalities, provincial authorities or water authorities.
Adaptation measures
Adaptation measures include both spatial and non-spatial measures. Spatial measures address adaptations through urban planning, renewal and restructuring. Non-spatial measures include technical measures (such as more extensive surveillance), early identification and assessment of health risks, more targeted public information, cultural and behavioural adaptation, regulatory changes, and making climate resilience an integral part of national and local environmental and planning policies.

The climate-proofing of the urban area against flooding is improved by local measures (drainage, green roofs and water squares) or by spatial measures such as the construction of new open water (ditches, canals and ponds). An example of adaptation to changing weather patterns is the update of the design guidelines for infrastructure in order to account for the changing characteristics of rainfall. Rijkswaterstaat (the Directorate-General for Public Works and Water Management) examines whether it is necessary to update and amend the guidelines for road design. The procedures for replacing essential water management structures such as locks and dams, as well as the plans for new infrastructure, take into account the risks imposed by climate change. ProRail, which manages the national rail infrastructure, has implemented measures to deal with risks during calamities that are associated with flooding and extreme weather. For the design of new infrastructure, climate change is taken into account.

[152] https://www.rijksoverheid.nl/onderwerpen/toerisme-en-recreatie/toerismebeleid-versterking-toeristische-sector

6.3.7 Energy, IT and telecommunications

Overall national policy outline
The definition of "vital" or "critical" infrastructure has been expanded to include the supply systems for energy, IT, telecommunications and drinking water, in addition to the infrastructure mentioned in the previous section[153,154]. Risks of climate change, and possible approaches or measures to mitigate those risks, are one component of the "all-hazard" safety and security approach which seeks to identify and manage all risks to the vital infrastructure in the Netherlands.

Adaptation measures
In a number of pilot projects, government authorities at all levels are working alongside private-sector companies and network managers to devise ways in which to climate-proof vital functions. Several grid managers have conducted research to determine the potential impact of climate change such as flooding on their section of the infrastructure, the objective being to identify measures intended to reduce risks. An important question being addressed is to what extent measures are necessary in order to ensure the required levels of performance. Research has also examined how a large-scale power outage would affect the chain of vital functions. The participation of the grid managers in the pilot projects has provided valuable experience and created a good basis for further cooperation.

Box 6.7. Climate adaptation in practice – *Five cities in the province of North Brabant sign a "Health Deal"*

A human environment which is both healthy and economically vital: this aim is shared by the fifteen organisations which signed the "Brabant Health Deal" partnership agreement in July 2016. With the agreement, all future economic and spatial decisions will take health and welfare into account. Climate adaptation is an integral component of the Brabant Health Deal.

The programme partners include the province of North Brabant, the five largest cities in the region, water management authorities, municipal health departments, the National Institute for Public Health and the Environment, Utrecht University, and the University of Tilburg and its Centre for Sustainable Development, Telos.

[153] http://ruimtelijkeadaptatie.nl/english/nas/
[154] Kennis voor Klimaat (Knowledge for Climate) 2014. Infrastructuur en netwerken. Klimaat en vitale infrastructuur (Infrastructure and networks. Climate and vital infrastructure). Programmabureau Kennis voor Klimaat/Consortium Infrastructuur en netwerken. http://edepot.wur.nl/315803.

7 FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

7.1 Introduction

Dutch support for climate action in developing countries is an integral part of its development cooperation and is financed from its budget for foreign trade and development cooperation. *A World to Gain: A New Agenda for Aid, Trade and Investment* (Dutch Ministry of Foreign Affairs, 2013) sets out the agenda of the Netherlands for aid and trade. Dutch development policy is based on four thematic priorities: security and legal order, food security, water, and sexual and reproductive health and rights. Climate change, gender and private-sector development are cross-cutting themes. The thematic focus (as opposed to the geographical focus or the implementation channel) has become the primary guiding principle. Thematic programmes that are centrally managed from The Hague dominate the bilateral allocation of the thematic funds and reach a broad group of developing countries. However, we also continue to work with our 15 partner countries, where the priority themes are supported by significant bilateral programmes as managed by the embassies. The 15 partner countries are Afghanistan, Bangladesh, Benin, Burundi, Ethiopia, Ghana, Indonesia, Kenya, Mali, Mozambique, the Palestinian Territories, Rwanda, South Sudan, Uganda and Yemen. Multilateral organisations continue to receive support, as they are key in forging international agreement on global challenges such as climate change while they also have advantages including scale, potential for coordination and political leverage. In line with the deliberate choice for theme-driven aid delivery, Dutch multilateral support is now primarily channeled to organisations that contribute to the priorities and cross-cutting themes. In addition, the Netherlands supports multilateral organisations with a systemic role in international cooperation, such as the World Bank, UNDP and UNICEF.

As climate change is a cross-cutting theme in Dutch development policy, there is a strong focus on integrating climate change adaptation and mitigation in relevant development programmes, as well as a budget that supports climate-specific programmes. With the budget for climate-specific programmes, we mainly support multilateral climate funds, programmes that focus on providing access to renewable energy and halting deforestation, and programmes that aim to mobilise private climate finance. Mainstreaming of climate action mostly takes place in the programmes for water and food security, but – where relevant – also in other fields such as private-sector development programmes and our partnerships with NGOs.

To support mitigation, we focus on providing access to renewable energy and on halting deforestation; to support adaptation, we focus on climate-smart agriculture, integrated water resource management and the provision of climate-resilient WASH services. Disaster risk reduction is an integral part of our programmes for integrated water resource management, while it also receives support through Partners for Resilience. Gender is an important cross-cutting theme, as climate action is most effective when it builds on the capacities of both genders and addresses the needs as well as the vulnerabilities of both.

7.2 (A) Provision of financial resources

7.2.1 Summary information on the provision of financial resources

Committed to scaling up its support for mitigation and adaptation activities in developing countries, the Netherlands has realised a year-on-year increase in climate finance after having delivered on its commitment of Fast-Start Finance during 2010–2012. While public climate finance amounted to € 286 million in 2013, it reached € 395 million in 2014, € 420 million in 2015 and € 472 million in 2016. Over the period 2013–2016, adaptation expenditures amounted to 28 per cent of Dutch public climate finance

and mitigation expenditures to 14 per cent. Most public climate finance supported cross-cutting activities (58 per cent), mainly due to substantial contributions through multilateral organisations, in particular multilateral development banks. Detailed information is provided in Tables 7.4a, 7.4b and 7.5 at the end of this chapter.
In 2015, the Netherlands started to track private climate finance mobilised by public finance according to the "Joint Statement on Tracking Progress Towards the $100 Billion Goal", which major donors adopted in 2015. Based on this Joint Statement, the Netherlands can now report that it mobilised in total € 73 million of private climate finance in 2015 and € 171 million in 2016. Detailed information is provided in Section 7.2.8. As data and methodological limitations are still a serious constraint, the reported amounts should be considered as best estimates.

7.2.2 New and additional financial support

As reported in the previous National Communication and the Second Biennial Report, the Netherlands delivered on its commitment of Fast-Start Finance during 2010–2012. In the period since Fast-Start Finance, we have chosen a more flexible approach in line with our pledge to contribute a fair share to the costs of mitigation and adaptation to climate change in developing countries. Over the years, we have also actively engaged with private funds, as presented in Section 7.2.8.
The financial resources over the period 2013–2016 as reported in this National Communication are considered to be "new and additional" to the financial resources reported over the years 2009–2012 in the previous national communication. As the Dutch Government's budgets are approved by Parliament on an annual basis, all annual disbursements represent new and additional resources.

7.2.3 Assistance to parties from developing countries particularly vulnerable to climate change

Dutch development cooperation and climate action are characterised by a strong focus on poverty. Most of the current policy instruments are aimed at LDCs as well as lower-middle income countries and are specifically intended to benefit poorer populations such as smallholder farmers, small entrepreneurs and people with no access to safe drinking water, sanitation or energy. Poorer people and communities are typically affected the most by the effects of climate change, not only because they are often the most exposed but also because they have the least resources to cope and adapt[155].

Of the 15 Dutch partner countries, 11 are least developed countries (LDCs), most of which are fragile and conflict-affected states. Although vulnerability to climate change played no role in the selection of these countries in 2010, closely related aspects such as the level of poverty and income as well as possibilities/opportunities to work on the four thematic priorities did. As a result, most of our partner countries are among the most vulnerable to climate change.

To address the needs of the poor, we work with a multitude of actors, including national, regional and local authorities, multilateral organisations, non-governmental organisations, private-sector organisations, farmers organisations, water boards, and so on. These organisations all have their own processes to ensure that their activities meet the needs of their target populations.

[155] IPCC, Climate Change 2014 Synthesis Report, Summary for Policymakers, 2014; Hallegatte, Stephane, Mook Bangalore, Laura Bonzanigo, Marianne Fay, Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, and Adrien Vogt-Schilb, 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development Series. Washington, DC: World Bank.

7.2.4 Public financial support: contribution through multilateral channels

Multilateral climate change funds to which the Netherlands contributed were the Least Developed Countries Fund (LDCF), the Green Climate Fund (GCF), the Global Environment Facility (GEF) and the Strategic Climate Fund's Scaling up Renewable Energy Program (SCF-SREP), one of the Climate Investment Funds (CIFs). The total contributions to the GEF are included in Table 7.1; the climate-relevant share of our contributions to these organisations is included in Tables 7.4 at the end of this chapter.
The Netherlands played an active role in the operationalisation of the GCF through its commitment of € 100 million, as a Board member and a co-chair of its Risk Management Committee. In the Board, our priorities have been the GCF's focus on poverty, gender responsiveness and private-sector involvement, as well as improving the project approval process. The Netherlands also continued to provide active support for the work of the GEF and the CIFs through its financial contributions, also as a member of the GEF Council and the Joint Trust Fund Committee of the CIFs.

Year	Amount in €	Amount in $
2013	20,725,000	25,906,250
2014	20,725,000	27,269,737
2015	0	0
2016	20,725,000	22,527,174

Table 7.1: Financial contributions to the Global Environment Facility (GEF)

The Netherlands is a major donor of core funding to Multilateral Development Banks as well as United Nations organisations and funds that play an important role to support developing countries in their climate action. In Tables 7.4 (included at the end of this chapter), the Netherlands reports on the climate-specific part of these core contributions.
Key climate-relevant programmes of multilateral organisations that we supported are IFAD's Adaptation for Smallholder Agricultural Programme (ASAP), the World Bank's Consultative Group on International Agricultural Research (CGIAR), the World Bank's Energy Sector Management Assistance Program (ESMAP), the World Bank's Cooperation in International Waters in Africa (CIWA), UNDP's Environment and Energy Thematic Trust Fund (SIDS programme), the ADB's Water Financing Partnership Facility, the World Bank's Water Partnership Program and the World Bank's Program on Forests (PROFOR). From 2015, the climate-relevant share of these programmes has been included in Tables 7.4 (in previous years, Table 5).
Please note that the format of Table 7.4 has been brought in line with the improved format of the CTF tables used for the Second and Third Biennial Reports, which cover the same period as this National Communication.

7.2.5 Provision of public financial support: contribution through bilateral, regional and other channels

Further to our support through multilateral channels, the Netherlands worked mostly through alliances with the private sector, knowledge institutes and NGOs to support climate action in developing countries. In countries with which we maintain a bilateral aid relationship, we continued to focus mainly on climate-smart agriculture, integrated water resource management and climate-resilient WASH services. Centrally managed programmes emphasised providing access to renewable energy, halting deforestation, promoting climate-smart agriculture, using integrated water resources management or offering climate-resilient WASH services. In many cases, these programmes were not limited to the countries with which the Netherlands maintains a bilateral aid relationship, but they were targeted at a broader group of countries and/or regions.
Table 7.5 (included at the end of this chapter) gives an overview of Dutch climate finance through bilateral, regional and other channels disbursed in the period 2013–2016. It provides the information

requested in the improved format of the CTF tables as used for the Second and Third Biennial Report so as to bring our National Communication in line with our Biennial Reports, which cover the same period. The columns “status”, “funding source” and “financial instrument” have been omitted to save space; the status of all reported projects is “provided”, the source of all funding is “ODA” and the financial instrument is always “grant”.

7.2.6 Mitigation

In the period 2013–2016, a total of € 220 million was spent on climate change mitigation in 58 activities, of which 38 activities had climate change mitigation as a principal objective and 20 as a significant secondary objective. Furthermore, over the same time period, € 913 million of climate finance was spent in 116 cross-cutting activities. The majority of the mitigation expenditures relate to the Dutch renewable energy programme. Most cross-cutting finance is provided through multilateral organisations, including multilateral climate change funds. Support for technological development and transfer as well as support for capacity-building is in many cases an integral part of the activities.

Support for access to renewable energy in developing countries
With its renewable energy programme, the Dutch government aims to provide access to renewable energy for 50 million people between 2015 and 2030. Between 2004 and 2014, the Netherlands had already provided 16.7 million people with access to energy against a target of 10 million people.

The bulk of the funds are channelled through bilateral projects and programmes executed by multilateral agencies (“worldwide” and “regional”). In addition, the renewable energy programme works with the private sector as well.

- The Netherlands works closely with Germany on the provision of access to renewable energy in the Energising Development Partnership (EnDev) in 26 countries. EnDev started as a Dutch initiative implemented by GIZ and has grown into a multidonor, multi-implementer programme co-managed by GIZ and RVO.nl. It focuses on market development for decentralised technologies such as cooking stoves, micro hydro and small-scale solar solutions.
- The Netherlands provides grants to result-oriented programmes for energy access. Examples of interesting projects within the Dutch renewable energy programme are the Africa Biogas Partnership Programme and the Rwanda National Energy Access Program. The Africa Biogas Partnership[156] aims to bring the successful work of SNV and HIVOS on domestic biogas in Asia to five countries in Africa. This partnership will provide households with clean cooking fuel, improved sanitation and an excellent organic fertiliser. Another example is the Sumba Iconic Island initiative, which aims to reach universal energy access through renewable energy on the Indonesian island of Sumba.
- In general, the Netherlands strives to cooperate with the private sector and encourages its non-governmental partners to do the same. FMO operates its Access to Energy Fund in order to support larger private-sector investments.
- The Netherlands invests in programmes of the World Bank Group (WBG) that promote access to renewable energy. It also supports greening the investment portfolio of the bank and the energy sector policies of WBG partner countries. Examples are the Lighting Global programme (for household solar lighting systems) and Scaling Solar (developing grid-connected solar power plants). The Netherlands has provided strong support to the Energy Sector Management Assistance Program (ESMAP) of the World Bank, which helps bank groups and recipient countries to develop activities in the field of energy access, renewable energy, energy efficiency and improved energy sector management, e.g. through reforming fossil fuel subsidies.

[156] http://africabiogas.org/

- In the context of the CIFs, the Netherlands made a considerable contribution to the launch of the Scaling up Renewable Energy Programme (SREP). This programme has the ambition to transform renewable energy sectors in low-income countries, especially geared towards the productive use of energy. The Netherlands has been co-chairing the SREP subcommittee on behalf of the donor countries since 2012.

Support for halting deforestation in developing countries
With a view to halting deforestation in developing countries, the Netherlands focuses on major drivers of deforestation: supply chains such as timber, soy and palm oil as well as forest-dependent communities trying to make a living.
To promote sustainable, deforestation-free supply chains, the Netherlands has initiated and promoted the Amsterdam Declarations. The two Declarations – one on stopping deforestation and one on sustainable palm oil – were launched on 7 December 2015 with the intention of improving cooperation between European countries committed to eliminating deforestation and achieving a supply chain for fully sustainable palm oil by 2020. These Declarations are intended to stimulate private-sector commitment and progress on agricultural commodities associated with deforestation (such as palm oil, soy and cocoa), in which Europe has a significant market share. By expanding the market demand for sustainable commodities in the European signatory countries, the Declarations aim to incentivise sustainable manufacture in producing countries. To date, the Netherlands, Denmark, Germany, Norway, the United Kingdom, and recently France and Italy have signed up. This Amsterdam Group has adopted a strategy with four pillars: facilitate European action on climate, deforestation and trade; stimulate a global value chain approach, e.g. through partnerships and integrated landscape approaches; enhance the dialogue with major consumer-producer countries such as China; and improve monitoring, e.g. by enhancing third-party monitoring on deforestation.
As a partner of the Tropical Forest Alliance (TFA) 2020, the Netherlands promotes sustainable supply chains at the global level. TFA 2020 is a public-private partnership, serving the needs of partners from business, government and civil society. It is committed to reducing tropical deforestation related to key global commodities by 2020, starting with soy, beef, palm oil, and paper and pulp.
Through the EU FLEGT programme (Forest Law Enforcement, Governance and Trade), we support producing countries to improve their legislation and enforcement in respect of illegal logging. To halt deforestation by forest-dependent communities, we support activities that improve the productivity and sustainability of their agriculture practices, enhance their role in land use planning and access rights, and promote benefit-sharing within landscapes. Other key programmes that we support are the Initiative for Sustainable Landscapes of the Sustainable Trade Initiative (IDH-ISLA) as well as several projects implemented by Solidaridad and Tropenbos International.
Climate change mitigation is also supported through the Dutch cooperation programmes with NGOs; for example, the strategic partnerships with Solidaridad, Milieudefensie, IUCN, IRC and SNV.

7.2.7 Adaptation

In the period 2013–2016, a total of € 440 million was spent on climate change adaptation in 246 activities, of which 21 activities had climate change adaptation as a principal objective and 225 as a significant secondary objective. Furthermore, over the same time period, € 913 million of climate finance was spent in 116 cross-cutting activities – as mentioned above. The majority of the adaptation expenditures relate to climate-smart agriculture, integrated water resources management and climate-resilient WASH programmes. Most cross-cutting finance is provided through multilateral organisations, including multilateral climate change funds. Support for technological development and transfer as well as support for capacity-building is in many cases an integral part of the activities.

Climate change is a major global challenge that risks undermining current and future development results, including the Sustainable Development Goal (SDG) of eradicating poverty. Crop failures due to reduced rainfall, spikes in food prices following extreme weather events, natural disasters that destroy assets and livelihoods, and emerging diseases may push 120 million people back into poverty by 2030[157]. Since the poorest people are often the most vulnerable to the effects of climate change, policies and actions need to be geared towards reducing their vulnerability to the current and expected impacts of climate change, in order to prevent it from unleashing a vicious cycle of growing vulnerability and poverty.

The Netherlands supports climate change adaptation through specific adaptation programmes such as Partners for Resilience and through the integration of climate change concerns, particularly in programmes for water and food security.

Guidelines for integrating climate-smart actions into development policies and activities were developed to support this process. In these guidelines, four steps are distinguished: (1) identifying the likely impact of climate change, (2) identifying the risks and opportunities that climate change presents, (3) lowering risks and increasing opportunities by integrating climate-smart actions, and (4) reflecting the climate-smart actions in the activity's appraisal document and in the assignment of climate Rio markers (only relevant for activities).

To assist embassies and their partners in the first two steps of this process, climate profiles were drafted for 14 out of 15 partner countries or regions in 2014 and have been updated regularly since that time[158]. They contain detailed information on the biophysical and socioeconomic vulnerability of the country concerned as well as an overview of relevant policies and strategies by national governments. The profiles are publicly available on the website of the Dutch Sustainability Unit. To assist programme development in other countries, the guidelines refer to various good sources of information such as the USAID Climate Risk Profiles and the Climate Development Knowledge overviews.

In our food security programmes, we focus on the promotion of climate-smart agriculture and sustainable land use through activities such as diversifying crops and income sources, enhancing water efficiency, adapting production methods (e.g. improved seeds, integrated soil management) and improving access to better weather information. Programmes are managed either from The Hague or by embassies in Bangladesh, Benin, Burundi, Ethiopia, Ghana, Indonesia, Kenya, Mali, Rwanda, South Sudan and Uganda.

Examples of programmes managed from The Hague:
IFAD's Adaptation for Smallholder Agriculture Programme (act. no. 24659) supports smallholder farmers in accessing the information tools and technologies that help build their resilience to climate change. It is operative in more than 30 developing countries to make rural development programmes more climate-resilient.
Geodata for Agriculture and Water Facility (act. no. 25484) aims to provide food producers with timely and reliable information and advice as well as financial products through operational information chains using satellite data, so as to increase both agricultural output and food producers' ability to deal with increased weather variability and more extreme weather caused by climate change. The Facility is managed by the Netherlands Space Office and focuses on 15 developing countries.

Examples of programmes managed by embassies:

[157] *Shock Waves: Managing the Impacts of Climate Change on Poverty*, World Bank, 2016.
[158] Bangladesh, Benin, Burundi, Ethiopia, Ghana, Indonesia, Kenya, Mali, Mozambique, the Palestinian Territories, Uganda, Rwanda, South Sudan and Yemen. For our partner country Afghanistan, no climate prolife was drafted as the cooperation programme with them has other priorities.

CASCAPE/Capacity-building for Scaling up evidence-based best Practices in Ethiopia (act. no. 22482) aims to validate climate-smart farming practices to be taken up by the agricultural extension service in the Agricultural Growth Programme 2 of the government of Ethiopia. The project is implemented by Wageningen University, five Ethiopian universities and two regional agricultural research institutes. It also aims to strengthen the capacity of stakeholders (research institutes, universities, extension services) to scale up best practices.
PAPAB/Supporting Agricultural Productivity in Burundi (act. no. 27741) aims to increase food production in Burundi sustainably by promoting market-oriented, climate-resilient and sustainable agricultural techniques, supported by targeted fertiliser subsidies. This project uses a participatory approach centring on integrated crop/soil/farm management and cooperation between stakeholders at all levels. The project consortium includes four partners: IFDC, Alterra Wageningen UR, Oxfam Novib and ZOA. In addition, over ten local organisations are involved (including Adisco, OAP, Consedi and Réseau Burundi 2000+) as well as Dutch organisations (HealthNetTPO, Soil Cares and Trimpact).

In our water programmes, we focus on better management of scarce water resources, better flood protection for populations living in deltas and improved access to climate-resilient WASH services. Programmes are managed by The Hague and by embassies in Bangladesh, Benin, Ghana, Indonesia, Kenya, Mozambique, the Palestinian Territories, Rwanda, South Sudan and Yemen.

Examples of programmes managed from The Hague:
Sustainable Water Fund I and II (act. nos. 23710 and 24011) is a public-private partnership facility in the field of water and sanitation which aims to contribute to water safety and water reliability in developing countries, including through innovative technological solutions. Themes include climate-relevant topics such as efficient water usage, safe deltas and improved basin management.
Dutch Disaster Risk Reduction Team (act. no. 25588) deals with the fact that climate change will increase water-related risks. As the Netherlands is renowned for its expertise in water management and risk prevention, we aim to make this knowledge available to other countries. This reason is why the Dutch government, together with the Dutch water sector, founded the Disaster Risk Reduction Team (DRR Team). The team of experts advises governments on how to resolve urgent water issues related to flood risks, water pollution and water supply, how to prevent disasters or how to rebuild after water-related disasters.

Examples of programmes managed by embassies:
Blue Gold Program in Bangladesh (act. no. 24007) rehabilitates and improves water management infrastructure in 115,000 hectares of polder land with a population of 1 million, resulting in better protection against floods and enhanced agricultural production.
Omidelta in Benin (act. no. 29296) concentrates on the Ouémé river delta, more specifically on the urban and surrounding areas. Disaster risk reduction is addressed through the introduction of the Dutch Delta approach, while support to the National Water Institute (INE Benin) reinforces national and regional capacity to cope with the uncertain effects of climate change.

Climate change adaptation is also supported through the Dutch cooperation programmes with NGOs. An example is the “Partners for Resilience” (PfR) initiative, a partnership of the Netherlands Red Cross, CARE Netherlands, Cordaid, the Red Cross Climate Centre and Wetlands International. PfR contributes to the resilience of communities by integrating climate change adaptation, ecosystem management and restoration, and disaster risk reduction into development processes. Other examples are the cooperation programmes with Solidaridad, UTZ, IUCN, IRC and SNV.

A detailed list of adaptation projects is included in the Third Biennial Report of the Netherlands. Further information on the projects is published by the Netherlands through the International Aid Transparency Initiative (IATI).

7.2.8 Mobilised private climate finance

Climate change cannot be addressed by public interventions only. The private sector must be part of the transformative change that is needed for low-carbon, climate-resilient development. Their knowledge and financial resources are indispensable to succeed.

The Netherlands has set up a number of bilateral instruments to collaborate with the private sector. For example, the Sustainable Water Fund, the Facility for Sustainable Entrepreneurship and Food Security, the Ghana WASH Window and FMO's Access to Energy Fund support public-private partnerships in the water, food and energy sector that help to address climate challenges in developing countries, including via the mobilisation of private finance. In addition, the Netherlands supports a number of multidonor trust funds, multilateral climate funds and development banks that mobilise private finance for climate action.

Apart from this approach, the Netherlands focuses on activities that indirectly assist the mobilisation of private climate finance by preparing the ground. One example is that we support funds which promote readiness for climate-relevant investments, such as the Energy Sector Management Assistance Program (ESMAP), the Public-Private Infrastructure Advisory Facility and the IFC Sustainable Business Advisory. Another example is that we support the Global Innovation Lab for Climate Finance, which identifies and pilots cutting-edge climate finance instruments that can attract private investment aimed at climate change mitigation and adaptation in developing countries. Also in the Netherlands, a process has been set up with the active support of the government which brings together entrepreneurs, policymakers and investors to formulate bankable business propositions that tackle climate change challenges in developing countries.

Mobilised private climate finance	**€ million**
Through bilateral programmes:	
Facility for Sustainable Entrepreneurship and Food Security	3
Sustainable Water Fund	4
Ghana WASH Window	1
Through multidonor funds:	
The Sustainable Trade Initiative	9
Energising Development (EnDev)	16
Global Agriculture and Food Security Programme (GAFSP)	10
Private Infrastructure Development Group (PIDG)	1
Through multilateral climate funds:	
Global Environment Fund	2
Green Climate Fund and Climate Investment Funds	pm
Through FMO:	27
Through Multilateral Development Banks:	pm
Total	**73**

Table 7.2: Private climate finance, 2015, in € million

Mobilised private climate finance	**€ million**
Through bilateral programmes:	
Facility for Sustainable Entrepreneurship and Food Security	7.44
Sustainable Water Fund	1.61
Ghana WASH Window	1.10
Solidaridad Partners for Change	0.26
Through multidonor funds:	
The Sustainable Trade Initiative (IDH)	6.96
Initiative for Sustainable Landscapes (IDH-ISLA)	0.40
Energising Development (EnDev)	14.47
Global Agriculture and Food Security Programme (GAFSP)	0.99
Private Infrastructure Development Group (PIDG)	0.72
Through multilateral climate funds:	
Global Environment Fund	3.38
Green Climate Fund and Climate Investment Funds	pm
Through FMO:	16.00
Through Multilateral Development Banks[159]***:***	117.89
Total	**171.22**

Table 7.3: Private climate finance, 2016, in € million

Following years of work in the Research Collaborative on Tracking Private Climate Finance, major donors adopted the "Joint Statement on Tracking Progress Towards the $100 Billion Goal" in September 2015, agreeing on a common understanding of mobilised private climate finance and its scope as well as a common methodology. Based on this Joint Statement, the Netherlands can now report that it mobilised in total € 73 million of private climate finance in 2015 and € 171 million in 2016[160]. Detailed information is presented in Tables 7.2 and 7.3. As data and methodological limitations are still a serious constraint, the reported amounts should be considered as best estimates.

7.2.9 Methodology used for reporting on financial resources

General remarks
The Netherlands reports on climate-specific ODA that has been disbursed. All ODA consists of grants. In Tables 7.4, the Netherlands reports on multilateral climate finance comprising:

- the contributions to multilateral climate change funds;
- the climate-specific share of our core contributions to GEF;
- the climate-specific share of our core contributions to multilateral financial institutions, including regional development banks;
- the climate-specific share of our core contributions to specialised UN bodies;
- the climate-specific share of our non-core contributions to multilateral organisations for worldwide programmes (as of 2015; before 2015 included in Table 7.5).

The climate-specific share of our non-core contributions to multilateral organisations for country-specific or region-specific programmes are reported under Table 7.6 for contributions through bilateral, regional and other channels, in line with OECD/DAC's definition of bilateral ODA..

[159] Excluding EIB.
[160] HGIS- Jaarverslag 2015; HGIS-Jaarverslag 2016

The Netherlands uses an annually established corporate currency exchange rate. This rate was €1 per US$ 1.25 for 2013; €1 per US$ 1.32 for 2014; €1 per US$ 1.35 for 2015 and €1 per US$ 1.09 for 2016.

Bilateral public climate finance
The Netherlands uses the OECD/DAC Rio Marker definitions for climate change adaptation and climate change mitigation.

For most activities (projects/programmes), the OECD/DAC Rio Markers are used to provide an approximate quantification of Dutch climate finance:

- If an activity is marked as "principal" for mitigation or adaptation, 100% of the support is considered and reported as climate finance.
- If an activity is marked as "significant" for mitigation or adaptation, 40% of the support is considered and reported as climate finance. Together with other donors, we consider this percentage to be a reasonable estimate of the average climate contribution by projects that have climate change adaptation or mitigation as a significant objective.

If more than one climate Rio Marker is assigned to an activity, double counting is avoided as follows:

- If an activity has 2 "principal" markers, both are counted for 50%.
- If an activity has 2 "significant" markers, both are counted for 20%.
- If an activity has 1 "principal" and 1 "significant" marker, the "principal" marker is counted for 60% and the "significant" marker for 40%.

For the sizeable contributions through and to NGOs in the framework of MSF-2 and the "Dialogue and Dissent" policy framework (the Dutch policy framework for grants when working with NGOs), the Netherlands uses a mixed approach. The aforementioned system of quantification through Rio Markers is used when climate change adaptation and/or mitigation is a principal or significant policy objective of the entire activity. When climate change adaptation and/or mitigation is only a principal or significant policy objective of parts of the programme, the Netherlands determines the climate-specific share of the NGO's programme. These percentages range between 4 and 38 per cent.

Multilateral climate finance
To determine the climate-specific share of our core contributions to multilateral organisations, the Netherlands applies the OECD/DAC "Imputed climate-related shares" (weighted averages) to our relevant core contributions to multilateral organisations.

For a number of multilateral/UN agencies carrying out climate-relevant work (UNDP, UNEP, FAO, WFP, UNCCD), OECD/DAC has not yet determined "Imputed climate-related shares". In consultation with the organisations concerned, we have ourselves determined climate-specific shares for these organisations and applied them to our core/general contributions. These figures range between 5 and 30 per cent.

Private climate finance
The Netherlands reports on private climate finance according to the "Joint Statement on Tracking Progress Towards the $100 Billion Goal", which major donor countries adopted in Paris on 6 September 2015. In this Joint Statement, private climate finance is defined as follows: "Private finance for climate-relevant activities that has been mobilised by public finance or by a public policy intervention, including technical assistance to enable policy and regulatory reform".
Key underlying principles that were agreed for tracking private climate finance are the following:

- Only finance mobilised by governments of developed countries is counted.

- Where multiple actors are involved, the resulting finance is only counted once in tracking.
- The reporting framework encourages and incentivises the most effective use of climate finance.

In view of methodological and data limitations, the private climate finance that the Dutch reports is a best estimate of the private finance that was mobilised by public finance from the Netherlands (bilateral and attributable multilateral finance) to support developing countries in their climate action.

Key methodological choices made are the following.
Definition of public and private finance:

- An entity was considered public if more than 50% was owned by public shareholders. In this case, 100% of finance deployed by these institutions was considered public finance (no apportioning if ownership was mixed).
- An entity was considered private if more than 50% was owned by private shareholders. In this case, 100% of finance deployed by these institutions was considered private finance (no apportioning if ownership was mixed).

Direct versus indirect mobilisation:

- Only climate-relevant activities that directly mobilise private finance were included.
- Climate-relevant activities that only indirectly mobilise private finance were not included.

Types of public finance instruments:

- Grants, loans and equity were included. Guarantees and insurances (e.g. export credit insurance) were not included in the calculations. All instruments were calculated at face value.

Collection of data:

- Preferably, data were collected at the project level. If project data were not available, aggregated figures were used.

Attribution:

- Attribution of private co-finance was based on a pro rata calculation (according to the share of Dutch public finance in the total amount of public finance for the project, including public finance from developing countries).[161]

Causality:

- All private co-finance in the same project was assumed to have been mobilised by public finance.

Point of measurement for public and mobilised private finance:

- Preferably, public and mobilised private finance were measured at the moment of disbursements.
- If disbursement data were not available, public and mobilised private finance were measured at the moment of commitment (Board approval).

[161] Exception is FMO. For FMO 100% of mobilized private finance has been attributed to FMO when they are the lead arranger while 0% has been attributed when they are not the lead arranger.

Classification of developing countries:

- Developing countries were classified on the basis of the OECD/DAC list of ODA recipients.

7.3 (D) Provision of support for technology development and transfer

Support for technology development and transfer forms an integral part of many activities related to climate change mitigation and/or adaptation, encompassing both hardware (equipment) and software (know-how, methods, practices). Both the private sector and several knowledge institutes are partners in providing this support. The combined innovative and financial strengths of these parties are essential to meet the challenges of climate change together with the government.

As we do not track technology development and transfer in our climate action, we provide an illustrative list of activities that were at the implementation phase in 2013–2016. Further information is provided in Table 7.5 (included at the end of this chapter), the format for which has been brought in line with the improved format of the CTF tables used for the Second and Third Biennial Report.

Sustainable Water Fund I and II – act. nos. 23710 and 24011
This fund is a public-private partnership facility in the field of water and sanitation. It aims to contribute to water safety and water reliability in developing countries, including through innovative technological solutions. Themes include climate-relevant topics such as efficient water usage, safe deltas and improved basin management.

Dutch Disaster Risk Reduction Team – act. no. 25588
Climate change will increase water-related risks. As the Netherlands is renowned for its expertise in water management and risk prevention, we aim to make this knowledge available to other countries. This reason is why the Dutch government, together with the Dutch water sector, founded our Disaster Risk Reduction Team (DRR Team). The DRR Team is able to cover the entire disaster management cycle from mitigation, preparedness and response to recovery. For instance, when a country has been struck by severe flooding and the first emergency relief workers have gone, the need for advice on how to build a sustainable and safer water future arises. To meet these needs with a swift response, the DRR Team of experts advises governments on how to resolve urgent water issues related to flood risks, water pollution and water supply, how to prevent disasters or how to rebuild after water-related disasters.

Energising Development Partnership Programme (EnDev) – act. no. 18315
EnDev contributes to making local, renewable energy accessible in 26 developing countries, mainly for the benefit of rural and peri-urban populations, social institutions, and small and medium-sized enterprises in Africa, Asia and Latin America. This fact is done by establishing economically sustainable energy solutions and distribution schemes, mainly for rural communities. More detailed information on the technological cooperation projects within EnDev is available on their website[162].

Energy Sector Management Assistance Program (ESMAP) – act. no. 29278
ESMAP supports, among other things, geothermal energy capacity and resource risk mitigation through south-south cooperation (support for targeted research, design and preparation, capacity development and knowledge dissemination). The Netherlands has specific expertise on how to improve the success rate of geothermal test drilling and how to mitigate geothermal resource risks. Through a trilateral approach, it will also build on the experience of countries which have a track record in geothermal development

[162] www.endev.info

(Indonesia, Kenya, the Philippines and Turkey) and which are open to share lessons with peer countries in the south.

Integrated Seed Sector Development Programme in Ethiopia – act. no. 23448
The overall objective is to increase agricultural productivity through the production and marketing of improved seeds that are drought- or flood-resilient. This programme is managed by Wageningen University and largely implemented by four Ethiopian universities, the Oromiya Seed Enterprise, and the Ethiopian Seed Growers and Processors Association. The programme builds the capacity of private entrepreneurs and farmer organisations (in terms of organisational, managerial, financial and technical skills) to maintain their own investments. It also strengthens the capacity of governments (at the regional and the woreda level) and non-government organisations (universities, research centres) to support the seed sector.

Capacity-building for Scaling up evidence-based best Practices in Ethiopia (CASCAPE) – act. no. 22482
The CASCAPE project aims to validate climate-smart farming practices to be taken up by the agricultural extension service in the Agricultural Growth Programme 2 of the government of Ethiopia. The project is implemented by Wageningen University, five Ethiopian universities and two regional research institutes on agriculture. It also intends to strengthen the capacity of stakeholders (research institutes, universities, extension services) to scale up best practices.

Integrated Seed Sector Development (ISSD) Programme and ISSD Plus Programme in Uganda – act. nos. 23617 and 29417
These projects aims to build the capacity of local seed groups to become businesses which produce improved drought- or flood-resilient seeds through collaboration with national research centres. The project also focuses on strengthening the relevant public institutions, such as the national seed certification service and the Uganda National Agro-Dealers Association.

Solar for Farms in Uganda/Milking the Sun – act. no. 26961
This project makes high-quality and affordable solar lamps and solar home systems available to dairy cooperative members through the provision of financing, thereby increasing farm production, lowering household emissions (substituting kerosene for solar) as well as providing improved lighting for dairy and household activities.

Supporting Agricultural Productivity in Burundi (PAPAB) – act. no. 27741
The PAPAB project aims to increase food production in Burundi sustainably by promoting market-oriented, climate-resilient and sustainable agricultural techniques, supported by targeted fertiliser subsidies. This project uses a participatory approach centred on integrated crop/soil/farm management and cooperation between stakeholders at all levels. The project consortium includes four partners: IFDC, Alterra, Wageningen University, Oxfam Novib and ZOA. In addition, over ten local organisations are involved (including Adisco, OAP, Consedi and Réseau Burundi 2000+) as well as Dutch organisations (HealthNetTPO, Soil Cares and Trimpact).

Water Grand Challenge: Securing Water for Food – act. no. 26393
Water scarcity is one of the main challenges which developing countries face, a challenge that will be further exacerbated by climate change. To help developing countries meet this challenge, the objective of the “Securing Water for Food” programme is to source and accelerate innovations that enable the production of more food with less water and/or make more water available for food production, processing and distribution in developing countries. Innovations involve a) water efficiency and reuse, b) water capture and storage, and c) salinity and water intrusion. The activity will catalyse new investments of businesses, governments at all levels, NGOs and others to address water scarcity in the food value chain by providing financial and technical support as well as innovation acceleration support.

IFAD's Adaptation for Smallholder Agriculture Programme (ASAP) – act. no. 24659
The Netherlands supports IFAD's Adaptation for Smallholder Agriculture Programme (ASAP), which supports smallholder farmers to access the information tools and technologies that help to build their resilience to climate change. This programme also contains capacity-building elements. It is operative in more than thirty developing countries to make rural development programmes more climate-resilient.

Urban Dredging Demonstration Project – act. no. 26397
This project aims to increase the knowledge and capacities (trained staff, resources and instruments) of the Dhaka Water Supply and Sewage Authority for remedial and maintenance dredging operations through the demonstration of new, internationally proven dredging technologies and the dissemination of dredging expertise. This fact will help to reduce the risk of increased floods as a result of climate change.

Ghana Climate Innovation Centre (GCIC) – act. no 26945
The GCIC, supported by infoDev/World Bank Group, helps local small and medium-sized enterprises (SMEs) in clean technology as well as climate innovators to commercialise and scale the most innovative private-sector solutions to climate change. It provides entrepreneurs in clean technology with the knowledge, capital and market access required to launch and grow their businesses. The success of these enterprises leads to emission reductions and improved climate resilience, while it also enables developing countries to realise greater value in the innovation value chain, build competitive sectors and create jobs.

Good examples of support for the development and enhancement of endogenous capacities and technologies are the Energising Development Partnership Programme (EnDev), the Integrated Seed Sector Development (ISSD) Programme in Ethiopia, the Integrated Seed Sector Development Programme and the ISSD Plus Programme in Uganda, and the Ghana Climate Innovation Centre (GCIC).

As technological development and transfer is a complex and long-term process, *successes and failures* can often only be established properly in retrospect. For instance, to promote the use of renewable energy technologies that contribute to universal energy access, we started to invest in various long-term innovation processes years or even decades ago. Nowadays, we consider our support of household solar systems a success, while our support of Jatropha was less successful.

The Netherlands has supported the promotion of household solar systems as an alternative to communal power projects since the first pilot in the early 1990s. Development funds were used to subsidise pilot projects, develop financing mechanisms, and shape policies and the enabling environment for the commercial dissemination of solar home systems. Around 2010, breakthroughs in the field of LED lighting and lithium batteries brought forward a new range of "pico solar" products, mostly solar lanterns and small plug-and-play solar home systems. The Netherlands invested in fast-start climate finance to fund further pilots on the ground in a large number of developing countries through the Daey Ouwens Fund and the EnDev programme, as well as via systematic efforts to strengthen the enabling environment through the Lighting Africa/Lighting Global programme. This combination of approaches has strongly contributed to a self-propelling commercial sector which has served more than 110 million people worldwide with off-grid lighting and rural electrification products, and which grows by about 35% annually.

To develop Jatropha as a sustainable biofuel crop in sub-Saharan Africa and Indonesia, the Netherlands supported twelve different projects between 2005 and 2014. There was substantial interest and co-investment from a wide variety of businesses, NGOs and governments. Projects ranged from pilot farms to policy development and from the direct use of jatropha oil at the village level to the production of biodiesel. In practice, however, all but one of the projects performed poorly and did not deliver on the promise of a potential breakthrough technology. The Netherlands excluded the technology from

subsequent subsidy calls of the Daey Ouwens Fund. Nowadays, the original interest from the broad range of stakeholders has largely disappeared and is looked back on as the “Jatropha hype”.

7.4 Provision of capacity-building support

Capacity-building of local partners in developing countries forms an integral part of many activities that support climate change mitigation and/or adaptation. As we do not consistently track capacity-building for climate action, we provide an illustrative list of activities that were at the implementation phase in 2013–2016.

Climate and Development Knowledge Network (CDKN) – act. no. 21868
CDKN helps to turn global and local research and information on climate change into policies and programmes, supporting developing countries to move to a climate-resilient future. This programme should result in relevant policy and strengthened capacity by putting an emphasis on knowledge management, research, partnership, technical assistance and services.

Partners for Resilience (PfR) – act. no. 27551
Partners for Resilience (PfR) is a partnership of the Netherlands Red Cross, CARE Netherlands, Cordaid, the Red Cross Climate Centre and Wetlands International. PfR contributes to the resilience of communities by integrating climate change adaptation, ecosystem management and restoration into disaster risk reduction. This approach helps communities in strengthening their capacities to reduce the impact of disasters.

Zambezi Valley Agency in Mozambique – act. no. 24658
This programme aims to build the capacity of the Zambezi Valley Agency (ADVZ) and the strategic partners of ADVZ to promote inclusive and sustainable agricultural development in the Lower Zambezi Valley.

Sustainable Agriculture, Food Security and Linkages in Bangladesh (SaFaL) – act. no. 24552
This project aims to enhance food security by promoting sustainable, climate-smart agricultural practices and linking farmers to markets. It includes training sessions for farmers to adopt innovative, climate-smart farming practices.

African Biogas Partnership Programme (ABPP) – act. no. 26010
The African Biogas Partnership Programme (ABPP) builds the capacity of the biogas sector in five African countries: Ethiopia, Uganda, Burkina Faso, Kenya and the United Republic of Tanzania. These countries are assisted in applying domestic biogas as a climate-friendly solution for energy, organic fertiliser and livestock keeping.

Urbanising Deltas of the World (UDW) – act. no. 24709
The Urbanising Deltas of the World is a research programme with the goal of supporting water safety, water and food security, and sustainable economic development in delta areas worldwide. Climate change is one of the challenges that the programme aims to address. The programme combines the generation of practical and applicable knowledge with capacity-building to use this new knowledge, e.g. in the design of interventions and in the formulation of new policies. In the Mekong Delta, for example, one of the research consortia is developing an integrated package of tools to understand the interrelations between increased land subsidence, sea level rise, reduced river flows, increased flood risks and salinisation of the delta's freshwater system better. The package will help decision-makers to assess the pros and cons of different interventions in land use, water management and infrastructure through an integrated approach.

Cooperation in International Waters in Africa (CIWA) – act. no. 25925
The World Bank's Cooperation in International Waters in Sub-Saharan Africa (CIWA) programme aims to strengthen cooperative management and development of international waters across sub-Saharan Africa in order to aid sustainable, climate-resilient growth. It supports transboundary cooperation in rivers, lakes and groundwater bodies, focusing among other things on capacity-building in transboundary institutions such as river basin authorities or on the nucleus of such organisations which riparians are in the process of establishing.

World Resources Institute (WRI) – act. no. 18813
The Dutch government supports WRI's work on international climate change issues. One of the aspects of WRI's work is to support developing countries in integrating climate risks into laws, policies and plans, leading to climate-resilient development outcomes.

Integrated Water Resource Management Programme in the Niger Basin (GIRE) in Mali – act. no. 26989
This programme aims, among other things, to improve knowledge on available water resources as well as to promote sustainable water allocation and monitoring for various sectors (energy, drinking water, fisheries, livestock, irrigation, and so on), taking into account the expected consequences of climate change. The programme includes a capacity-building component for relevant public and private-sector personnel, research institutes and user groups.

Women Delegates Fund (WDF) – act. nos. 27054 and 29215
The Women Delegates Fund aims to increase the effective participation of women from developing countries, mostly LDCs, in the UNFCCC climate negotiations. This fund combines the payment of travel costs with a capacity-building programme.

Small-Scale and Micro Irrigation Support Project (SSMISP) in Ethiopia – act. no. 26389
The objective of SSMISP is to build the capacity of relevant public and private institutions in four Ethiopian states for establishing and managing small-scale irrigation systems and micro irrigation schemes.

Professional Education in the Niger Basin (FIBANI) in Mali – act. no. 24966
Through this programme, professional education centres for sustainable land and water management in the Niger Basin are strengthened with a view to increasing food security.

IGG-IHE Delft Institute for Water Education Programmatic Cooperation – act. nos. 17133 and 28325
IHE Delft Institute for Water Education supports capacity-building in the water sector of developing countries through education, research and partnerships programmes. Climate change is an integral part of the programmes. The geographical focus is on the partner countries in Dutch development cooperation as well as on river basins in Africa and the Middle East.
In addition, the Netherlands supports a scholarship programme for Small Island Developing States (SIDS) to strengthen their capacity in the water sector and to cope with the effects of climate change. The IHE Delft Institute for Water Education is one of the world's foremost education and research institutes in water-related fields. This programme offers 25 scholarships for 18-month Master of Science courses as well as 70 short courses for water professionals and policymakers.

Netherlands Red Cross Response Preparedness II – act. no. 28677
This programme focuses on building the capacity for response preparedness of national Red Cross and Red Crescent societies in Mali, the Central African Republic, Lebanon and Zambia so they can better respond to disasters, including climate-related disasters, e.g. by translating early warning information into proactive action.

Support to ATA in Ethiopia – act. no. 28735
The Agricultural Transformation Agency (ATA) is responsible for addressing issues that limit productivity at the farmers' level as well as market issues, while also tackling underlying systemic issues. Climate change adaptation and mitigation are cross-cutting concerns. Building the capacity of the Ministry of Agriculture and Natural Resources, the Ministry of Livestock and Fisheries as well as other key players is part of ATA's mandate.

Institutional support to FIPAG in Mozambique – act. no. 29748
The Netherlands provides capacity-building support to the Fundo de Investimento e Património do Abastecimento de Água (FIPAG), the asset manager of water supply infrastructure in the major cities of Mozambique (21 cities) as well as the operator of the water supply systems. Part of the support focuses on ensuring that FIPAG's investments are more resilient to the effects of climate change.

OmiDelta programme in Benin – act. no. 29296
This activity focuses on the Ouémé river delta, more specifically on the urban and surrounding areas. Disaster risk reduction is addressed through the introduction of the Dutch Delta approach, while support to the National Water Institute in Benin reinforces national and regional capacity to cope with the uncertain effects of climate change. The National Water Institute aims to develop the capacity for data collection, hydraulic modeling and advisory services. The OmiDelta programme consists of three funding instruments: (1) a fund for the development of government projects, (2) a fund for civil-society and private-sector projects, and (3) a technical assistance instrument.

Palestinian-Dutch Academic Water Cooperation – act. no. 29135
This cooperation programme between 10 Dutch and Palestinian universities aims to tackle key challenges facing the Palestinian water sector both on a policy and on a practical level, while enhancing the capacity of the Palestinian academic institutions throughout the activities. Key challenges include increasing water productivity in the agricultural sector as well as improving river basin management and safe deltas, both of which promote an increasing resilience to climate change.

National Geothermal Capacity-Building Programme in Indonesia – act. no. 25280 works to develop Indonesia's geothermic potential at various locations, calculated to be 27,000 MW, of which only 1,052 MW (4%) was being used in 2008. A challenge for achieving geothermal goals is the lack of knowledge and capacity at the provincial governments and knowledge institutes regarding the assessment of geothermal potential and the development of geothermal production. The objective of this public-private partnership is to develop and strengthen the structure of human resources development, which is needed to provide the workforce for the development and implementation of the planned capacity for geothermal energy in Indonesia.

7.5 (E) Information under Article 10 of the Kyoto Protocol

The information on activities, actions, and programmes undertaken to meet commitments under Article 10 have already been described in various parts of this National Communication (see also the summary table in Annex 3). A brief summary:

Cost-effective programmes to improve quality of inventories/national systems (a)
This is described in Chapter 3.C (3.3.). Besides national programmes, the Netherlands also participates in the EU Monitoring Mechanism working groups, workshops, and studies on the exchange of experiences and further improvement of inventory aspects, and in G2G projects, for example with Romania, and recently with Indonesia where further exchange of experiences is implemented.

Domestic and regional programmes (b)
These are described in Chapter 4 (e.g. 4.3) and Chapter 6 (on adaptation).

Transfer of technology (c)
This is described in the previous section.

Research and systematic observation (d)
This is described extensively in Chapter.

Education and training and public awareness (e)
Chapter 9 describes the actions in the Netherlands.

Table 7 4a: Dutch provision of public financial support – summary information, 2013–2016

Provision of public financial support: summary information in 2013										
Allocation channels	*2013*									
	European euro – EUR					*USD*				
	Core/ general	*Climate-specific*				*Core/ general*	*Climate-specific*			
		Mitigation	*Adaptation*	*Cross-cutting*	*Other*		*Mitigation*	*Adaptation*	*Cross-cutting*	*Other*
Total contributions through multilateral channels:		532,836	0	71,385,593			631,045	0	89,231,991	
Multilateral climate change funds				31,621,720					39,527,150	
Other multilateral climate change funds		504,836					631,045			
Multilateral financial institutions, including regional development banks				35,214,027					44,017,533	
Specialised United Nations bodies		28,000		4,549,846				0	5,687,308	
Total contributions through bilateral, regional and other channels		74,038,509	33,664,314	106,942,487			92,548,136	42,080,393	133,678,109	
Total		74,571,345	33,664,314	178,328,080			93,179,181	42,080,393	222,910,100	

Exchange rate EUR 1 : USD 1.25

Provision of public financial support: summary information in 2014										
Allocation channels	*2014*									
	European euro – EUR					*USD*				
	Core/ general	*Climate-specific*				*Core/ general*	*Climate-specific*			
		Mitigation	*Adaptation*	*Cross-cutting*	*Other*		*Mitigation*	*Adaptation*	*Cross-cutting*	*Other*
Total contributions through multilateral channels:		12,060,766	0	90,157,228			3,155,226	0	118,627,932	
Multilateral climate change funds				11,440,200					15,052,895	
Other multilateral climate change funds		2,397,972					3,155,226			
Multilateral financial institutions, including regional development banks				71,055,842					93,494,530	
Specialised United Nations bodies		9,662,794		7,661,186				0	10,080,508	
Total contributions through bilateral, regional and other channels		71,403,956	134,351,471	86,711,871			93,952,574	176,778,251	114,094,567	
Total		83,464,722	134,351,471	176,869,099			97,107,800	176,778,251	232,722,499	

Exchange rate EUR 1 : USD 1.25

Provision of public financial support: summary information in 2015										
Allocation channels	*2015*									
	European euro – EUR					*USD*				
	Core/ general	*Climate-specific*				*Core/ general*	*Climate-specific*			
		Mitigation	*Adaptation*	*Cross-cutting*	*Other*		*Mitigation*	*Adaptation*	*Cross-cutting*	*Other*
Total contributions through multilateral channels:		2,473,580	23,098,350	154,570,319			3,342,676	31,213,986	208,878,809	
Multilateral climate change funds				6,700,000					9,054,054	
Other multilateral climate change funds		2,473,580					3,342,676			
Multilateral financial institutions, including regional development banks				139,725,228					188,817,876	
Specialised United Nations bodies			23,098,350	8,145,091				31,213,986	11,006,880	
Total contributions through bilateral, regional and other channels		28,919,817	93,032,880	118,037,994			39,080,834	125,720,108	159,510,803	
Total		31,393,397	116,131,230	272,608,313			42,423,509	156,934,095	368,389,612	

Exchange rate EUR 1 : USD 1.25

Provision of public financial support: summary information in 2016										
Allocation channels	*2016*									
	European euro – EUR					*USD*				
	Core/ general	*Climate-specific*				*Core/ general*	*Climate-specific*			
		Mitigation	*Adaptation*	*Cross-cutting*	*Other*		*Mitigation*	*Adaptation*	*Cross-cutting*	*Other*
Total contributions through multilateral channels:		3,075,262	33,692,804	198,872,817			3,342,676	36,622,613	216,166,106	
Multilateral climate change funds				26,207,500					28,486,413	
Other multilateral climate change funds		3,075,262					3,342,676			
Multilateral financial institutions, including regional development banks				148,630,796					161,555,213	
Specialised United Nations bodies			33,692,804	24,034,521				36,622,613	26,124,480	
Total contributions through bilateral, regional and other channels		27,625,660	122,614,269	86,007,038			30,027,891	133,276,379	93,485,911	
Total		30,700,922	156,307,073	284,879,855			33,370,567	169,898,992	309,652,017	

Exchange rate EUR 1 : USD 1.25

Provision of public financial support: summary information in 2013- 2016										
Allocation channels	*2013-2016*									
	European euro – EUR					*USD*				
	Core/ general	*Climate-specific*				*Core/ general*	*Climate-specific*			
		Mitigation	*Adaptation*	*Cross-cutting*	*Other*		*Mitigation*	*Adaptation*	*Cross-cutting*	*Other*
Total contributions through multilateral channels:		18,142,444	56,791,154	514,985,957			10,471,623	67,836,600	632,904,838	
Multilateral climate change funds				75,969,420					92,120,512	
Other multilateral climate change funds		8,451,650					10,471,623			
Multilateral financial institutions, including regional development banks				394,625,893					487,885,152	
Specialised United Nations bodies		9,690,794	56,791,154	44,390,644				67,836,600	52,899,175	
Total contributions through bilateral, regional and other channels		201,987,942	383,662,934	397,699,390			255,609,435	477,855,132	500,769,390	
Total		220,130,386	440,454,088	912,685,348			266,081,058	545,691,731	1,133,674,228	

Exchange rate EUR 1 : USD 1.25

All definitions are the same as in CTF Table 7.

Table 7. 4b: Dutch provision of public financial support by organisation, 2013–2016

Donor funding	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total 2013-2016	Type of support	Sector
Total contributions through multilateral channels	71,918,428.96	102,217,994.45	180,142,249.52	235,640,883.59	589,919,556.52		
Multilateral climate change funds	32,126,556.20	13,838,172.00	9,173,580.24	29,282,761.92	84,421,070.36		
1. Global Environment Facility	11,621,720.00	11,440,200.00		14,507,500.00	37,569,420.00	Cross-cutting	Other Multi-Sector
2. Least Developed Countries Fund	20,000,000.00				20,000,000.00		
3. Special Climate Change Fund							
4. Adaptation Fund							
5. Green Climate Fund			6,700,000.00	11,700,000.00	18,400,000.00	Cross-cutting	General Environment
6. UNFCCC Trust Fund for Supplementary Activities							
7. Other multilateral climate change funds							
Montreal Protocol	504,836.20	2,397,972.00	2,473,580.24	3,075,261.92	8,451,650.36	Mitigation	Cross-cutting
Multilateral financial institutions, including regional development banks	35,214,026.76	71,055,842.45	139,725,228.19	148,630,796.44	394,625,893.84		
1. World Bank	34,990,550.06	10,590,407.00	99,040,937.79	128,342,127.08	272,964,021.93	Cross-cutting	Other Multi-Sector
2. International Finance Corporation		9,962,675.84	4,488,847.40	2,208,000.00	16,659,523.24	Cross-cutting	Other Multi-Sector
3. African Development Bank	201,876.70	677,248.00	708,713.55	2,501,773.68	4,089,611.93	Cross-cutting	Other Multi-Sector
African Development Fund		42,334,357.13	28,003,339.80	12,194,298.92	82,531,995.85	Cross-cutting	Other Multi-Sector
4. Asian Development Bank		405,802.00	2,997,869.65	365,396.76	3,769,068.41	Cross-cutting	Other Multi-Sector
Asian Development Fund		7,085,352.48	4,485,520.00	3,019,200.00	14,590,072.48	Cross-cutting	Other Multi-Sector
5. European Bank for Reconstruction and Development	21,600.00				21,600.00	Cross-cutting	Other Multi-Sector
6. Inter-American Development Bank							
7. Other							
International Development Association							
International Bank for Reconstruction and Development							
European Development Fund							

Donor funding	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total 2013-2016	Type of support	Sector
Association							
ODA Budget European Union							
Regional Development Bank Group							
Specialised United Nations bodies	4,577,846.00	17,323,980.00	31,243,441.09	57,727,325.23	110,872,592.32		
1. United Nations Development Programme							
UNDP	2,875,000.00	1,486,340.00	875,000.00	1,400,000.00	6,636,340.00	Cross-cutting	Other Multi-Sector
UNDP specific programmes			61,650.29		61,650.29	Adaptation	Water and Sanitation
UNDP specific programmes			277,500.00		277,500.00	Cross-cutting	Other Multi-Sector
2. United Nations Environment Programme							
UNEP specific programmes							
UNEP	1,424,846.00	1,424,846.00	2,142,668.40	1,542,600.00	6,534,960.40	Cross-cutting	Other Multi-Sector
3. Other							
FAO	250,000.00	250,000.00	325,000.00	325,000.00	1,150,000.00	Cross-cutting	Other Multi-Sector
FAO specific programmes			504,563.08	5,156,536.15	5,661,099.23	Adaptation	Water and Sanitation
International Fund for Agricultural Development			13,372,638.86	16,242,218.38	29,614,857.24	Adaptation	Food Security
International Fund for Agricultural Development		9,639,000.00			9,639,000.00	Mitigation	Water and Sanitation
IFAD specific programmes				20,000,000.00	20,000,000.00	Adaptation	Food Security
United Nations Convention to combat Desertification			24,922.80	24,702.80	49,625.60	Cross-cutting	Other Multi-Sector
United Nations Convention to Combat Desertification	28,000.00	23,794.00			51,794.00	Mitigation	Water and Sanitation
United Nations Educational, Scientific and Cultural Organization specific programmes			655,600.00		655,600.00	Adaptation	Water and Sanitation
United Nations International Children's			6,653,643.40	5,336,267.90	11,989,911.30	Adaptation	Water and

Donor funding	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total 2013-2016	Type of support	Sector
Emergency Fund specific programmes							Sanitation
World Food Programme		4,500,000.00	4,500,000.00	4,500,000.00	13,500,000.00	Cross-cutting	Agriculture, Other Multi-Sector
World Food Programme specific programmes			1,850,254.26	3,200,000.00	5,050,254.26	Adaptation	Water and Sanitation

All definitions are the same as in CTF Table 7.

Table 7.5: Dutch climate finance through bilateral, regional and other channels disbursed in the period 2013–2016

Recipient country/region/ project/ programme	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total	Type of support	Sector
Total contributions through bilateral, regional and other channels	214,645,310.62	292,467,298.00	239,990,691.32	236,246,966.05	983,350,265.98		
Worldwide	33,664,314.31	53,590,785.00	33,205,950.81	38,960,324.88	159,421,375.00	Adaptation	Cross-cutting
Worldwide	72,271,705.72	44,568,171.00	12,378,280.00	21,147,193.40	150,365,350.12	Mitigation	Cross-cutting
Worldwide		74,390,000.00	104,472,581.34	64,705,776.61	243,568,357.95	Cross-cutting	Cross-cutting
Afghanistan		3,800,000.00			3,800,000.00	Adaptation	
Bangladesh		12,480,357.00	8,425,201.93	8,775,497.95	29,681,056.88	Adaptation	Cross-cutting, Agriculture, Water and Sanitation
Bangladesh	11,909,730.00	425,600.00		193,200.00	12,528,530.00	Cross-cutting	Energy, Agriculture, Water and Sanitation, Cross-cutting
Benin		6,070,585.00	3,806,185.87	6,857,089.05	16,733,859.92	Adaptation	Cross-cutting, Agriculture, Water and Sanitation
Benin	8,121,700.77	4,416,241.00	463,482.12	2,019,344.74	15,020,768.64	Cross-cutting	Energy, Agriculture, Water and Sanitation
Benin		10,042.00			10,042.00	Mitigation	
Bolivia		166,919.00	33,700.00		200,619.00	Adaptation	Cross-cutting
Bolivia	*1,918,973.91*				*1,918,973.91*	*Cross-cutting*	*Agriculture, Water and Sanitation, Cross-cutting*
Brazil	*20,494.10*	*712.00*			*21,206.10*	*Cross-cutting*	*Forestry, Cross-cutting*
Burundi		*1,043,168.00*	*3,445,683.60*	*2,947,801.60*	*7,436,653.20*	*Adaptation*	*Agriculture*
Burundi	*4,011,612.40*			*3,915,520.00*	*7,927,132.40*	*Cross-*	*Energy, Agriculture*

Recipient country/region/ project/ programme	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total	Type of support	Sector
						cutting	
Burundi		*231,600.00*			*231,600.00*	*Mitigation*	
Colombia		*858,269.00*	*958,996.16*	*298,313.00*	*2,115,578.16*	*Adaptation*	*Agriculture, Forestry, Cross-cutting*
Colombia	*3,874,088.27*		*103,252.74*	*10,384.80*	*3,987,725.81*	*Cross-cutting*	*Agriculture, Forestry, Cross-cutting, Water and Sanitation*
Colombia		*211,834.00*	*14,286.18*		*226,120.18*	*Mitigation*	*Cross-cutting*
Ethiopia		*8,808,005.00*	*4,638,249.79*	*14,012,102.27*	*27,458,357.06*	*Adaptation*	*Agriculture, Economic Sectors, Cross-cutting*
Ethiopia	*6,425,302.40*	*2,149,405.00*	*348,226.60*	*595,200.06*	*9,518,134.06*	*Cross-cutting*	*Agriculture, Forestry, Cross-cutting*
Ghana		*1,909,660.00*	*1,661,922.68*	*490,580.56*	*4,062,163.24*	*Adaptation*	*Agriculture, Forestry, Cross-cutting, Water and Sanitation*
Ghana	2,861,707.61		1,525,712.40	519,662.65	4,907,082.66	Cross-cutting	Agriculture, Forestry, Cross-cutting
Ghana		2,613,768.00		798,100.00	3,411,868.00	Mitigation	Economic Sectors
Great Lakes Region		1,939,907.00	2,016,089.75	1,418,954.29	5,374,951.04	Adaptation	Cross-cutting, Agriculture, Water and Sanitation
Great Lakes Region			9,945,988.75		9,945,988.75	Mitigation	Economic Sectors
Indonesia		1,410,734.00	1,069,674.40	1,054,961.44	3,535,369.84	Adaptation	Agriculture, Water and Sanitation, Cross-cutting, Economic Sectors
Indonesia	1,919,034.00	347,079.00	412,461.20	240,818.00	2,919,392.20	Cross-cutting	Energy, Agriculture, Water and Sanitation, Cross-cutting, Economic Sectors

Recipient country/region/ project/ programme	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total	Type of support	Sector
Indonesia		711,170.00	1,994,321.00	1,873,927.00	4,579,418.00	Mitigation	Energy
Kenya		6,700,687.00	3,739,334.45	5,077,945.11	15,517,966.56	Adaptation	Water and Sanitation, Other (Biodiversity), Economic Sectors, Cross-cutting
Kenya	6,123,812.00		1,017,115.98	495,121.36	7,636,049.34	Cross-cutting	Water and Sanitation, Other (Biodiversity), Cross-cutting
Kenya		935,263.00			935,263.00	Mitigation	
Mali		4,211,108.00	7,509,029.87	4,956,932.87	16,677,070.73	Adaptation	Cross-cutting, Water and Sanitation
Mali	3,251,543.11				3,251,543.11	Cross-cutting	Energy, Cross-cutting, Water and Sanitation
Morocco	87,616.20				87,616.20	Cross-cutting	Water and Sanitation
Mongolia	44,833.58				44,833.58	Cross-cutting	Energy, Cross-cutting
Mozambique		10,461,396.00	5,337,475.44	9,538,137.99	25,337,009.44	Adaptation	Economic Sectors, Cross-cutting, Producing Sectors, Water and Sanitation
Mozambique	19,490,239.92				19,490,239.92	Cross-cutting	Energy
Mozambique		3,077,405.00	3,470,814.61	763,637.00	7,311,856.61	Mitigation	Energy
Myanmar			198,897.60	255,750.80	454,648.40	Adaptation	Water and Sanitation
Nigeria				93,225.61	93,225.61	Mitigation	Cross-cutting
Pakistan	975,027.25	664,300.00	59,472.35		1,698,799.60	Mitigation	Energy
Palestinian Authority			84,800.00	436,016.83	520,816.83	Adaptation	Water and Sanitation
Palestinian Authority		66,880.00	49,075.00		115,955.00	Cross-cutting	Other Aid

Recipient country/region/ project/ programme	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total	Type of support	Sector
Regional Africa		2,253,022.00	279,424.80	8,698,652.00	11,231,098.80	Adaptation	Agriculture, Forestry, Water and Sanitation
Regional Africa	33,914,003.45	4,174,798.00	6,956,853.52	11,354,557.79	56,400,212.76	Cross-cutting	Energy, Agriculture, Forestry, Water and Sanitation
Regional Africa		17,083,200.00	1,056,654.00	2,641,113.00	20,780,967.00	Mitigation	Economic Sectors
Regional Asia		2,432,000.00			2,432,000.00	Adaptation	
Regional Asia				80,000.00	80,000.00	Cross-cutting	
Regional Asia		146,000.00			146,000.00	Mitigation	
Regional Horn of Africa			1,200,000.00		1,200,000.00	Adaptation	Cross-cutting
Regional Latin America	793,817.29	344,465.00	395,775.16	103,150.83	1,637,208.28	Cross-cutting	Forestry, Water and Sanitation
Rwanda		7,754,923.00	8,152,576.96	7,874,966.41	23,782,466.36	Adaptation	Cross-cutting, Water and Sanitation
Rwanda			1,502,454.00	501,448.40	2,003,902.40	Cross-cutting	Agriculture
Rwanda				108,463.60	108,463.60	Mitigation	Economic Sectors
Senegal		400,000.00		2,316,058.34	2,716,058.34	Adaptation	Agriculture
Senegal	1,304,999.99				1,304,999.99	Cross-cutting	Energy, Cross-cutting
Senegal		1,000,314.00			1,000,314.00	Mitigation	
South Africa	791,776.00				791,776.00	Mitigation	Energy
South Sudan		1,746,164.00	3,199,579.60	2,914,266.77	7,860,010.37	Adaptation	Water and Sanitation
Surinam	678,294.40	463,571.00	204,638.71	262,495.50	1,608,999.62	Cross-cutting	Forestry, Cross-cutting
Tanzania				200,000.00	200,000.00	Mitigation	Economic Sectors
Uganda		5,419,235.00	4,058,603.96	4,014,716.55	13,492,555.51	Adaptation	Agriculture
Uganda			586,365.20	1,010,356.80	1,596,722.00	Cross-cutting	Energy

Recipient country/region/ project/ programme	Total amount						
	Climate-specific						
	EUR	EUR	EUR	EUR	EUR		
	2013	2014	2015	2016	Total	Type of support	Sector
Uganda		84,009.00			84,009.00	Mitigation	
Vietnam	190,683.94				190,683.94	Cross-cutting	Water and Sanitation, Cross-cutting
Yemen		894,547.00	11,502.80	385,200.18	1,291,249.98	Adaptation	Water and Sanitation
Zimbabwe				1,330,000.00	1,330,000.00	Adaptation	Humanitarian Aid

Table 7.6 Provision of support for technological development and transfer

Recipient country and/or region	Targeted area	Measures and activities related to technological transfer	Sector	Source of the funding for technologi-cal transfer	Activities under-taken by	Status	Additional information
worldwide	Adaptation	Sustainable Water Fund I and II	Water and Sanitation	Public	Private and Public	Implemented	See text in Section 7.3 of NC7
worldwide	Adaptation	Dutch Risk Reduction Team	Water and Sanitation	Public	Private and Public	Implemented	See text in Section 7.3 of NC7
worldwide	Mitigation	Energising Development Partnership Programme (EnDev)	Energy	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7
worldwide	Mitigation	Energy Sector Management Assistance Program (ESMAP)	Energy	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7
Ethiopia	Adaptation	Integrated Seed Sector Programme in Ethiopia	Agriculture	Public	Private and Public	Implemented	See text in Section 7.3 of NC7
Ethiopia	Adaptation	Capacity-building for Scaling up evidence-based best Practices in Ethiopia (CASCAPE)	Agriculture	Public	Public	Implemented	See text in Section 7.3 of NC7
Uganda	Adaptation	Integrated Seed Sector Development (ISSD) and ISSD Plus Programme in Uganda	Agriculture	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7

Uganda	Mitigation and Adaptation	Solar for Farms in Uganda/Milking the Sun	Energy, Agriculture	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7
Burundi	Adaptation	Supporting Agricultural Productivity in Burundi (PAPAB)	Agriculture	Public	Private and Public	Implemented	See text in Section 7.3 of NC7
worldwide	Adaptation	Water Grand Challenge: Securing Water for Food	Water and Sanitation	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7
worldwide	Adaptation	IFAD's Adaptation for Smallholder Agricultural Programme (ASAP)	Agriculture	Public	Private and Public	Implemented	See text in Section 7.3 of NC7
Bangladesh	Adaptation	Urban Dredging Demonstration Project	Water and Sanitation	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7
Ghana	Mitigation and Adaptation	Ghana Climate Innovation Centre	Business and Other Services	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC 7
worldwide	Mitigation and Adaptation	Facility for Entrepreneurship and Food Security	Agriculture	Private and Public	Private and Public	Implemented	See text in Section 7.3 of NC7

8 RESEARCH AND SYSTEMATIC OBSERVATIONS

8.1 (A) General policy on research and systematic observation

General policy and funding
Research activities in the Netherlands cover the themes: climate system, impact and policy support, and implementation studies. These activities are characterised by:

- intensive participation in international and European programmes, the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW) coordinate Dutch contributions to the international research arena;
- clustering into a large national research network of the Netherlands knowledge innovation programme for water and climate (NKWK)

The Ministry of Infrastructure and Water Management (I&W) is the leading department on adaptation to climate change and supports research on climate-proofing the Netherlands, and supports research on water and infrastructure; the Ministry of Economic Affairs and Climate Policy focuses on as innovation, energy infrastructure, emissions from industrial sectors, and climate policy; the Ministry of Agriculture, Nature and Food Quality deals with nature, agriculture, and fisheries, as well land use.

With regard 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 the implementation of the Netherlands contribution to GCOS has not yet been established. A well defined structure is lacking as no funding and resources are available. Moreover, a national focal point for GCOS is missing.

Cooperation in scientific and technical research/exchange of data
Cooperation is assured through clustering nationally and internationally. The national research programmes actively seek private-sector participation and facilitate the dialogue between stakeholders from scientific, policy, and private sectors. To overcome barriers to the exchange of data and information, the national research programmes closely coordinate their communication and research activities.

The research community in the Netherlands participates in a few European Joint Programming Initiatives for climate: JPI Climate, Facce (agriculture), Oceans and Water. These initiatives aim at aligning various fields of climate research activities in the different countries. They have been supportive in framing the content of Horizon 2020, the new European research programme. JPI's are supported by the Dutch government.

Monitoring activities on systematic observation and GCOS in the Netherlands are firmly embedded in international programmes such as the Framework programmes, on a European level, and GEOSS, on a global level. We also see international cooperation at the individual project level, e.g. developing Earth and NASA missions, and data-retrieval methods. Data are exchanged internationally and submitted to numerous databases around the world.

Results from the international, European, and national research programmes are made available to the international community through reports and (online) publications. These results can often be obtained free of charge or at low cost.

8.2 (B) Research

8.2.1 Cooperation in European research

Many of the leading Dutch institutions participate in research projects under the EU's Horizon 2020 Research and Innovation programme and the Copernicus Climate Change Service (C3S). Horizon 2020 is organised along three pillars: excellent science, industrial leadership and societal challenges. The synergy and cooperation between European projects and the national research programmes reinforce the crucial international dimension to Dutch research activities. The most relevant research projects and networks financed by the EU's Horizon 2020 programmes in which the Netherlands contribute are: Development of Climate Services, Climate Modelling, Seasonal / Decadal Prediction, Process Studies, and Satellite Services. These projects are Integrated Project, Network Activities, Infrastructure Programmes, and Transnational Access Programmes.

The Copernicus Climate Change Service is in the development phase and will combine observations of the climate system with the latest science to develop authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide. The portfolio of service products will include: consistent estimates of multiple Essential Climate Variables (ECVs), global and regional reanalyses (covering a comprehensive Earth system domain: atmosphere, ocean, land, carbon). products based on observations alone (gridded; homogenised station series; reprocessed Climate Data Records including Data Rescue), a near-real-time climate monitoring facility, multi-model seasonal forecasts and climate projections at global and regional scales. This wealth of climate information will be the basis for generating a wide variety of climate indicators aimed at supporting adaptation and mitigation policies in Europe in a number of sectors.
The EU-programme InGOS, Integrated non-CO2 Greenhouse Gas Observing System[163] coordinated by ECN and involving 34 partners from 15 countries and has been finalized in 2016. This programme integrated the observing capacity of Europe on non-CO_2 greenhouse gases. The infrastructure project worked on standardising the measurements, strengthening the existing observation sites into supersites, capacity building in new member states, and preparing for integration of the network with other networks already in place or being set up (e.g. ICOS).

8.2.2 Cooperation beyond the European domain

The Netherlands' research on climate change is well embedded in, acknowledged by and co-steered within three large international scientific programmes in the field of global change research: the International Geosphere Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), and the International Human Dimensions Project (IHDP). The Royal Netherlands Meteorological Institute (KNMI) participates in IGBP and (through its WMO membership) in WCRP.

Extensive support is also given to the work of the Intergovernmental Panel on Climate Change (IPCC). KNMI coordinates the Netherlands' contributions to the IPCC. Research for Working Group I in mainly carried out by KNMI and by the Utrecht University and for Working Groups II and III by Wageningen University and Research Centre (WUR) and the Netherlands Environmental Assessment Agency (PBL). Seventeen Dutch scientists contribute as (lead) authors to the 5th IPCC assessment report, while the Environmental Assessment Agency (PBL) has made the head of the Technical Support Unit for the Synthesis Report. The IPCC sixth assessment cycle started in 2015. Dutch scientists participated in the scoping meetings for the sixth assessment report, the three Special Reports and the refinement of the

[163] http://www.ingos-infrastructure.eu/

methodology report. The Netherlands also hosts a number of international programmes that specifically aim at technology transfer and international cooperation (see chapter 7).
The Netherlands is involved in the Belmont Forum[164], a high-level group of world's major and emerging funders of global environmental change research and international science councils. It aims to accelerate international research by aligning and coordinating the participants' research programmes. In October 2015 the Netherlands Organization for Scientific Research (NWO) joined the Belmont Forum membership too and is participating in the Group of Program Coordinators dealing with Climate Predictability and Inter-Regional Linkages, while Wageningen University and Research Centre (WUR) is in the Group dealing with Food Security and Land Use Change. Additional NWO is one of the Thematic Programme Office for the Group on Transformations to Sustainability, with NWO as Era-Net Coordinator for NORFACE Era-Net.

During the COP23 in Bonn the Global Centre of Excellence on Climate Adaptation (GCECA) has been launched. GCECA focuses its activities on those areas where acceleration is most needed: where action is most urgently required and where this is complementary to the work of others. It is an independent organisation, working across the Global North and South, with offices in the Netherlands (Rotterdam and Groningen). GCECA was initiated by UN Environment, the government of the Netherlands and NIES Japan and has established partnerships with global organisations, NGOs, governments, financial institutions knowledge institutions and businesses to accelerate climate adaptation.

National research programmes The Global Facility for Disaster Reduction and Recovery (GFDRR) is a global partnership that helps developing countries better understand and reduce their vulnerability to natural hazards and climate change. GFDRR is a grant-funding mechanism, managed by the World Bank, that supports disaster risk management projects worldwide. Working on the ground with over 400 local, national, regional, and international partners, GFDRR provides knowledge, funding, and technical assistance. GFDRR, in partnership with France, the World Bank, WMO, and UNISDR, has launched the CREWS Initiative to finance weather stations, radar facilities, and early warning systems in poor and vulnerable countries where weather data is unreliable or lacking. The Netherlands is participating in CREWS with climate analysis and data in the Indonesian region (in the context of the Joint Cooperation Programme Indonesia) following the well-established European Climate and Data project (ECAD). Plans exist to extend this for the West-African region as well.

8.2.3 National research programmes

General
National research programmes add to, and support, international research programmes. The national research activities in the Netherlands include:

- Research programme through NWO
- Research programmes supported by various ministries
- Knowledge networks and programmes

Below we describe the programmes in some more detail.

Beyond the programmes described below, the Netherlands is an active participant in the Joint Programming Initiative for Food, Agriculture and Climate Change (JPI-FACCE), a EU-programme aiming at aligning national research programmes in this area and advising EU Member States and the European Commission on research needs. In this respect, JPI FACCE has spawned an ERA-net on Climate Smart Agriculture in 2013.

[164] http://www.belmontforum.org/about/

Research programmes through NWO
Within the NWO theme Water and Climate, climate scientists, hydrologists, oceanographers, civil engineers, information technologists, chemists, and fluid mechanics experts are working together on research issues centred around water.[165] The Dutch government has designated nine top economic sectors that are the most important to the Netherlands, in which it is a world leader, and in which the government will make targeted investments in coordination with private industry and research institutes. Research within the NWO theme Water and Climate generates knowledge that is important for the top sector Water. This top sector includes the three clusters of Water Technology, Delta Technology, and Maritime Technology / Research. Dutch knowledge and expertise in the area of these three clusters ranks among the best in the world. The activities of the top sector Water and the priority areas of the NWO theme Water and Climate are closely aligned.
NWO[166] contributes 275 million euro annually to the top sectors, of which more than 100 million euro in the context of public-private partnership (PPP) in which scientists and businesses set up and finance research projects together. NWO selects the research projects to be funded via the system of competition and according to NWO's customary quality standards. As the research themes are so relevant to society, knowledge utilisation is an important focus within the top sectors

The Netherlands Polar Programme funds scientific research into and in the polar regions. On behalf of the Netherlands, the programme contributes to solutions for fundamental scientific and socio-political issues, such as the consequences of climate change. As a signatory to the Antarctica Treaty, the Netherlands is also obliged to carry out scientific research in Antarctica. One of the focal points of the Netherlands Polar Programme is the construction of a Dutch research facility on the Antarctic Peninsula.[167]

Integrated Research in the NWO Theme Sustainable Earth and the National Programme Knowledge for Climate is part of the NWO Theme Sustainable Earth and is being realised under the auspices of the National Partnership for Sustainable Earth research (NPDA), whose members include the NWO, Knowledge for Climate Foundation, Energy research programmes, and several larger and smaller institutes that direct research in the field of sustainability and the Earth.

Feedbacks in the Climate System is a programme that aims to generate knowledge focused on quantifying uncertainties in the climate system, and in particular for the development of this system in the longer term until the year 2200. Knowledge of the climate system is vital for the development of policy based on scientifically supported scenarios of climate change. Useful predictions and scenarios can only be modelled if the many gaps in knowledge that exist with respect to the complex climate system are filled. Although climate research is interdisciplinary by its very nature, it has to date strongly focused on the physical and chemical processes involved and representations of these in climate models.

The Open Programme funded under NWO strives to be a breeding ground for innovation and talent. Proposals are not related to a theme or ambition. The Open Programme's aim is to promote innovative scientific research of a high quality across the entire breadth of the earth and life sciences. The earth and life sciences research domain covers geology, the seas, the atmosphere, living organisms in the biosphere, and the interactions between and within these facets.[168]

The National programme on Sea and Coastal Research (ZKO) [169] aims to facilitate collaboration between various research institutes in this field. Research focuses on strengthening the understanding and

[165] http://www.nwo.nl/en/our-ambitions/Collaboration+in+themes/Water+and+Climate/about+this+theme
[166] https://www.nwo.nl/en/policies/top+sectors
[167] http://www.nwo.nl/en/research-and-results/programmes/Netherlands+Polar+Programme
[168] http://www.nwo.nl/en/funding/our-funding-instruments/nwo/free-competition/alw/open-programme.html
[169] https://www.nwo.nl/en/documents/alw/national-programme-sea-and-coastal-research-zko---programme-booklet

knowledge of coastal development, the role of biogeochemical cycles and particle flows in relation to water quality, the capacity for a sustainable yield of the ecosystem, changes in biodiversity, the influence of seas and oceans on climate change, and the effects of climate change on the marine system. This understanding can provide a basis for possible predictions. The ZKO programme is divided into three sub programmes, chosen by geographical location (Coastal Zone and Wadden Sea, North Sea, Oceans).

Furthermore, there are some internationally oriented programmes for which the first calls for proposals were launched recently. Urbanizing Deltas of the World[170] aims to contribute to global water safety, water and food security, and sustainable economic development in river deltas worldwide. Increasing pressure and climate changes in these areas demand more effective and efficient responses. A second international, merely DFID-funded programme, is directed at Conflict and Cooperation in the management of Climate Change[171] with the objective to strengthen the evidence of the impact of climate change and climate change policies on conflict or cooperation in developing countries.

More specific R&D programmes, supported by various ministries

Various Ministries have Policy-Support Research, including studies stipulated from questions from the Ministries, where appropriate in consultation with other organisations:

- Up to 2017 the studies for Infrastructure and Environment were clustered within a scientific assessment and policy analysis programme on climate change issues. From 2017 these topics are integrated in the regular work of PBL and RIVM;
- With 'knowledge basis research' (KB) Wageningen University and Research Centre provides the basis for answers to questions that will be relevant for the Ministry of Economic Affairs and other stakeholders in three to five years. The knowledge base program "Sustainable development of the blue green space" is a broad program where many parties are involved. KB research thematically focuses on developing expertise that can support medium-term governmental policies in the green-blue domain on aspects of :
  a) mitigation, including increasing societal pressure to achieve a transition to climate-neutral agriculture and food production, production and use of biofuels, and efforts to maximise net effects on emissions, and knowledge in the area of emissions and absorption of greenhouse gases from land use. These include analysis of relevant biophysical processes, management and improving monitoring techniques;
  b) adaptation of agriculture and fisheries to actual (and expected) climate change and rising sea levels, as well as nature conservation, questioning the policy on species (and Natura 2000), and on dealing with the risks of new diseases and pests in both agriculture and nature;
  c) impact of climate change and international climate policy on the dynamics of international markets for raw bio produce, and hence the nature and profitability of companies in this sector.
- As reported in the BR2, R&D related to energy transition is to a large extent implemented through the top sector approach as mentioned ahead and in chapter four. One of the top sectors is Top Sector Energy (TSE)[172]: the driving force behind innovations that are necessary for the transition to an affordable, reliable and sustainable energy system. The transition paths from the energy agenda determine the priorities of the TSE. The programme management initiates stimulates a dialogue

[170] http://www.nwo.nl/en/research-and-results/programmes/Urbanising+Deltas+of+the+World
[171] https://www.nwo.nl/en/research-and-results/programmes/conflict+and+cooperation+in+the+management+of+climate+change+%28ccmcc%29
[172] https://topsectorenergie.nl/en

between the national government and parties in society and promotes connection. Within the top sector energy platform business people, trendsetting companies, knowledge institutes, and creative non-governmental organisations (NGOs) work together on central energy related themes. Each platform, with a non-governmental chairperson, plays a stimulating role to get RD&D and the market moving and to find new ways to realise sustainable initiatives. Altogether, initially seven themes had been defined on which focus should be in RD&D in order to realise a sustainable energy supply. Some have later been combined or redirected. The themes have been chosen because they offer the Netherlands considerable economic opportunities and are feasible for this country. A platform has been set up for each theme: off shore wind energy, energy and industry, biobased economy, urban energy, new gas and system integration. Supportive programmes include projects and activities in the field of socially responsible innovation approaches and on human capital agenda.

Knowledge networks and programmes

The Delta Programme[173]. The Delta programme was initiated in 2010 to address the issue of keeping the Netherlands attractive to both live and work in for future generations. In 2014 five decisions have been approved by the Dutch government on water safety, availability of fresh water, spatial adaptation, IJsselmeer (lake used for fresh water storage) and on the Rhine Meuse delta (division water across the rivers). Questions in the knowledge agenda 2015 have been included in the knowledge development programmes of the Ministry of Infrastructure and Water management, STOWA, KNMI, Deltares, and universities. The articulated knowledge questions also have been directive for the new knowledge and innovation agenda. NWO translated the research questions into the calls of Urban Deltas of the World and New Deltas. In 2017 a signal group of the Delta Programme has been established. This group is aiming to signalling new insights in the field of natural sciences and socio-economic development, which maybe important for adapting the strategy of the Delta Committee.

The National Climate Adaptation Strategy (NAS) aims at making the Netherlands more climate-resilient. The NAS is the result of a participative process involving public sector authorities at regional and local level, water management authorities, knowledge institutes, private sector companies and societal organizations. The programme is complementary to the Delta Programme and considers seven sectors: energy systems, ICT networks, transport and infrastructure, health, agro-food, fishery and nature. The NAS includes the combined inputs of experts in a wide range of disciplines and workshops with stake holders. The NAS is now working towards implementation.

The National Knowledge and innovation programme on Water and Climate (NKWK) is a national programme within which government authorities, knowledge institutes and companies, work in conjunction on pilot projects, topical issues and long-term developments. It invests in knowledge and innovation with courage, vision and entrepreneurial spirit. The NKWK brings the parties together, which leads to surprising and promising connections. However, NKWK has no financial resources and contributions of participating institutes are in-kind. The NKWK serves as the Dutch Wing of the Delta Alliance. An international knowledge-driven network organisation with the mission of improving the resilience of the world's deltas. With increasing pressure from population growth, industrialisation and a changing climate, it is more important than ever that these valuable and vulnerable locations increase their resilience to changing conditions.

[173] http://www.rijksoverheid.nl/onderwerpen/deltaprogramma

8.3. (C) Systematic observations

The Netherlands actively participates in the various fields of climate-related monitoring, both nationally and within European and global programmes, including atmospheric climate observation systems, including those measuring atmospheric constituents; ocean climate observation systems; and terrestrial climate observation systems. Here, we summarize the ground-based observations, ocean observations, and satellite observations and briefly discuss an integration effort.

8.3.1 Ground-based observations

Systematic observations of many climate parameters are carried out in a network of over 40 observation stations spread out over the Netherlands and the continental shelf attributable to the Netherlands. These observations are enhanced by special observational programmes carried out at CESAR[174].

CESAR
The Cesar Observatory is located in the western part of the Netherlands (51.971° N, 4.927° E) in a polder 0.7 m below mean sea level. At the site, a large set of instruments is operated to study the atmosphere and its interaction with the land surface.

The Cesar site is used for a) Monitoring of long term tendencies in atmospheric changes, b) Studies of atmospheric and land surface processes for climate modelling, c) Validation of space-borne observations, d) The development and implementation of new measurement techniques, and e) Training of young scientists at post-doc, PhD, and master level.

Three universities and five major research institutes collaborate in Cesar [KNMI, TUDelft, WUR, TNO, ECN, ESA, UU, RIVM]. It is the focal point of experimental atmospheric research in the Netherlands and is internationally connected through EU-funded research and transnational access programmes.

CESAR is one of the selected certified stations for the GCOS Reference Upper-Air Network, GRUAN[175]. CESAR, through GRUAN, provides long-term, highly accurate measurements of the atmospheric profile, complemented by ground-based state of the art instrumentation, to constrain and calibrate data from more spatially-comprehensive global observing systems (incl. satellites and current radiosonde networks), in order to fully characterize the properties of the atmospheric column and their changes. GRUAN is envisaged as a network of 30-40 high-quality, long-term, upper-air observing stations, building on existing observational networks. GRUAN builds on, but is not confined to, the larger GCOS Upper Air Network (GUAN).

CESAR, through ICOS,[176] contributes to a European effort to understand and predict the global carbon cycle. The aims of the Integrated Carbon Observation System [ICOS] are to a) provide the long-term observations required to understand the present state and b) predict future behaviour of the global carbon cycle and greenhouse gas emissions, and c) to monitor and assess the effectiveness of carbon

[174] http://www.cesar-observatory.nl/
[175] http://www.wmo.int/pages/prog/gcos/index.php?name=GRUAN
[176] http://www.icos-infrastructure.eu/
[15] http://www.actris.eu/

sequestration and/or greenhouse gases emission reduction activities on global atmospheric composition levels, including attribution of sources and sinks by region and sector.

CESAR, through ACTRIS [177] participates in an integrated project for measuring policy-relevant parameters. ACTRIS (Aerosols, Clouds, and Trace gases Research InfraStructure Network) is a European Project aiming at integrating European ground-based stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds, and short-lived gas-phase species. ACTRIS will have the essential role of supporting the accumulation of new knowledge as well as policy issues on climate change, air quality, and long-range transport of pollutants.

BSRN

The Baseline Surface Radiation Network (BSRN) is a project of the Data and Assessment Panel from the Global Energy and Water Cycle Experiment (GEWEX) under the umbrella of the World Climate Research Programme (WCRP) and as such is aimed at detecting important changes in the Earth's radiation field at the Earth's surface which may be related to climate changes. The data are of primary importance in supporting the validation and confirmation of satellite and computer model estimates of these quantities. The Netherlands participate with several radiation measurements to this network.

Paramaribo

Paramaribo[178] station was established in 1999, under a grant from the Foundation for Netherlands Scientific Research (NWO), as a joint initiative of KNMI and the Meteorological Service of Surinam (MDS). Here, there is a programme to measure ozone profiles and ozone columns at regular intervals through the troposphere and stratosphere. The programme was supported for several years by the EU-programme STAR but is now fully funded by KNMI. There is considerable synergy with other research groups, notably with several German groups that take their observations at the same location.

Other

Climate / Synoptic station observations in the Netherlands are communicated with the Regional Basic Synoptic Network and the Regional Basic Climate Network of the World Meteorological Organisation (WMO).[179]

A special Particulate Matter [PM] measurement programme is in place to monitor the regional variations in aerosol concentration run by the Dutch Institute for Health and Environment (RIVM)[180]

8.3.2 Ocean-based observations, ARGOS

The Dutch effort of systematic oceanic observations are bundled in the ARGOS[181] programme. Argos is a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection. The Netherlands supports 7 floats.

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[178] http://www.knmi.nl/samenw/paramaribo/
[179] http://www.wmo.int/pages/prog/www/ois/rbsn-rbcn/rbsn-rbcn-home.htm
[180] http://www.rivm.nl/bibliotheek/rapporten/680704018.html
[181] http://www.argo.ucsd.edu/index.html

8.3.3 Satellite-based observations

Satellite records are comprehensive enough now that systematic long-tem records can be obtained. Under the auspices of EUMETSAT, the Netherlands participates in a number of Satellite Application Facilities (SAFs[182]) with the express aim of developing high quality operational products to be used for weather and climate purposes. The specific SAFs in which the Netherlands participates through KNMI are the Climate Monitoring SAF, The Ocean, Sea and Ice SAF, the Ozone and Atmospheric Chemistry SAF, and the Numerical Weather Prediction SAF.

The Netherlands also participates vigorously in ESA's CCI initiative. To respond to the need for climate-quality satellite data, the European Space Agency (ESA) has set up the ESA Climate Change Initiative or CCI[183]. The aim of the programme is to realize the full potential of the long-term global Earth Observation archives that ESA, in cooperation with its member states, has established over the last thirty years, as a significant and timely contribution to the ECV (Essential Climate Variables) databases required by United Nations Framework Convention on Climate Change (UNFCCC).

The goal is to provide stable, long-term, satellite-based ECV data products for climate modellers and researchers. The ECVs will be derived from multiple satellite data sets (not just ESA but all sources via international collaboration) and include specific information on the errors and uncertainties of the data set. Comprehensive information will also be provided on calibration and validation, long-term algorithm maintenance, data procurement, and reprocessing. The Climate Change Initiative will bring together European expertise covering the full range of scientific, technical, and development specialisations available within the European Earth Observation community, and will establish lasting and transparent access for global climate scientific and operational communities to its results. The contributions to the CCI initiative of the Netherlands are though the themes Aerosol, Cloud and Ozone (all through KNMI), Greenhouse Gases (SRON), and Land Cover (WUR).

Since 1995, KNMI is involved with reprocessing and data supply of atmospheric composition using the satellite (instruments) of GOME / SCHIAMACHY / GOME2 / OM I[184].

Furthermore, the Netherlands had the lead in developing a new satellite system TROPOspheric Monitoring Instrument (TROPOMI)[185] on board of the Copernicus Sentinel-5 Precursor satellite that is probing the atmospheric composition with unsurpassed resolution and accuracy from October 2017 onwards.

[182] http://www.eumetsat.int/website/home/Satellites/GroundSegment/Safs/index.html
[183] http://www.esa-cci.org/
[184] http://www.temis.nl/
[185] http://www.tropomi.nl/?lang=en and http://www.tropomi.eu/

9 EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1 General policy towards education, training and public awareness

Introduction

Education, awareness and public participation are key to building a wider circle of informed individuals who are able to review and take decisions that will be crucial for achieving the Sustainable Development Goals (as included in the 2030 Agenda for Sustainable Development) and fulfilling the Paris Climate Agreement.

This chapter describes governmental activities in the Netherlands for education, training and public awareness regarding climate change. It also describes actions by other parties such as NGOs, as well as actions undertaken to cooperate in and promote international development or implementation of education and training programmes.

Websites

The government publishes extensive information on climate change policies and plans on various websites. Important websites, both from the government and from other organisations, are mentioned throughout this communication. The website of the Dutch government[186] contains a dossier on climate change, which explains the causes and nature of climate change as well as the consequences for the Netherlands. It also describes national and international climate policy, provides links to other relevant websites and publishes press releases. At present, most governmental information on environmental and climate issues is found on the websites referred to in the footnote above, in Dutch as well as in English. More specific information is also provided in Section 9.6.

General policy of the Dutch government

There is a high-level mandate for education, training and public awareness. The Dutch climate envoy is responsible for following up on this matter and works closely with the Ministries of Education, Infrastructure and Foreign Affairs, as well as with NGOs and in particular youths. The climate envoy is also the ACE National Focal Point for the UNFCCC.

In summary, the general policy to promote education, training and public awareness is aimed at:

- integrating sustainability in the curricula of primary and secondary education (see Section 9.2);

[186] https://www.rijksoverheid.nl/; https://www.government.nl
https://www.rijksoverheid.nl/onderwerpen/klimaatverandering
https://www.rijksoverheid.nl/onderwerpen/duurzame-energie
https://www.rijksoverheid.nl/onderwerpen/duurzaam-bouwen-en-verbouwen
https://www.rijksoverheid.nl/onderwerpen/energielabel-woningen-en-gebouwen
https://www.government.nl/
https://www.government.nl/topics/climate-change
https://www.government.nl/topics/renewable-energy
https://www.government.nl/topics/energy-performance-certificates-for-homes-and-buildings

- fostering the network of initiatives, organisations and educational institutions that work on education for sustainable development (see Section 9.2 as well);
- funding organisations which contribute to increasing awareness of climate change (see Section 9.3 and throughout this chapter);
- organising events to build momentum and create partnerships (see Section 9.4).

In the implementation of these actions, working with youths is a cross-cutting aim.

A number of ministries implement activities in education, training and public awareness in their respective fields of responsibility. The Ministry of Infrastructure and the Environment (I&M)[187] was responsible for coordinating national climate policy, the reduction of non-CO_2 greenhouse gases, the Clean Development Mechanism and Joint Implementation projects, energy savings in transport and the adaptation of Dutch water management to climate change. At present the Ministry of Economic Affairs and Climate Policy (EZK) is responsible for industrial energy savings, renewable energy, and (since end of 2017) also the coordinating the national climate policy. The Ministry of Agriculture, Nature and Food Quality is responsible for the energy savings in agriculture and LULUCF (land use, land use change and forestry). The Ministry of the Interior (BZK) bears the responsibility for sustainable building and energy efficiency in residential and non-residential buildings. In the approach taken, we may distinguish between activities responding to *general elements and needs* of climate change on the one hand and related actions and activities responding to more *specific needs* of target groups through policies and measures on the other hand.

General trends in public awareness of climate change
In the Netherlands, there is a significant public awareness of climate change. A number of surveys, carried out for the former Ministry of I&M (or others) with relative frequency, confirm a high level of awareness; e.g. Wissels omzetten: 21e eeuw vraagt om robuust milieubeleid, PBL Netherlands Environmental Assessment Agency, 2013[188] and Omgevingsbeeld Duurzaamheid en Milieu 2012, Ministry of I&M, 2013 (in Dutch), a survey into the awareness, knowledge, attitude and behaviour (in practice) of the general public.

A large survey conducted by the government, “Continu Onderzoek Burgerperspectieven”, reported the following results at the end of 2016[189]:
- Of the respondents, 46% think that the Netherlands should lower its use of fossil fuels more rapidly than it does now.
- Only 40% of the respondents think it clearly proven that fossil fuels have an effect on climate change, 27% are neutral, 14% do not know and 19% disagree.

[187] At the end of the year 2017, the responsibilities of the Ministries changed due to the new Cabinet; Climate Policy is now within the Ministry of Economic Affairs and Climate Policy; water management still remains within the Ministry of Infrastructure and Water Management.
[188] http://www.pbl.nl/node/57074
[189] https://www.scp.nl/Publicaties/Alle_publicaties/Publicaties_2016/Burgerperspectieven_2016_4

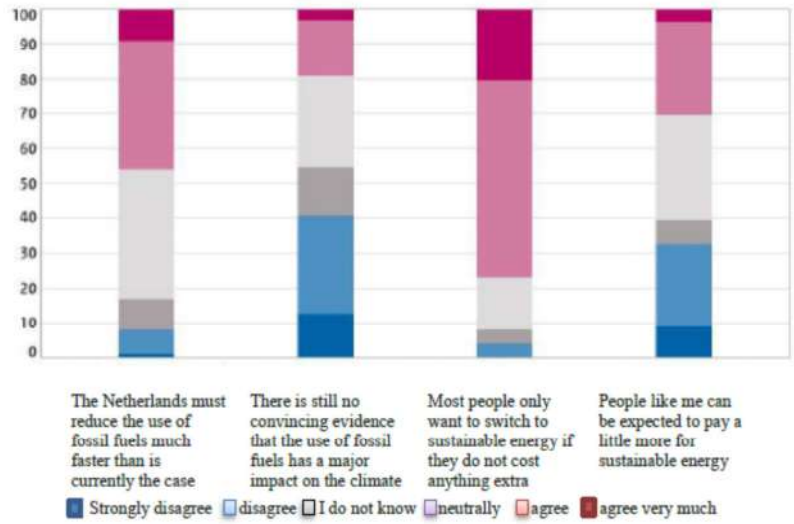

Figure 9.1 Opinions on climate impact of fossil fuels, 2016

Public access to environmental information

Public access to environmental information that is available from the government, including data on greenhouse gas emissions and energy use, has been further strengthened as a result of the Aarhus Convention and implemented into Dutch law. Data on greenhouse gas emission as reported by companies to the government are publicly available; arguments about the competitive sensitivity of business and manufacturing data are no reason to treat emissions data as confidential. Detailed data on greenhouse gas emissions in the Netherlands are easily accessible to the public on the website of the Pollutant Release and Transfer Register [190], while broader information on climate and the environment is available on websites[191].

The government also publishes extensive information about climate change policies and plans on various websites. Important websites, both from the government and from other organisations, are mentioned throughout this communication.

9.2 Primary, secondary and higher education

Sustainability and the primary and secondary education curriculum
Over the next few years, the theme of sustainability will be given increasing attention in primary and secondary education. It will also be included in the comprehensive review of the formal primary and secondary education curriculum, launched in 2016. The ideal situation is when schools apply the curriculum content alongside sustainable operational management and integration of sustainability concepts in their own policies as well as in their relationships with local sustainability partners. Both the ACE National Focal Point (climate envoy) and the Dutch youth representatives are involved in this process to ensure that sustainability is properly integrated.
The Dutch government launched a large consultative process on “Onderwijs 2032” (Education 2032), the future of education. This initiative was aimed at making the substance of the education system more future proof[192].

[190] http://www.emissieregistratie.nl/erpubliek/bumper.en.aspx
[191] www.rivm.nl; www.knmi.nl; www.pbl.nl
[192] http://onsonderwijs2032.nl/

Education and training are aspects of the work carried out by intermediary organisations such as Netherlands Enterprise Agency (RVO.nl), Rijkswaterstaat and Milieu Centraal. For example, the Milieu Centraal website includes a subsection for pupils at the levels of primary and secondary education. Examples are given in the following sections.

Integral approach to education for sustainable development

In 2014, youth organisations joined forces and urged for an increase in education for sustainable development (ESD). Together with multinational corporations, teacher unions and research institutes, the youth organisations managed to sign an agreement with a majority of Parliament to take the next step in education for sustainable development. The government reacted to this agreement with a request for comprehensive research on two points: 1) how are we currently doing in terms of education for sustainable development and 2) what is needed to take things forward?

The report[193], published in 2015, notes that one of the areas where the Netherlands is performing well (in an international perspective) is taking an integrated approach to education for sustainable development. Research by UNECE, among others, shows that education for sustainable development in many countries is restricted to "green themes" within the realm of nature or the environment and is focused on primary education. In the Netherlands, there tends to be a more comprehensive view of education for sustainable development. Having said so, the report notes that – especially in the formal education system – there is limited support for schools to move forward on this topic. Furthermore, structural implementation is far from optimal, as can be seen in the table below.

The research found that only a very limited number of schools effectively integrated education for sustainable development. The classification "sustainable educational institution" was awarded to 4% of schools in primary education, 9% in secondary education, 7% of higher education institutions and 11% of research universities.

SECTOR	SCHOOLS/PROG.	% (approx.)	COMMENTS
Primary	229	4%	
Secondary	119	9%	
Secondary vocational	Unclear	Unclear	100% of Agricultural Training Centres (AOCs) are working on sustainability. At Regional Training Centres (ROCs), the picture is too fragmented to be able to give a clear percentage.
Higher professional	120	7%	17 universities of applied sciences are working via DUPLHO on collaboration in the area of sustainability.
University	152	11%	7 universities have named sustainability as a key issue in their vision.

Table 9.1 Schools and integrated education for sustainable development, 2015

Source: Research report sustainable education, page 4

The report notes that there are also initiatives offered to schools by non-school actors, which makes the situation a little brighter. Still, these initiatives are often ad hoc and focus only on a subfield of sustainability (e.g. food or water). As a result, they only contribute a limited amount to integrating the sustainability of the Dutch education system.

[193] https://www.rijksoverheid.nl/documenten/rapporten/2015/06/29/rapportage-onderzoek-duurzaam-onderwijs

To this end, the report proposes the strengthening of partnerships and connections between different actors (at the local, regional and national level) as a next step. This process could help to institutionalise all the actions that different actors are taking and to set a more comprehensive course to integrate education for sustainable development into the system. The report notes that leadership is needed to achieve this goal and that the establishment of an institute could be a means to facilitate it.

Finally, the report noted that there was limited cooperation between different actors in the realm of education for sustainable development.

Cooperation Learning for Tomorrow (Coöperatie Leren voor Morgen)
As a follow-up to the above report, a broad-based collaboration project, "Learning for Tomorrow" was launched in 2016 by a number of existing youth networks – such as the National Youth Council – together with existing education networks, which will arrange financial, knowledge and resource support through the DD programme. "Learning for Tomorrow" unites three different approaches:

- expertly connecting substantive sustainability themes with education partners (such as water education, food education and concrete questions from the business sector);
- facilitating networks and sharing best practices; and
- working on a more conceptual integration of sustainability into the education system, based on the demand from schools.

Figure 9.2 presents an overview of the relationships between the key players in education and the relevant actors in sustainable development, subdivided into the preschool period (kinderopvang, 0–4 years), primary education (primair onderwijs, 4–12 years), secondary education (voortgezet onderwijs, 12–18 years), and senior secondary vocational education (middelbaar beroepsonderwijs, 16–20 years) and higher education (hoger onderwijs, 18–22 years)[194].

[194] https://www.duurzaamdoor.nl/sites/default/files/Praatplaat%20Duurzaam%20Onderwijs%20A2.pdf
https://www.duurzaamdoor.nl/projecten/leren-voor-morgen

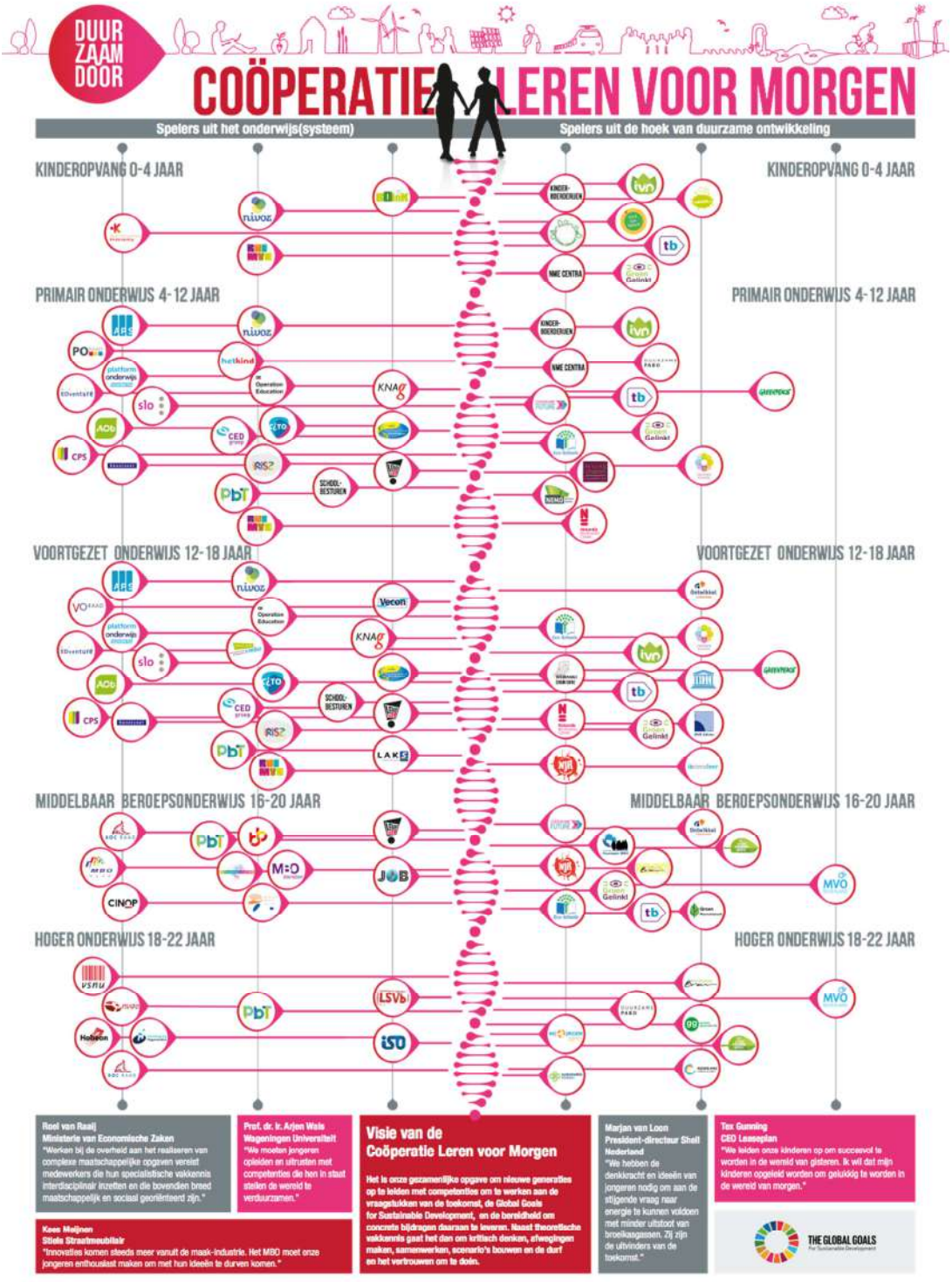

Figure 9.2: relationship between key players in education

Learning for Sustainable Development – Duurzaam Door[195]

Just as its predecessors "Learning for Sustainable Development" and "Environmental Education", the Dutch Intergovernmental Programme "Duurzaam Door" (Continue Sustainably, established in 2004) stimulates learning processes for sustainable development. The target group comprises both youths and adults. This programme, funded by Netherlands Enterprise Agency (RVO.nl), finances different organisations that are active in education, training and public awareness. Together, these organisations form a platform to facilitate policy advice, knowledge and contacts between local governments, entrepreneurs, and education, research and civil organisations. Themes that play a central role are energy, water, biodiversity, natural resources and food.

The programme promotes and enhances the inclusion of climate change issues in school curricula and teacher training programmes. It does so by supporting networks of organisations in the field of education and teaching, publications, projects, and so on. Furthermore, it stimulates "social learning" by facilitating the cooperation between professionals, local or regional government officials and other participants in decision-making processes so as to resolve problems, carefully balancing the interests of people, nature and the environment, and the economy. In the period 2008–2011, a number of projects and actions were developed targeting education, local and regional government, companies, and more[196].

From 2013, with the start of the new Duurzaam Door programme, energy is one of the leading topics. Knowing and establishing regional networks and trying to work together on national or international policies is the main focus of the Duurzaam Door programme. The Dutch policy for the Energy top sector is an important policy document in this regard. Projects include cooperating with the formal education sector on so-called Energetic Schools, where local governments, schools and environmental organisations work together to save energy in schools. A concrete example is the publication produced by the organisation for Sustainable Educational Training for Primary Schools (Duurzaam PABO) at the end of 2012, in which these UNECE elements were presented in a practical way for use within primary schools[197]. Both civil society and the business sector are also involved in programmes and activities to promote energy literacy.

For the period 2017–2020, this programme will be targeted more towards social innovation for a green economy. This knowledge programme for social innovation aims to expedite the transition to a green, sustainable, circular economy and to help achieve breakthroughs. It ensures consistency between national, regional and local initiatives using a "social tool kit" and provides an opportunity to learn from each other's knowledge and experiences. The programme is focused on "learning and innovation" and is built around five social transition projects: food, biodiversity, energy, water and the circular economy. It will also look at underlying and interrelated themes such as climate, raw materials and waste, cycles, mobility, landscape, sustainable chains, etc. To sharpen its focus, priority will be given to those projects and processes which are likely to have the greatest impact on social innovation or education.
A range of networks – from childcare to higher education – are active within the DD programme, resulting in the sharing of best practices, knowledge networks, the development of lecturers' expertise and the creation of a portfolio with teaching materials, field trips, classroom visits, guest lectures, and so on. The DD programme also includes collaboration with providers such as Kennisnet to connect these types of activities digitally, as well as supporting the link between the demand from schools and the supply of educational programmes. There are "benchmarks" for education that is looking to raise its profile, such as "Eco-schools" and the "SustainaBul" (higher academic and professional education).

[195] https://www.duurzaamdoor.nl
[196] http://www.lerenvoorduurzameontwikkeling.nl/content/learning-sustainable-development-2008-2011
[197] http://www.plado.nl/

Figure 9.3 : Duurzaam Door

The Duurzaam Door programme was also the Dutch focal point for the UNESCO Decade of Education for Sustainable Development (2005–2014), cooperating with governments in Croatia, Montenegro and Georgia on this issue. Within the framework of G2G projects, the programme works together with NGO partners in India and participates in EU networks.

SustainaBul

Since 2014, the “SustainaBul” has been published annually; see Figure xx for the 2017 results. The SustainaBul evaluates sustainability and transparency within four themes: Education, Research, Operational Management and Integrated Approach. Institutions complete a questionnaire and provide evidence to support every answer: a policy document, agreement or other document showing that the answer is correct. The SustainaBul emphasises the sharing of information, so institutions are encouraged to include links to pages on their websites. A team of 30 independent students, the Rankers, check the answers against the policy documents and award points. The rankings are determined from the total number of points achieved by each institution. Realisation of the SustainaBul is made possible by RVO.nl’s Duurzaam Door programme.
In recent years, all participating institutions have exhibited a marked increase in sustainability, as can be seen from student rankings. The top three have integrated sustainability into all levels of the organisation. This development is the result of a long-term strategy, spearheaded by staff and student engagement.

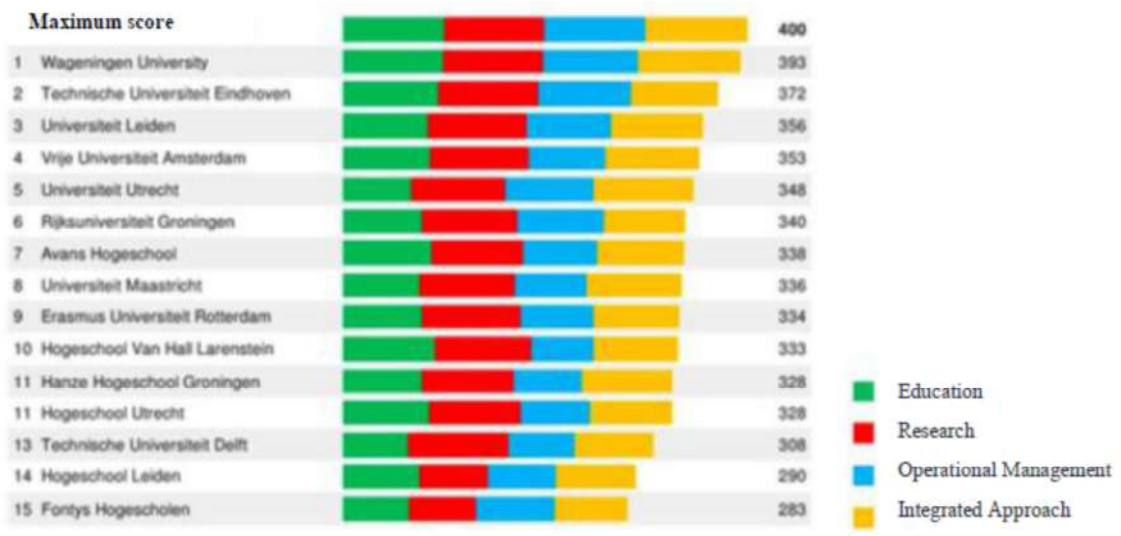

Figure 9.4 SustainaBul 2017[198]

The Education for Sustainable Development Guide

Three organisations, Groene Generatie (Green Generation), het Groene Brein (the Green Brain) and Studenten voor Morgen (Students for Tomorrow) have jointly developed the website ToekomstBehendig.nl[199], where teachers and students can interactively consult the Education for Sustainable Development Guide.
Based on the five growth phases, this guide gives an indication of the stage in which a school or programme may find itself in terms of growth towards sustainable education (see Figure xxx). In 2017, there were 103 schools at Growth Phase 3 (plant). A school or programme in this growth phase has developed integrated sustainable activities, making it system-oriented. This process means that sustainability is included in the school's vision. You would expect all classes at this school to be systematically working on sustainability.
Another 111 schools have received an Eco-Schools quality mark.[200] The international Eco-Schools quality mark was developed in 1994 by the Foundation for Environmental Education (FEE) to implement the agreements from the VN conference "Environment and Development". The Eco-Schools network stretches across the globe, with more than 49,000 participants in 64 countries. In the Netherlands, IVN Nederland is responsible for the Eco-Schools quality mark. It has outsourced the management and implementation of the mark to SME Advies.

[198] http://www.studentenvoormorgen.nl/uitslag-2017/
[199] http://toekomstbehendig.nl/
[200] https://eco-schools.nl

The five growth phases

Phase 1. Seed(s)
This school or programme covers sustainability **occasionally**. For example, a primary school uses a teaching resource theme pack in the area of drinking water as a one-off.

Phase 2. Seedling
This school or programme has developed **integrated** activities in the area of sustainability. Sustainability is becoming an important theme.

Phase 3. Plant
This school or programme has developed **integrated** sustainable activities, making it **system-oriented**. This process means that sustainability is included in the school's vision. You would expect all classes at this school to be working on sustainability systematically.

Phase 4. Flower
This school or programme has a **chain-oriented** view of sustainable education. This process means that this school is not only working on sustainability systematically in all classes, but chain partners are also involved, such as employers or facilities services. For example, if the school needs a new building, the class works with a builder to learn about sustainable construction and sustainable energy.

Phase 5. Fruit
This school or programme is working on sustainability systematically in all classes, involving not only chain partners but **society as a whole**. The school looks at the **impact** on education. The school evaluates whether students are actually finding a place in the labour market in the new, circular economy.

Figure 9.5 Five growth phases for sustainable education model[14]

9.3 Public information campaigns

9.3.1 Local Climate Agenda

The transition to structural sustainable energy use and supply must above all be achieved at the local level. For this reason, close cooperation is needed between the municipal, provincial and water authorities. Each has its own part to play, as authorities should complement each other, share knowledge and act transparently towards the private sector. To this aim, the *Local Climate Agenda* was a joint initiative bringing together representatives of local authorities and central government. The former Ministry of Infrastructure and the Environment coordinated the activities establishing the Agenda in 2011, together with nine climate ambassadors (representing the municipal, provincial and water authorities) and their working groups. Over 135 local and regional governments signed up for the agenda. Local authorities that join the Local Climate Agenda gain access to the network and its knowledge infrastructure, while promising to promote sustainable initiatives as well as to inspire and connect societal

actors[201]. The changing role of the government from initiator to facilitator of local initiatives is a key building block of the agenda.

Local climate policy covers a broad spectrum: the built environment, sustainable mobility, corporate responsibility, renewable energy, and climate-neutral towns and regions. These themes form the core structure of the Local Climate Agenda. They are based on the local situation and draw inspiration from best practices. The Ministry supports a knowledge exchange structure around these themes. For each priority, actions have been identified for both local authorities and the central government. The central government aims to facilitate and strengthen initiatives of local authorities by bringing together stakeholders and removing obstacles. For instance, to reduce energy use in existing dwellings, local authorities offer insulation schemes for private homes. The central government supported these efforts, e.g. in the period 2012–2014 through the "Blok voor Blok" programme (Block by Block), which refitted entire housing blocks to make them more energy-efficient and which provided proof that large-scale renovation is feasible.

After an evaluation, a number of points on the Local Climate Agenda have been improved and continued as the adaptive Local Climate Action Programme 2014–2020:

- increasing the involvement of community partners (such as housing associations, builders, installers and citizens) and holding annual meetings to develop local climate policy;
- developing a knowledge bank, where people and organisations can find best practices. These examples can be made widely available using a website, such as that of the Dutch Climate Coalition;
- appointing a new team of Local Climate Ambassadors. The ambassadors are distinguished by their enthusiasm to become involved and to forge links with companies as well as other partners with the aim of further supporting climate mitigation and climate adaptation. They know how to connect these themes with opportunities for employment, the economy and sustainable development, at the local and national level. Each ambassador is locally responsible for promoting the entire local climate policy, while they each have their own theme at the national level.

In the adaptive Local Climate Action Programme (LKA), which is running until 2020, the climate-neutral and climate-robust city/region is an important theme. A key facet of this theme is drawing up a plan with solid and concrete steps to make local government climate neutral by 2050. Some municipal authorities already have such a climate or energy plan, but many still do not. Twelve municipal authorities drafted such plans in 2017, including spatial opportunities and impacts. The lessons learnt in drafting these plans will be recorded and used to create a handbook in order to help other parties get started on their own plans. Over the coming months and years, in collaboration with LKA participants, work will be done on the concrete implementation of actions in the following fields:

- speeding up the insulation and renovation as well as improving the sustainability of the existing housing stock, improving the sustainability of the government's own buildings and applying more energy-efficient lighting in public places;
- encouraging renewable energy production by individuals, small businesses and cooperatives, as well as setting up and rolling out more heating networks;
- promoting climate and energy measures with short payback periods for SMEs and developing new revenue models;

[201] https://www.lokaalklimaatportaal.nl/netwerk+lokaal+klimaatbeleid/default.aspx

- deploying more energy-efficient vehicles and fuels;
- creating and implementing an adaptation plan for a heat-resistant city;
- using landscaping and nature in spatial planning so as to adapt to climate change;
- encouraging health promotion measures.

Information on the CO_2 footprint of municipalities and regions, as well as several thousand indicators related to climate and energy, is available in an online database (the "Klimaatmonitor" or Climate Monitor)[202]. Moreover, for over 25 years, the "Klimaatverbond" (Climate Alliance) has formed an active network of local and provincial authorities that cooperate in projects as well as exchanging information to support and strengthen local climate-related policies (see also Section xx on the involvement and support of non-governmental organisations). The alliance maintains a website[203] that contains information on projects and activities.

9.3.2 Campaigns for the general public

Climate Agenda
Since the end of 2008, the Ministry of I&M has also maintained a special website for the campaign on climate change[204], in cooperation with Milieu Centraal. On a special website, information is available about the Climate Agenda, dealing with governmental actions as well as actions taken by a number of organisations and companies.

Figure 9.6 Klimaatagenda[205]

Klimaatklappers (2015, Milieu Centraal)
Milieu Centraal has created an overview of the top "klimaatklappers", the activities that have the greatest impact on the climate. The overview is divided into four themes: your home, simple tips, conscious eating and green travel. An interactive infographic on a website[206] gives a light-hearted presentation of the least environmentally friendly activities. There are four areas where the choices that you make have an impact on the climate: holidays, transport, homes and food. The website was launched in October 2015 and

[202] http://www.klimaatmonitor.databank.nl/
[203] https://www.klimaatverbond.nl/
[204] www.beterklimaat.nl
[205] *http://klimaatagenda.minienm.nl*
[206] www.klimaatklappers.nl

widely publicised in conjunction with the Dutch Broadcasting Foundation through the #klimaatklappers campaign. A whole week was dedicated to sustainability. NPO Radio 2 broadcast 24/7 from the Green Station in Utrecht. Via the NPO Green app, anyone could take part in the various challenges. On Sustainability Day, Friday, 9 October 2015, sustainable activities were organised all over the country with two comprehensive reports broadcast live on TV in the evening.

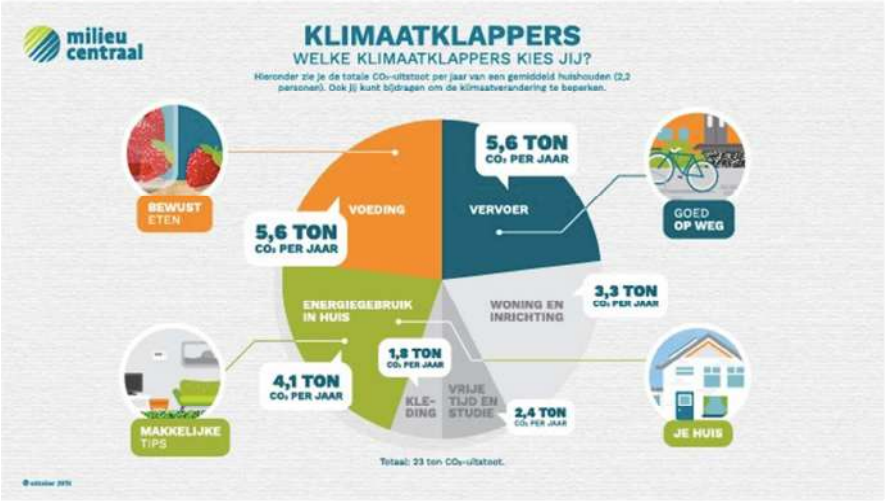

Figure 9.7 Klimaatklappers[207]

The HIER campaign (2007–present)
In the "HIER" climate campaign (Dutch for "Here"), 40 organisations (mostly NGOs such as WWF, Red Cross and Oxfam Novib) work together to counter the negative effects of climate change through activities such as coordinated consumer campaigns, raising awareness, joint communication efforts and political lobbying. The campaign is supported by the Dutch government (Ministry of I&M), both financially and through cooperation. In addition, the business community is involved as well[208].

- HIER campaign
  The solution to the climate problem comes within reach when the public, consumers and businesses feel part of this solution. For this reason, HIER supports all steps in the right direction and initiates a multitude of initiatives. For example, it is the driving force behind campaigns such as the Climate Street Party. HIER also created "Daar ben ik" (Here I am), manages the CO_2 Performance Ladder and published the book "Help, my igloo is melting". The environmental NGOs that participate in the campaign have each taken up one of the consumer options. For instance, the Netherlands Society for Nature and Environment has presented a top ten list of energy-efficient products from which to choose (including refrigerators and TVs[209]), while the WWF has introduced the most economical cars, and so on.
- HIER Climate Street Party
  The Climate Street Party campaign has been running for more than ten years.[210] It is a competition in which you earn climate points by getting as many people as possible to save energy during the heating season. After signing up on the website, you can get started with energy-saving activities.

[207] https://www.milieucentraal.nl/nieuwsbrieven/consumenten/oktober-2015/klappers-voor-een-beter-klimaat/
[208] https://www.hier.nu/
[209] www.topten.info
[210] http://www.klimaatstraatfeest.nl/

These activities are divided into six categories. For the 2017/2018 heating season, all activities must be performed during the competition period (10 October 2017 to 31 March 2018). The knock-out round starts on 1 March 2018. In the knock-out round, only the top 50 climate teams compete for the title of Best Climate Team in the Netherlands. This final round lasts until 31 March 2018, when the competition ends. The winners will be announced at a celebration event on Saturday, 14 April 2018.

Examples of private-sector actions

AH vegetable gardens for children

Since 2014, Albert Heijn (AH, a national supermarket chain) has been running an annual "Veggie Garden" initiative. Over a three-week period, customers of the chain can save up for little containers with a soil pellet and a bag of seeds for twenty different types of vegetables. This initiative enables children to grow their own vegetables and see how plants develop.

Figure 9.8 Moestuintje

n 2017, customers saved up for more than 44 million veggie gardens over a four-week period. To improve the likelihood of a successful crop, attention was also paid in 2017 to making a garden plan; in addition, there was a Veggie Garden app and an AH Community where customers could find answers to questions about their gardens. IVN, the Institute for Nature Education and Sustainability, helps children and their parents with tips and more information, mini-veggie garden courses in Albert Heijn stores and education using a mobile vegetable garden with plants at different stages.

Ben and Jerry's/Unilever sustainable living brand

Ben and Jerry's is Unilever's poster child for sustainability. In a variety of ways, consumers are given clear information that Ben and Jerry's ice cream and frozen dairy products are sustainably produced. In the Netherlands, for instance, they collaborate with a local organisation of 200 farmers who supply milk to Unilever. Under the Ben and Jerry's Caring Dairy Programme, farmers are provided with financial assistance and expertise to assess their farms against 11 sustainability indicators and to make improvements. As part of this programme, attention is also paid to animal welfare. A "Chunkinator" has

been installed at the Ben & Jerry's factory in Hellendoorn, which generates power from ice cream waste products. Unilever has created a separate section about climate change on Ben & Jerry's Dutch website.[211]

"Choose Climate" campaign

This campaign shows that the climate affects us all. Large companies, well-known Dutch people, SMEs, farmers, local politicians as well as many others are deeply concerned and are each working in their own way to find solutions. The site kiesvoorklimaat[212]. features posters with the CEOs of companies such as Philips, PostNL and the Tauw Group expressing their concern about climate change and explaining the actions that they are taking.

Adaptation

The campaign 'The Netherlands lives with Water' (2003–2011)

Climate change projections for the Netherlands would reflect an increased risk of coastal and river flooding if the sector's ability to adapt weren't as good as it actually is. Measures are taken to keep the risk within a determined bandwidth.
Around the year 2000, it was acknowledged that water management focussed very much on technological solutions. Other types of solutions, providing more resilience, better spatial accommodation and better integration with other domains, were hardly studied or implemented.
At the same time, it was acknowledged that citizens insufficiently recognised and acknowledged the potential problems associated with water, which was partially due to the high safety standards applied. Consequently, the public awareness campaign 'The Netherlands lives with Water' was launched in 2003. The campaign emphasised the need to consider not only technological, but also more integrated solutions in order to solve problems caused by excessive rainfall or high river discharges. In the first decade of this century, the search for solutions broadened to more integrated solutions. New programmes were developed, like the programme 'Room for the River', and regional water authorities completed many resilience-oriented projects, whilst existing programmes focussing on technological solutions continued. The campaign also promoted individual action against different threats.
The campaign stopped in 2011. Independent reviewers have assessed the campaign as an effective approach to raising awareness.

The Delta Programme (from 2010 onwards)

After the Royal Netherlands Meteorological Institute (KNMI) published its climate scenarios in 2006, a commission was installed to advise the government on the protection of the Netherlands against the implications of climate change. The commission's advice was adopted/ratified by the government and resulted in the Delta Act, the Delta Programme and the Delta Fund. Between 2010 and 2014, the preparation phase of the Delta Decisions was carried out. The approach of this phase involved many actors, among which all layers of government (local, provincial and national authorities as well as regional water authorities). This generated widespread support for these decisions.

The Delta Programme on Spatial Adaptation (from 2010 onwards)

The Delta Programme focusses on three issues: flood risk, fresh water supply and spatial adaptation.

[211] http://www.benjerry.nl/waarden/onderwerpen-die-ons-bezig-houden/klimaatrechtvaardigheid
[212] http://kiesvoorklimaat.nu/

With regard to the spatial adaptation dossier, a knowledge portal on spatial adaptation[213] has been available since 2014. This portal supports a range of users with tasks regarding the climate-proofing and water-resilient planning of their environment. It receives about 9,000 users and 22,500 visits annually, with 8% coming from outside the Netherlands. Sometimes the number of visits explodes, as was the case when the Delta Programme 2018 was presented in September this year. An interesting feature of this portal is the map with examples, where all parties can exhibit the results of their climate adaptation efforts.

Within the framework of the recently formulated Delta Plan on Spatial Adaptation[214] (2017), municipalities have committed themselves to completing vulnerability assessments (NL: stresstesten) in order to be able to determine what adaptation measures are needed. A first assessment can be made using the recently updated Climate Impact Atlas[215], which dates from 2010. Some provinces and regions have since developed their own atlas, like the province of Zuid-Holland.[216]

And last but not least, since 2014 the Delta Programme on Spatial Adaptation has provided incentives to stimulate the implementation of climate adaptation measures.

The National Climate Adaptation Strategy (from 2012 onwards)

The National Climate Adaptation Strategy 2016 is rooted on the one hand in the report 'Adapting to Climate Change: strategy and policy' from the Netherlands Court of Audit, which recommends the development of a policy that effectively addresses all aspects of climate change, and on the other hand in the EU Climate Adaptation Strategy. Both documents were published in 2012.

'Climate-proofing' the Netherlands is considered to be a joint undertaking for which every member of Dutch society is responsible. The National Climate Adaptation Strategy (NAS) sets out the course. During the formulation phase, all interested parties were invited to participate in three sessions and to contribute to the strategy. This process was overseen by a support group composed of various ministries, the Association of Netherlands Municipalities (VNG), the provinces and the regional water authorities, as well as some research institutes.
Since the strategy was ratified by the government in December 2016, climate adaptation dialogues have been started around the most pressing issues, like heat stress and biodiversity. All interested parties are invited to participate in these dialogues, which start with an assessment of the issue to tackle together and are intended to result in planning actions and taking measures. The aforementioned support group also oversees these dialogues.

*The programme 'Our Water' (Ons Water*217*), from 2014 onwards*

The programme 'Our Water' was launched in 2014 following the conclusions in the OECD study 'Water governance in the Netherlands: fit for the future?'. In this study, the OECD concluded that the awareness gap among citizens needed to be addressed: 'Dutch citizens take current levels of water safety for granted. As a consequence, they tend to be less involved in water policy debates, they tend to ignore water risks and functions when they develop property, and tend to be little concerned with water pollution. Their willingness to pay for a service they take for granted may erode in the future.'
The programme 'Our Water' was initiated by the Dutch public sector and focusses on creating, increasing and maintaining awareness among citizens of different types of water management issues. 'Our Water'

[213] http://ruimtelijkeadaptatie.nl/english/
[214] http://ruimtelijkeadaptatie.nl/english/delta-plan/
[215] http://www.klimaateffectatlas.nl/en/
[216] https://pzh.maps.arcgis.com/apps/MapSeries/index.html?appid=64c6ea0ab8944935afe44ea93d9739de
[217] www.onswater.nl

consists of multi-annual programming regarding issues like the Netherlands' mission to prepare for climate change and to address environmental issues. The main principle of the programme is that local and regional governments and organisations play an active role and design their own strategies focussing on local and regional needs and priorities, linked to national programming. The first organisations to participate in 'Our Water' were the national and local governments, regional water authorities and water companies. The programme is currently expanding to other organisations, like museums, youth organisations (such as the Dutch Wavemakers) and the Red Cross. Among the first results of this programme are a national website containing local information on water, intended to inform citizens (onswater.nl), as well as two national awareness weeks and a communications and education community.

*The tool 'Do I Flood' (Overstroomik.nl*218*), launched in 2014*

As part of the programme 'Our Water', a tool was made available in 2014 to provide people with information about the flood risk of their neighbourhood and their home. This tool, 'Do I Flood', provides information on flood levels in case of flooding and gives people information on how to prepare for flooding. Anyone can enter the unique postal code of, for example, his or her residence, after which one receives worst-case information on the flood level that can be reached at that location. If the location is floodable, further information is given that enables one to decide whether it would be sensible to leave the area in case of flooding or to stay. Citizens turn out to be very interested in this kind of information. Since its launch, the website has been visited by over a million unique visitors. An application with the same functionality has been downloaded several hundred thousand times.
In the recent past, citizens hardly ever received this kind of information. The government is often still reticent in sharing this kind of information out of fear for misinterpretation.

9.4 Events

9.4.1 National Climate Change Summit – "bring Paris home"

[218] http://www.overstroomik.nl/

Figure 9.9: Some Delegates National Climate Change Summit

On 26 October 2016, the first National Climate Change Summit "bring Paris home" was organised[219]. About 1,700 participants from NGOs, businesses, local authorities and the government participated in this event.

While there were starring roles for Prime Minister Mark Rutte and then Minister for the Environment Sharon Dijksma, there were also policy debates with the mayor of Rotterdam and the CEOs of Greenpeace, Shell, KLM, ABP, Tesla, the Port of Rotterdam, and so on.
The target for the National Climate Change Summit was initiating, accelerating or linking as much climate action as possible. For this group of 50, breakout sessions were organised. The results were 14 climate deals in various sectors with an estimated impact of approximately 17 Mt in reductions by 2030 (the equivalent of 9% of the current Dutch emissions). Figure 9.9 shows the CO2 impact for the Netherlands in 2030, broken down by initiative. This information includes the twelve new agreements as well as the three that are planned. The colours for the new agreements reflect the theme classification for the break-out sessions at the Climate Summit. In the key, the themes are noted. The three planned initiatives are highlighted.

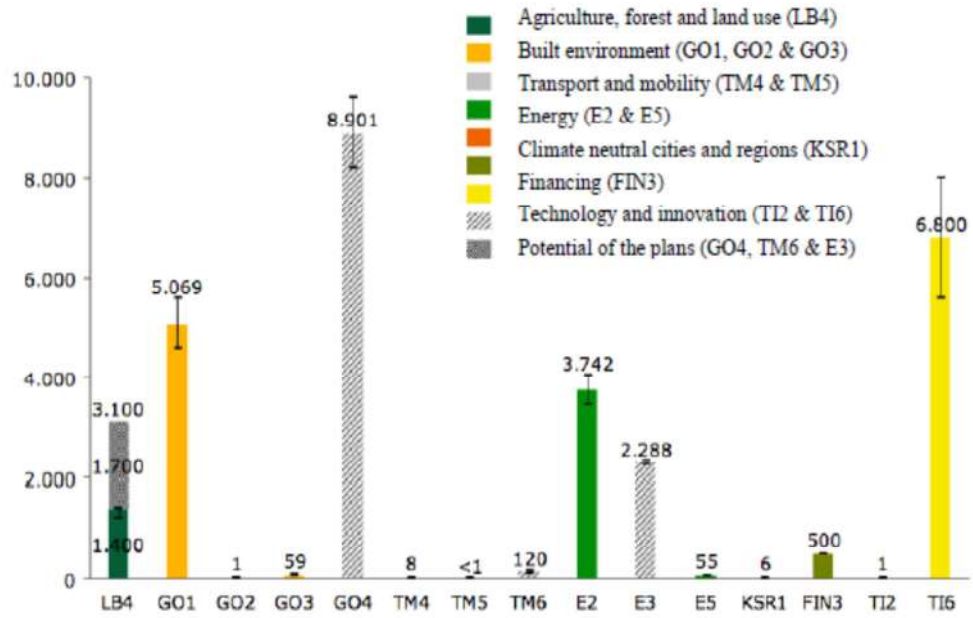

Figure 9.10 Estimated emission reductions by 2030 for specific actions[220]

9.4.2 Cooperation the Netherlands – California 2017

In May 2017, the then Dutch Minister for the Environment Dijksma headed a climate mission to California (the United States). Together with a number of Dutch companies, she explored how climate-related cooperation between the Netherlands and the United States can be enhanced further. The mission focused on the exchange of smart innovations in cleaner fleets, public transport and sustainable buildings, as well as combating the impact of rising sea levels, among other things. In addition to contributing to the

[219] https://www.klimaattop2016.nl/
[220] https://www.klimaattop2016.nl/documenten/rapporten/2016/10/26/de-impact-van-de-nationale-klimaattop-2016-in-kaart

attainment of the Paris climate goals, the new technologies and smart solutions also boost economic growth and generate more jobs[221].
In the context of the mission, the Dutch Ministry of Infrastructure and the Environment organised the "Climate is Big Business" conference in San Francisco on 24 May together with the State of California (Environmental Protection Agency)[222].

Figure 9.11 Climate is Big Business

9.5 Training programmes, including exchange of personnel

The "Learning for Sustainable Development" programme (see 9.2) also encompasses training. In addition, the programme targets professionals (such as public servants) to strengthen "the learning government" in developing, implementing and improving policies related to sustainable development. This strengthening is done through publications and by creating a better environment for "learning and improving" which is structural embedded in decision-making processes, e.g. through networks of governments, knowledge institutions and social/environmental interest organisations.

Training is also an integral aspect of the work carried out by the intermediary organisations Netherlands Enterprise Agency (RVO.nl) and Milieu Centraal. For example, information materials and training to increase energy efficiency are provided to companies under the framework of the Long-Term Agreements. Furthermore, for the eco-drive programme (Het Nieuwe Rijden), driver training was organised in driving licence courses on efficient driving[223].

Various Dutch universities and institutes offer training and other professional education programmes for domestic and international students as well as for professionals in areas related to climate change, mitigation and adaptation, among other things[224] (see also Section 9.8). PBL Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving) contributes to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations of climate change. PBL publishes studies and essays within an international context. By organising symposia, it informs and educates Dutch professionals[225].

[221] https://www.government.nl/ministries/ministry-of-infrastructure-and-the-environment/news/2017/05/15/environment-minister-dijksma-to-lead-climate-mission-to-california
[222] http://www.climateisbigbusiness.com/default.aspx
[223] http://www.hetnieuwerijden.nl/; http://www.truckvandetoekomst.nl/; https://www.rwsleefomgeving.nl/onderwerpen/energie-en/ https://www.rwsleefomgeving.nl/onderwerpen/broeikasgassen/publicaties/
[224] http://www.knmi.nl/faq/index.php?o=Klimaatverandering.
[225] http://www.pbl.nl/en/topics/energy-and-climate-change

9.6 Access to information: resource and information centres

As part of their activities in education, training and raising public awareness, the ministries involved in climate policy also commission intermediary organisations to implement certain tasks. This process concerns two major centres: Netherlands Enterprise Agency (RVO.nl) and Milieu Centraal (Environment Central). While RVO.nl focuses on professional parties such as the industry, local governments and companies, Milieu Centraal concentrates on consumers. Both organisations are described below. Further communication activities are implemented under the framework of the "Climate change spatial planning" programme through the Platform Communication on Climate Change. NGOs also provide information services (see next section). The most relevant activities are described later on in this chapter.

Netherlands Enterprise Agency (Rijksdienst Voor Ondernemend Nederland; RVO.nl)[226] is part of the Ministry of Economic Affairs and works at the instigation of ministries and the European Union. Some activities of the Commodities Boards are also included. The agency works in the Netherlands and abroad with governments, knowledge centres, international organisations and countless other partners. RVO.nl encourages entrepreneurs in sustainable, agrarian, innovative and international business. It helps with grants, finding business partners, know-how, and compliance with laws and regulations. The aim is to improve opportunities for entrepreneurs and strengthen their position. It also implements programmes for various ministries on innovation, energy and climate, as well as the environment and spatial planning. By clustering knowledge, RVO.nl aims to strengthen the economy through sustainable development and innovation. Examples of the many programmes that RVO.nl carries out include innovation support programmes, renewable energy programmes, Long-Term Agreements with the industry to increase energy efficiency, the reduction programme for non-CO_2 greenhouse gases and many energy transition/innovation programmes for a sustainable energy economy. Education, training and raising public awareness form an integral part of its activities. Its activities, training, information and general website mainly target professional parties in many sectors of society. RVO.nl also hosts the website of the National Inventory Entity (NIE) at https://english.rvo.nl/topics/sustainability/national-inventory-entity (on behalf of I&M). Its main aim is to provide information on the National System for monitoring, the trends in greenhouse gas emissions within the Netherlands and climate policy, as reported in the National Inventory Reports and the National Communications, respectively. This site also makes available much of the relevant background information.

Milieu Centraal[227] is an independent organisation that provides consumers with practical and reliable information on the environment. The quality of this information is assured via a review process, in which information from various sources is gathered and various experts are consulted. Milieu Centraal hosts a website and a call centre. It initiates communication campaigns, usually in cooperation with other organisations, which are aimed directly at consumers. The organisation also conducts public surveys on environmental issues. Milieu Centraal maintains the website Energie en consument[228] (Energy and consumer), following up on an initiative by the Ministry of Economic Affairs. This website aims to provide consumers with independent and reliable information on renewable energy, energy savings and selecting an energy supplier. In parallel, the "Knowing by measuring" campaign has started, which aims to improve public knowledge of energy savings.

[226] https://english.rvo.nl/
[227] https://www.milieucentraal.nl
[228] http://www.energie-nederland.nl/consument-en-energie/

Figure 9.12 Milieu Centraal

In addition, more targeted programmes are often supported by websites that provide important resource information for the relevant target groups. One example is the "More with Less" programme for the housing and building sector (see Chapter 4), supported by a website with resource information for tenants, homeowners (corporations) and suppliers in the sector[229].

"Climate changes Spatial Planning" and *"Knowledge for Climate"*, two major R&D programmes (see also Chapter 8) together operate a website on research results[230]. Their communication activities aim to increase the knowledge on climate research, including the consequences of climate change and possible adaptation measures, on the part of politicians, policymakers, the industry, non-governmental organisations, the media and the general public. It also aims to stimulate the dialogue between politicians, government officials and the industry, as well as the transfer of knowledge, by bringing together parties that either offer or need knowledge on climate change. Activities include publishing fact sheets, brochures and summaries of scientific reports.

Kennis voor Klimaat ("Knowledge for Climate") is a research programme into climate change and adaptation. The programme was funded with money from FES and ran from 2007 to the end of 2014. Its six partners were Utrecht University, Wageningen University & Research, VU University Amsterdam, KNMI, TNO and Deltares[231].

The ***Klimaat voor Ruimte*** ("Climate changes Spatial Planning", KvR) research programme was launched in 2004. Under the programme, research was conducted into five themes with opportunities presented by climate change for Dutch society in terms of adjustments to land use. The KvR programme, which was

[229] http://www.meermetminder.nl/home
[230] https://klimaatonderzoeknederland.nl
[231] http://www.kennisvoorklimaat.nl/

wrapped up at the end of 2011, focused on the consequences of climate change for spatial planning and land use through the themes of climate scenarios, adaptation and mitigation.

International knowledge centre for climate adaptation

The United Nations international knowledge centre for climate adaptation is coming to Rotterdam and Groningen. Crucial for the selection committee were the cities' location and the knowledge that they can already draw on locally. It is intended that around twenty people will work at this Global Centre of Excellence on Climate Adaptation (GCECA). The knowledge centre brings together international partners such as knowledge institutes, businesses, NGOs and governments. It helps them to implement measures for a better climate. This centre will also look at ways of making infrastructure more resistant to climate change. The GCECA, founded by Japan, the Netherlands and UN environmental organisation UNEP, will be housed in climate-neutral offices. It was already announced in February that the centre would be based in the Netherlands.

9.7 Involvement and support of non-governmental organisations

A large number of non-governmental organisations are active in climate change topics. Several of these organisation are also involved in public awareness raising, training and education, such as HIER, Consumentenbond, Vereniging Eigen Huis, Natuur&Milieu and Milieudefensie.

Some examples are given below.

Green Knowledge (Net Groen Kennisnet)

Groen Kennisnet (Green Knowledge Net) is a project run by Wageningen University & Research, in which green educational institutes, their professorships, the education reform programme, the Centre for Innovative Workmanship and the Centres of Expertise are joint implementing partners. A website[232] provides information on food and the climate: How large a role does food play in global warming? Is CO_2 the only culprit? Which measures are the government and the industry taking to improve the climate? What can you do as a consumer? The "Food and Climate" file presents the information clearly on the website.

Climate Alliance (Klimaatverbond)

For over 25 years, the "Klimaatverbond" (Climate Alliance) has formed an active network of local and provincial authorities as well as other organisations. The alliance maintains a website[233] that contains information on projects and activities such as the "Energy Battle" between municipalities[234]. The Minister of I&M supports the Klimaatverbond in organising the annual "children's climate summit" (Kinderklimaattop), among other things[235].
For the Children's Climate Summit, every school can send four children who have a good idea for reducing CO_2 emissions. Schools set their own criteria to select the children who represent them at the Children's Climate Summit; for instance, students from Grade 7 or 8 who have accumulated the most Green Footsteps, have personally taken action or have the best tip for improving the climate. At the Children's Climate Summit, the representatives come together on behalf of all Green Footstep

[232] http://www.groenkennisnet.nl/nl/groenkennisnet/dossier/dossier-Voedsel-en-klimaat.html
[233] https://www.klimaatverbond.nl/
[234] https://www.klimaatverbond.nl/nieuws/klimaatverbond-energy-battle-van-start-nieuw-gedrag-bespaart-energie
[235] http://www.rijksoverheid.nl/regering/bewindspersonen/wilma-mansveld/nieuws/2013/06/24/mansveld-neemt-jongerenadvies-over-klimaatbeleid-in-ontvangst.html
http://www.jongerenvertegenwoordigers.nl/info/door_wie_worden_jongerenvertegenwoordigers_gesteun

participants to discuss the green tips that they want to submit to the Minister over the coming year. At past Children's Climate Summits, the jury chose the following Golden Tips: Energised playground (2015), Children's Climate Summit in the classroom (2012), Charge your cell phone with your bike (2011).

The Hemweg campaign "Wij willen #hemweg" ("We want #hemweg gone")

Various organisations are trying to use crowdfunding for making an offer to purchase the Nuon coal-fired power plant at the Hemweg in Amsterdam with the intention of closing it down. Supporters of this action include Vandebron, Triodos Bank, Stichting DOEN, Greenpeace and Hete Kolen. The Amsterdam Municipal Council has also agreed to contribute 1 million euros, on certain conditions. Supporters can sign up on the website[236] and contribute to increasing the purchase offer for the power station.

9.8 International cooperation and implementation of education and training

The previous sections also describe activities and efforts taken to implement the amended New Delhi work programme, integrated in the Dutch communication approach on climate change. Since a new work programme on Article 6 of the UNFCCC was agreed in Doha (Decision 15/CP.18, Doha work programme on Article 6 of the Convention), this fact is taken into consideration when developing future education, training and awareness actions regarding climate change.

A few special aspects of international relevance related to the implementation of education and training (Kyoto Protocol Art. 10) may be highlighted further.

The previous sections also include activities aimed at international education, training and capacity building. As mentioned in Section 9.5 and elsewhere, various Dutch universities and institutes offer training or other professional education programmes for international students and professionals in areas related to climate change, mitigation and adaptation. In addition, universities offer MSc degrees to international students in sustainable energy technology or environmental sciences, among other things. Activities for international students and professionals include postgraduate courses and training in the field of water management, flood risk management, energy management and cleaner energy, climate change adaptation in agriculture and natural resources management.

To improve international awareness of these courses and trainings, a website[237] is available, providing an overview of courses, available support and practical information for studying in the Netherlands. The site also contains topical information on available courses; for example, almost 300 courses related to climate change are available in 2017. Information on scholarships is also present, such as:

- the Mena Scholarship and Programme (for students from Algeria, Egypt, Iran, Iraq, Jordan, Lebanon, Libya, Morocco and Tunisia) with courses in 2018 on e.g.
  - Evaluating and managing for sustainable development impact at Wageningen UR;
  - Strategic Environmental Assessment and Environmental Impact Assessment at University of Twente;
- the Netherlands Fellowship Programmes (NFP), which from 1 July 2017 have entered a new phase as a novel five-year programme under the name Kennisontwikkelings-programma (Knowledge

[236] https://wijwillenhemweg.nl
[237] https://www.studyinholland.nl/

development programme, KOP). KOPs aim to advance the development of the capacity, knowledge and quality of both individuals and institutions in higher and vocational education. Examples of previous NFP courses are
  - Urban Management Tools for Climate Change (IHS) at Erasmus University Rotterdam;
  - IWRM as a tool for adaptation to climate change at the UNESCO-IHE Institute for Water Education;
  - Assessment of the Effect of Climate Change on Agro-ecological Systems Using Optical and SAR Remote Sensing and GIS at University of Twente.

When it was first created, "Nuffic" stood for Netherlands Universities Fellowships For International Cooperation, but that acronym no longer reflects its activities and "Nuffic" has become a proper noun. Nuffic is a non-profit organisation that supports internationalisation in education, research and professional training, as well as managing a number of programmes to improve the knowledge and skills of individuals and organisations in developing countries. The major funding providers are the Dutch Ministry of Foreign Affairs and the Dutch Ministry of Education, Culture and Science. In 2015, there was a merger between Nuffic with its focus on higher education and the European Platform with a comparable objective for primary and secondary education. From 2015 to early 2017, the organisation was called EP-Nuffic. Since March 2017, the name has reverted to Nuffic.
Its website[238] presents an overview of programmes and students in international studies. Nuffic also manages Netherlands Education Support Offices (NESO's) in a number of countries such as Brazil, China, India, Indonesia, Mexico, Russia, South Africa, South Korea, Thailand, Turkey and Vietnam.

Desmond Fortes Scholarships target ambitious professionals from Asia, Africa, Latin America and the Caribbean, eastern Europe and central Asia who are employed within the client network of FMO (the Dutch development bank) and who have a strong interest in green finance (Climate Change Mitigation, Climate Change Adaptation and Other Footprint Reduction).

9.9 Cross-cutting issues of youths and ACE

9.9.1 Youth organisations

Youth organisations contribute to public awareness of climate change, as well as advocating increased ambition and youth participation at the national level.

A lot of youth organisations are active in creating public awareness of climate change via various means, such as organising events, providing guest lectures, social media campaigns, and so on. The most important youth organisations working on this matter at the national level are:

- the Dutch Youth Climate Movement, an umbrella organisation for more than 40 youth organisations, on whose behalf it advocates more ambitious climate action. Some of their landmark campaigns include klimaatkandidaat (climate candidate), the Dutch Youth Climate Summit and the Dutch Youth Climate Agenda[239]

[238] https://www.nuffic.nl/
[239] https://jongeklimaatbeweging.nl/

- JMA (Young Friends of the Earth NL), an organisation focusing on actions to enhance climate ambitions[240]
- Students for Tomorrow, an organisation focusing on making the higher education system more sustainable, coordinating green offices and umbrella organisations for green student associations. Landmark campaigns include SustainaBul, a ranking of the sustainability of universities, which is becoming an international trend[241]
- NJR (Dutch National Youth Council), an umbrella organisation of youth organisations. It supports two youth representatives on sustainable development to the UN and a "young and sustainable" working group. In addition, it gives guest lectures on sustainability around the country and organises events to spread awareness. The youth representatives also advocate more ambitious climate action.

9.9.2 Youth participation at the UNFCCC

As the Netherlands highly values meaningful youth participation, youth delegates are an integral part of its delegation. The youth delegates have been democratically elected in a national campaign and are supported by the Dutch National Youth Council. To allow for meaningful participation, the youth delegates receive comprehensive briefings and join delegation meetings. Within the delegation, the youth delegates play an active role in the negotiations on Action for Climate Empowerment (ACE); for example, during the intermediate review of the Doha work programme and the yearly ACE dialogues. At UNFCCC conferences, the youth representatives also play an important role in capacity building of other youths present at these conferences. This way, they contribute to a better involvement of youths in the international processes related to climate change.

9.9.3 ACE National Focal Point

After consultations in Bonn in June 2015, Ms Figueres – the then Executive Secretary of the UNFCCC – announced that Action for Climate Empowerment (ACE) had been chosen as the popular way to refer to Article 6 of the UNFCCC.

For many years, the Netherlands has had a National Focal Point for Article 6 under the Netherlands Enterprise Agency.
The National Focal Point participated in a number of meetings as part of the Dialogues on Action for Climate Empowerment and attended the meetings of the UNFCCC secretariat organised for the National Focal Points.
In addition, the National Focal Point also participated in the first workshop of the UNFCCC secretariat organised in May 2016. This workshop provided a forum for National Focal Points on Action for Climate Empowerment and/or relevant government representatives to share their experiences and exchange ideas, good practices and lessons learnt in implementing the Doha work programme on Article 6 of the Convention. The workshop strengthened the existing skills and capacities of National Focal Points.

At the end of 2017, the Dutch climate envoy became the ACE National Focal Point. This development should create a stronger link with national actions on education, training and awareness.

[240] http://www.jma.org
[241] http://www.studentenvoormorgen.nl/

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GLOSSARY

CHEMICAL COMPOUNDS

C	Carbon
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-eq.	Carbon dioxide equivalent (in this report using a GWP-100)
F-gases	Fluorinated gases
HFCs	Hydrofluorocarbons
HCFCs	Hydrochlorofluorocarbons
HCFC23	Hydrochlorofluorocarbons
NMVOC	Non-Methane Volatile Organic Compounds
NF_3	Nitrogentrifluorides.
N_2O	Nitrous oxide
NO_x	Nitrogen oxides (NO and NO_2), expressed as NO_2
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
SO_2	Sulphur dioxide

UNITS

Gg	Giga gramme (10^9 gramme = kton)
GJ	Giga Joule (10^9 Joule)
g/km	gram per kilometer
ha	hectare
kton	kilo ton (= 1,000 metric ton = 1 Kton)
km/h	kilometre per hour
kW	kilo Watt (1000 Watt)
kWh	kilo Watt hour
mg/km	milligrams per kilometer
mld	1,000 million
mln	million
Mton	Mega ton (= 1,000,000 metric ton = 1 Tg)
MW	MegaWatt
Nm^3	Normal cubic metre (volume of gas at 10^5 Pa and 20^{o}C)
Pg	Peta gramme (10^{15} gramme)
PJ	Peta Joule (10^{15} Joule)
TJ	Tera Joule (10^{12} Joule)
TWh	Tera Watt hour (10^{12} Watt hour)
Tg	Tera gramme (10^{12} gramme= Mton-eq)
US$	US Dollar
USD	US Dollar
€	Euro
EUR	Euro

ABBREVIATONS

A

AAU	Assigned Amount Unit
ABPP	African Biogas Partnership Program
ADB	Asian Development Bank
ADVZ	Zambezi Valley Agency
AEA	Annual Emission Allocation
AER	Annual Environmental Reports
ANWB	Algemene Nederlandse Wielrijders Bond
ASAP	Adaptation for Smallholder Agricultural Programme
ATA	Agricultural Transformation Agency
AR2	2nd IPCC Assessment Report
AR4	4th IPCC Assessment Report

B

BEMS	Emission Requirements Combustion Installation Decree
BLOW	Intergovernmental Wind Energy Agreement
BOVAG	Bond Van Automobielhandelaren en Garagehouders
BPM	Belasting personenauto's en motorrijwielen 4.5.4
BR	Biennial Report

C

CASCAPE	Capacity-Building for Scaling-up evidence-based best Practices in Ehiopia
CAF	Corporación Andina de Fomento (Development Bank of Latin America)
CBS	Netherlands Statistics (Centraal Bureau voor de Statistiek)
CCPM	Common and Coordinated Policies and Measures (of EU)
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CER	Certified Emission Reductions Unit
CGIAR	Consultative Group on International Agricultural Research\
CIE	European Commission
CIF	Climate Investment Funds
CITL	Community Independent Transition Log
CIWA	Cooperation in International Waters in Africa
CHP	Combined Heat and Power (= WKK)
CMP	Conference of Membership (parties) of the (Kyoto) Protocol
COP23	23th Conference of Parties
CP	Conference of Parties
CRF	Common Reporting Format
CTF	Common Tabular Format

D

DAC	Development Assistance Committee
DEI	Demonstratie Regeling Energie Innovatie
DES	Data Exchange Standards
DRR	Disaster Risk Reduction

E

EC	European Commission/European Community
ECN	Netherlands Energy Research Centre (Energie Centrum Nederland)
EED	Energy Efficiency Directive
EHG	Energy efficiency and renewable energy horticulture
EIA	Energie Investerings Aftrek (Energy Investment Allowance)
EnDev	Energising Development Partnership
ENINA	Task Force on Energy, Industry and Waste Management
EPA	Energie Prestatie Advies (Energy Performance Assesment)
EPBD	Energy Performance of Buildings Directive
EPK	Energie Prestatie Keurmerk (Periodical Energy Performance Assesment)
ER	Emissions Registration
ERU	Emission Reduction Unit
ESD	Effort Sharing Decision
ESMAP	Energy Sector Management Assistance Programme
ETFF	Energy Transition Financing Facility
ETS	Emission Trading Scheme
EU	European Union
EZK	Ministry of Economic Affairs and Climate Policy (Ministerie van Economische Zaken en Klimaat)

F

FAO	Food and Agriculture Organisation of the United Nations
FEH	Fund for improving the energy efficiency of rental housing
F-gases	Fluorinated greenhouse gases (HFCs, PFCs, SF_6)
FIBANI	Professional Education in the Niger Basin
FIPAG	Fundo de Investimento e Património do Abastecimento de Água
FMO	Dutch development bank

G

GAFSP	Global Agriculture and Food Security Program
GCF	Green Climate Fund

GCIC	Ghana Climate Innovation Centre
GEF	Global Environment Facility
GHG	Green House Gas
GIRE	Integrated Water Resource Management Programme in the Niger Basin
GWP	Global Warming Potential

H

HER	Hernieuwbare Energie Regeling
HNR	Het Nieuwe Rijden (Ecodriving)
HNT	Het Nieuwe Telen (The Next Generation Cultivation)

I

IFC	International Finance Corporation
IGG	Inclusive Green Growth Department, Ministry of Foreign Affairs of the Netherlands
I&M	Ministry of Infrastructure and the Environment (Ministerie van Infrastructuur en Milieu)
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
ISDE	Investment Subsidy Renewable Energy
ISSD	Integrated Seed Sector Development
ITL	Independent Transition Log
IVDM	Institute for Sustainable Mobility

J

JI	Joint Implementation

K

KP	Kyoto Protocol

L

LDC	Least Developed Countries
LEE	Long-Term Agreement on Energy Efficiency for ETS companies (= MEE)
LED	Light Emitting Diode
LEI	Agricultural Economics Institute (Landbouw Economisch Instituut)
LNG	Liquefied Natural Gas
LNV	Ministry of Agriculture, Nature and Food quality
LTA	Long-Term Agreement (= MJA)
LULUCF	Land-use, Land-Use Change and Forestry

M

MEI	Market Introduction Energy Innovations
MEP	Environmentally Friendly Electricity Production Programme
MEWAT	Taskforce on Wate
MIA	Milieu Investeringsaftrek
MIT	Medium Sized Enterprise in Topsectors
MMR	Monitoring Mechanism Regulation
MS	Member State (s)

N

NEa	Nederlands Emissie Autoriteit
NEF	National Energy Savings Revolving Fund
NEV	Nationale Energie Verkenning (National Energy Outlook)
NGO	Non-Governmental Organisation
NIA	Netherlands Investment Agency
NIE	National Inventory Entity (Single National Entity under Kyoto Protocol)
NIR	National Inventory Report

O

ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OOF	Other Official Flows

P

PAMs	Policies and measures
PAPAB	Supporting Agricultural Productivity in Burundi
PBL	Netherlands Environmental Assessment Agency
PCF	Protocol Carbon Funds
PFR	Partners for Resilience
PHEV	Plug-In Hybrid Electric Vehicle
PIDG	Private Infrastructure Development Group
PMR	Partnership for Market Readiness
PROFOR	Program on Forests
PRTR	Pollutant Release and Transfer Register

Q

QA	Quality Assurance
QC	Quality Control

R

RAI	Amsterdam Convention Centre
RDW	Rijksdienst voor Wegverkeer
REB	The Regulatory Energy Tax
RED	Renewable Energy Directive
RIVM	National Institute of Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu)
RMU	ReMoval Unit on the basis of land use, land-use change and forestry
ROB	Reduction Programme for non-CO_2 greenhouse gases (Reductieprogramma Overige Broeikasgassen)
RVO.nl	Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency)

S

SAFAL	Sustainable Agriculture, Food Security and Linkages in Bangladesh
SCF	Strategic Climate Fund
SDE+	Stimulation of Sustainable Energy Production (Stimulering Duurzame Energieproductie)
SER	Sociaal economische Raad (Social Economic Counsel)
SGEI	Services of General Economic Interest
SIDS	Small Island Developing States
SME	Small and Medium-sized Enterprises
SREP	Scaling up Renewable Energy Program
SSMISP	Small-Scale and Micro Irrigation Support Project
STEP	Subsidy scheme for improving energy efficiency in social housing

T

TERT	Technical Expert Review Team
TNO	Netherlands Organisation for Applied Scientific Research
TSE	Top Sector Energy

U

UDW	Urbanising Deltas of the World
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar

V

VAMIL	Arbitrary Depreciation of Environmental Investments
VROM	(Ministry of Housing, Spatial Planning and the Environment (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer): In 2010 a merger took place with the Ministry of V&W. The new name is: Ministry of Infrastructure and the Environment (IenM)
VWS	Ministry of Health, Welfare and Sport

W

WAM	With Additional Measures
WASH	Water, Sanitation and Hygiene
WBSO	Wet Bevordering Speur en Ontwikkelingswerk
WDF	Women Delegates Fund
WEM	With Existing Measures
WESP	Task force on Consumers and other sources of emissions
WFP	World Food Programme
WKK	Warmte Kracht Koppeling (Combined Heat and Power, CHP)
WRI	World Resources Institute

Z

ZOA	International relief and recovery organisation based in the Netherlands

ANNEX 1: SUMMARY TABLES ON EMISSION TRENDS

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1995	2000	2005	2010	2015
	CO_2 equivalent (kt)						
CO_2 emissions without net CO_2 from LULUCF	162271.29	162271.29	172858.59	171650.16	177180.06	182545.60	165127.23
CO_2 emissions with net CO_2 from LULUCF	168325.66	168325.66	179039.96	177632.18	183074.68	188574.64	171708.19
CH_4 emissions without CH_4 from LULUCF	32316.45	32316.45	30332.97	25090.46	20467.12	20116.21	19000.75
CH_4 emissions with CH_4 from LULUCF	32316.69	32316.69	30333.23	25090.74	20467.42	20116.53	19001.08
N_2O emissions without N_2O from LULUCF	17687.11	17687.11	17741.08	15711.14	14155.28	8125.93	8331.87
N_2O emissions with N_2O from LULUCF	17692.93	17692.93	17775.09	15773.35	14241.78	8231.78	8461.45
HFCs	5606.33	5606.33	7571.44	4765.06	1728.04	2666.32	2335.72
PFCs	2662.85	2662.85	2279.92	1902.81	365.99	313.77	104.22
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO
SF_6	206.70	206.70	260.97	258.78	203.72	153.79	138.83
NF_3	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE
Total (without LULUCF)	220750.73	220750.73	231044.97	219378.41	214100.21	213921.63	195038.63
Total (with LULUCF)	226811.17	226811.17	237260.61	225422.92	220081.62	220056.82	201749.50
Total (without LULUCF, with indirect)	221416.70	221416.70	231514.37	219714.18	214353.46	214158.17	195245.67
Total (with LULUCF, with indirect)	227477.14	227477.14	237730.01	225758.69	220334.87	220293.37	201956.54

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015
	CO_2 equivalent (kt)						
1. Energy	156404.87	156404.87	167729.83	165903.27	171756.63	178772.85	160967.83
2. Industrial processes and product use	24850.90	24850.90	26210.89	22409.51	17243.35	12145.26	11482.49
3. Agriculture	25314.77	25314.77	24528.35	21243.78	18822.76	18495.31	19210.26
4. Land use, land-use change and forestry[5]	6060.44	6060.44	6215.64	6044.51	5981.41	6135.20	6710.87
5. Waste	14180.20	14180.20	12575.90	9821.84	6277.47	4508.20	3378.06
6. Other	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)[5]	226811.17	226811.17	237260.61	225422.92	220081.62	220056.82	201749.50

Table 1 Emission trends (Summary) (kton CO_2 equivalents)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015
	(kt CO_2 eq)						
Total (net emissions)[2]	226811.17	226811.17	237260.61	225422.92	220081.62	220056.82	201749.50
1. Energy	156404.87	156404.87	167729.83	165903.27	171756.63	178772.85	160967.83
A. Fuel combustion (sectoral approach)	153284.46	153284.46	164846.31	164278.47	169310.68	175905.18	158192.37
1. Energy industries	53075.52	53075.52	62335.43	64323.06	67824.69	66677.83	68357.61
2. Manufacturing industries and construction	32123.55	32123.55	27629.62	26879.82	26832.64	27161.72	24129.87
3. Transport	28139.98	28139.98	30681.03	33076.25	35490.70	35381.65	31159.83
4. Other sectors	39627.07	39627.07	43890.44	39735.71	38962.91	46422.86	34366.82
5. Other	318.34	318.34	309.79	263.63	199.74	261.13	178.25
B. Fugitive emissions from fuels	3120.40	3120.40	2883.52	1624.80	2445.95	2867.67	2775.46
1. Solid fuels	413.46	413.46	523.50	427.03	510.69	979.09	815.71
2. Oil and natural gas and other emissions from energy production	2706.94	2706.94	2360.02	1197.76	1935.26	1888.59	1959.75
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	24850.90	24850.90	26210.89	22409.51	17243.35	12145.26	11482.49
A. Mineral industry	1247.88	1247.88	1481.02	1324.55	1345.70	1240.72	1156.59
B. Chemical industry	17523.63	17523.63	19501.97	15652.42	11767.37	6929.98	6499.41
C. Metal industry	5312.38	5312.38	4151.96	3178.12	1756.65	1077.00	951.62
D. Non-energy products from fuels and solvent use	187.67	187.67	205.71	259.27	306.06	315.19	308.75
E. Electronic industry	25.17	25.17	49.75	260.74	253.92	205.04	85.47
F. Product uses as ODS substitutes	NO,IE,NA	NO,IE,NA	273.71	1230.80	1434.82	2057.16	2187.24
G. Other product manufacture and use	481.68	481.68	516.26	454.65	345.37	291.10	268.18
H. Other	72.48	72.48	30.51	48.97	33.45	29.07	25.22
3. Agriculture	25314.77	25314.77	24528.35	21243.78	18822.76	18495.31	19210.26
A. Enteric fermentation	9227.40	9227.40	8907.92	7890.60	7597.26	7969.00	8511.55
B. Manure management	6736.83	6736.83	6476.44	5802.13	4899.75	5049.94	5160.65
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	9167.40	9167.40	9045.79	7453.43	6251.01	5416.66	5469.34
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO
G. Liming	183.15	183.15	98.20	97.62	74.74	59.72	68.72
H. Urea application	IE	IE	IE	IE	IE	IE	IE
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO
J. Other	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
4. Land use, land-use change and forestry[2]	6060.44	6060.44	6215.64	6044.51	5981.41	6135.20	6710.87
A. Forest land	-1910.71	-1910.71	-2030.83	-2186.16	-2134.69	-2333.58	-2427.40
B. Cropland	1640.03	1640.03	1815.82	1991.66	2145.05	2422.45	2744.91
C. Grassland	5483.65	5483.65	5210.30	4937.58	4355.54	4312.02	4425.99
D. Wetlands	88.19	88.19	67.20	46.27	51.42	62.92	67.23
E. Settlements	889.83	889.83	1034.61	1179.74	1397.43	1494.79	1678.10
F. Other land	26.64	26.64	52.60	78.58	95.77	114.82	133.67
G. Harvested wood products	-157.20	-157.20	65.94	-3.15	70.89	61.77	88.38
H. Other	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
5. Waste	14180.20	14180.20	12575.90	9821.84	6277.47	4508.20	3378.06
A. Solid waste disposal	13679.15	13679.15	11960.36	9225.43	5714.25	4059.48	2944.98
B. Biological treatment of solid waste	20.20	20.20	221.77	252.30	254.67	161.81	150.95
C. Incineration and open burning of waste	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE
D. Waste water treatment and discharge	480.84	480.84	393.77	344.12	308.54	286.91	282.13
E. Other	NO	NO	NO	NO	NO	NO,NA	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO
Memo items:							
International bunkers	39948.78	39948.78	42657.38	52723.35	61849.69	55372.37	50922.51
Aviation	4643.79	4643.79	7662.83	9962.28	11009.65	10293.74	11466.93
Navigation	35304.99	35304.99	34994.54	42761.07	50840.03	45078.64	39455.58
Multilateral operations	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass	4081.08	4081.08	4821.66	6805.78	9496.76	13250.48	12819.61
CO_2 captured	NO,NA	NO,NA	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
Indirect CO_2 [3]	665.96	665.96	469.40	335.77	253.25	236.55	207.04
Total CO_2 equivalent emissions without land use, land-use change and forestry	220750.73	220750.73	231044.97	219378.41	214100.21	213921.63	195038.63
Total CO_2 equivalent emissions with land use, land-use change and forestry	226811.17	226811.17	237260.61	225422.92	220081.62	220056.82	201749.50
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	221416.70	221416.70	231514.37	219714.18	214353.46	214158.17	195245.67
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	227477.14	227477.14	237730.01	225758.69	220334.87	220293.37	201956.54

Table 2 Emission Trends Greenhouse gases CO_2 eq (kton CO_2 equivalents)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015
	(kt)						
1. Energy	153192.62	153192.62	164108.74	163234.79	169116.78	175182.62	157965.18
A. Fuel combustion (sectoral approach)	152015.48	152015.48	163155.03	162546.14	167536.41	173157.25	155839.14
1. Energy industries	52855.93	52855.93	62068.85	64018.98	67434.70	66292.49	67933.32
2. Manufacturing industries and construction	32015.61	32015.61	27525.32	26767.13	26730.04	27051.56	24022.39
3. Transport	27838.08	27838.08	30290.32	32701.17	35154.56	35041.87	30847.22
4. Other sectors	38993.83	38993.83	42967.23	38801.31	38022.20	44514.71	32861.01
5. Other	312.03	312.03	303.31	257.54	194.90	256.62	175.20
B. Fugitive emissions from fuels	1177.14	1177.14	953.71	688.65	1580.37	2025.37	2126.04
1. Solid fuels	402.51	402.51	512.51	421.71	505.09	974.05	810.68
2. Oil and natural gas and other emissions from energy production	774.63	774.63	441.20	266.94	1075.28	1051.33	1315.36
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	8895.52	8895.52	8651.65	8317.75	7988.55	7303.27	7093.34
A. Mineral industry	1247.88	1247.88	1481.02	1324.55	1345.70	1240.72	1156.59
B. Chemical industry	4712.72	4712.72	5012.40	5148.57	4648.28	4708.04	4657.18
C. Metal industry	2674.70	2674.70	1921.78	1536.04	1654.65	1009.78	945.12
D. Non-energy products from fuels and solvent use	187.52	187.52	205.56	259.03	305.81	314.89	308.45
E. Electronic industry							
F. Product uses as ODS substitutes							
G. Other product manufacture and use	0.22	0.22	0.39	0.59	0.66	0.76	0.77
H. Other	72.48	72.48	30.51	48.97	33.45	29.07	25.22
3. Agriculture	183.15	183.15	98.20	97.62	74.74	59.72	68.72
A. Enteric fermentation							
B. Manure management							
C. Rice cultivation							
D. Agricultural soils							
E. Prescribed burning of savannas							
F. Field burning of agricultural residues							
G. Liming	183.15	183.15	98.20	97.62	74.74	59.72	68.72
H. Urea application	IE	IE	IE	IE	IE	IE	IE
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [2]	6054.37	6054.37	6181.37	5982.02	5894.61	6029.04	6580.96
A. Forest land	-1911.34	-1911.34	-2033.09	-2190.05	-2139.92	-2339.54	-2433.81
B. Cropland	1636.98	1636.98	1797.51	1958.10	2098.91	2364.89	2666.52
C. Grassland	5483.31	5483.31	5208.83	4934.96	4351.66	4306.90	4420.05
D. Wetlands	88.04	88.04	66.29	44.59	49.13	60.17	64.03
E. Settlements	888.29	888.29	1025.35	1162.75	1373.39	1466.35	1649.59
F. Other land	26.30	26.30	50.55	74.83	90.55	108.51	126.20
G. Harvested wood products	-157.20	-157.20	65.94	-3.15	70.89	61.77	88.38
H. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
5. Waste	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
A. Solid waste disposal	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
B. Biological treatment of solid waste							
C. Incineration and open burning of waste	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE
D. Waste water treatment and discharge							
E. Other	NO	NO	NO	NO	NO	NA	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO
Memo items:							
International bunkers	39560.79	39560.79	42247.54	52218.82	61255.99	54840.69	50434.53
Aviation	4604.60	4604.60	7598.17	9878.21	10916.75	10206.87	11370.17
Navigation	34956.19	34956.19	34649.38	42340.61	50339.24	44633.82	39064.36
Multilateral operations	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass	4081.08	4081.08	4821.66	6805.78	9496.76	13250.48	12819.61
CO_2 captured	NO,NA	NO,NA	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O							
Indirect CO_2 [3]	665.96	665.96	469.40	335.77	253.25	236.55	207.04
Total CO_2 equivalent emissions without land use, land-use change and forestry	162271.29	162271.29	172858.59	171650.16	177180.06	182545.60	165127.23
Total CO_2 equivalent emissions with land use, land-use change and forestry	168325.66	168325.66	179039.96	177632.18	183074.68	188574.64	171708.19
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	162937.25	162937.25	173327.99	171985.93	177433.32	182782.15	165334.28
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	168991.63	168991.63	179509.36	177967.95	183327.93	188811.19	171915.24

Table 3 Emission Trends CO_2 (kton CO_2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1995	2000	2005	2010	2015
	(kt)						
1. Energy	113.86	113.86	123.38	83.28	81.39	118.03	92.85
A. Fuel combustion (sectoral approach)	36.13	36.13	46.19	45.84	46.76	84.34	66.87
1. Energy industries	2.89	2.89	3.87	4.40	5.99	5.32	4.48
2. Manufacturing industries and construction	2.60	2.60	2.64	2.92	2.56	2.57	2.39
3. Transport	7.85	7.85	5.41	3.74	3.14	2.90	2.45
4. Other sectors	22.76	22.76	34.24	34.74	35.05	73.54	57.53
5. Other	0.03	0.03	0.03	0.03	0.02	0.02	0.01
B. Fugitive emissions from fuels	77.73	77.73	77.19	37.45	34.62	33.69	25.98
1. Solid fuels	0.44	0.44	0.44	0.21	0.22	0.20	0.20
2. Oil and natural gas and other emissions from energy production	77.29	77.29	76.75	37.23	34.40	33.49	25.78
C. CO_2 transport and storage							
2. Industrial processes	17.21	17.21	17.21	17.72	20.11	19.13	18.08
A. Mineral industry							
B. Chemical industry	15.20	15.20	15.20	15.86	18.35	17.44	16.37
C. Metal industry	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
D. Non-energy products from fuels and solvent use	0.01	0.01	0.01	0.01	0.01	0.01	0.01
E. Electronic industry							
F. Product uses as ODS substitutes							
G. Other product manufacture and use	2.00	2.00	2.01	1.85	1.76	1.68	1.70
H. Other	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	601.52	601.52	578.83	518.16	473.83	493.62	519.92
A. Enteric fermentation	369.10	369.10	356.32	315.62	303.89	318.76	340.46
B. Manure management	232.43	232.43	222.51	202.53	169.94	174.86	179.46
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO
G. Liming							
H. Urea application							
I. Other carbon-containing fertilizers							
J. Other	NA	NA	NA	NA	NA	NA	NA
4. Land use, land-use change and forestry	0.01	0.01	0.01	0.01	0.01	0.01	0.01
A. Forest land	0.01	0.01	0.01	0.01	0.01	0.01	0.01
B. Cropland	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Wetlands	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
E. Settlements	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products							
H. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
5. Waste	560.06	560.06	493.90	384.46	243.36	173.86	129.18
A. Solid waste disposal	547.17	547.17	478.41	369.02	228.57	162.38	117.80
B. Biological treatment of solid waste	0.55	0.55	5.42	6.19	6.16	3.02	2.95
C. Incineration and open burning of waste	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE
D. Waste water treatment and discharge	12.35	12.35	10.06	9.25	8.63	8.46	8.43
E. Other	NO	NO	NO	NO	NO	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	1292.66	1292.66	1213.32	1003.62	818.68	804.65	760.03
Total CH_4 emissions with CH_4 from LULUCF	1292.67	1292.67	1213.33	1003.63	818.70	804.66	760.04
Memo items:							
International bunkers	3.20	3.20	3.18	3.88	4.62	4.11	3.63
Aviation	0.03	0.03	0.05	0.07	0.08	0.07	0.08
Navigation	3.16	3.16	3.13	3.81	4.54	4.04	3.55
Multilateral operations	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass							
CO_2 captured							
Long-term storage of C in waste disposal sites							
Indirect N_2O							
Indirect CO_2 [(3)]							

Table 4 Emission Trends CH_4 (kton CH_4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015
	(kt)						
1. Energy	1.23	1.23	1.80	1.97	2.03	2.15	2.29
A. Fuel combustion (sectoral approach)	1.23	1.23	1.80	1.97	2.03	2.15	2.29
1. Energy industries	0.49	0.49	0.57	0.65	0.81	0.85	1.05
2. Manufacturing industries and construction	0.14	0.14	0.13	0.13	0.13	0.15	0.16
3. Transport	0.35	0.35	0.86	0.95	0.86	0.90	0.84
4. Other sectors	0.22	0.22	0.23	0.22	0.22	0.23	0.23
5. Other	0.02	0.02	0.02	0.02	0.01	0.01	0.01
B. Fugitive emissions from fuels	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
C. CO_2 transport and storage							
2. Industrial processes	23.66	23.66	23.55	22.56	21.66	4.13	4.56
A. Mineral industry							
B. Chemical industry	22.90	22.90	22.86	22.06	21.33	3.81	4.27
C. Metal industry	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
E. Electronic industry							
F. Product uses as ODS substitutes							
G. Other product manufacture and use	0.75	0.75	0.69	0.50	0.33	0.32	0.29
H. Other	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	33.87	33.87	33.42	27.49	23.16	20.45	20.62
A. Enteric fermentation							
B. Manure management	3.11	3.11	3.07	2.48	2.19	2.28	2.26
C. Rice cultivation							
D. Agricultural soils	30.76	30.76	30.35	25.01	20.98	18.18	18.35
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO
G. Liming							
H. Urea application							
I. Other carbon containing fertlizers							
J. Other	NA	NA	NA	NA	NA	NA	NA
4. Land use, land-use change and forestry	0.02	0.02	0.11	0.21	0.29	0.36	0.43
A. Forest land	0.00	0.00	0.01	0.01	0.02	0.02	0.02
B. Cropland	0.01	0.01	0.06	0.11	0.15	0.19	0.26
C. Grassland	0.00	0.00	0.00	0.01	0.01	0.02	0.02
D. Wetlands	0.00	0.00	0.00	0.01	0.01	0.01	0.01
E. Settlements	0.01	0.01	0.03	0.06	0.08	0.10	0.10
F. Other land	0.00	0.00	0.01	0.01	0.02	0.02	0.03
G. Harvested wood products							
H. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
5. Waste	0.60	0.60	0.77	0.71	0.65	0.54	0.50
A. Solid waste disposal							
B. Biological treatment of solid waste	0.02	0.02	0.29	0.33	0.34	0.29	0.26
C. Incineration and open burning of waste	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE
D. Waste water treatment and discharge	0.58	0.58	0.48	0.38	0.31	0.25	0.24
E. Other	NO	NO	NO	NO	NO	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	59.35	59.35	59.53	52.72	47.50	27.27	27.96
Total direct N_2O emissions with N_2O from LULUCF	59.37	59.37	59.65	52.93	47.79	27.62	28.39
Memo items:							
International bunkers	1.03	1.03	1.11	1.37	1.60	1.44	1.33
Aviation	0.13	0.13	0.21	0.28	0.31	0.29	0.32
Navigation	0.91	0.91	0.90	1.09	1.30	1.15	1.01
Multilateral operations	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass							
CO_2 captured							
Long-term storage of C in waste disposal sites							
Indirect N_2O	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
Indirect CO_2 [3]							

Table 5 Emission Trends N_2O (kton N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015
	(kt)						
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	8269.18	8269.18	9851.36	6667.87	2094.02	2980.09	2439.94
Emissions of HFCs - (kt CO_2 equivalent)	5606.33	5606.33	7571.44	4765.06	1728.04	2666.32	2335.72
HFC-23	0.38	0.38	0.49	0.21	0.02	0.03	0.01
HFC-32	NO	NO	0.00	0.01	0.02	0.03	0.04
HFC-41	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	0.00	0.07	0.11	0.18	0.19
HFC-134	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO,IE,NA	NO,IE,NA	0.04	0.17	0.36	0.46	0.50
HFC-143	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	0.00	0.08	0.10	0.15	0.15
HFC-152	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	0.02	0.02	0.00	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO
HFC-236cb	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs[4] - (kt CO_2 equivalent)	NO	NO	200.97	827.97	150.89	203.56	161.46
Emissions of PFCs - (kt CO_2 equivalent)	2662.85	2662.85	2279.92	1902.81	365.99	313.77	104.22
CF_4	0.28	0.28	0.24	0.16	0.01	0.01	0.00
C_2F_6	0.05	0.05	0.04	0.04	0.00	0.00	0.00
C_3F_8	NO	NO	NO	NO	NO	NO	NO
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO
c-C_3F_6	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs[4] - (kt CO_2 equivalent)	25.17	25.17	49.75	260.74	263.98	246.55	97.72
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO
Emissions of SF_6 - (kt CO_2 equivalent)	206.70	206.70	260.97	258.78	203.72	153.79	138.83
SF_6	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Emissions of NF_3 - (kt CO_2 equivalent)	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE
NF_3	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE

Table 6 Emission Trends F-gases (kton CO_2 equivalents)

ANNEX 2 MODELLING SYSTEM FOR PROJECTIONS

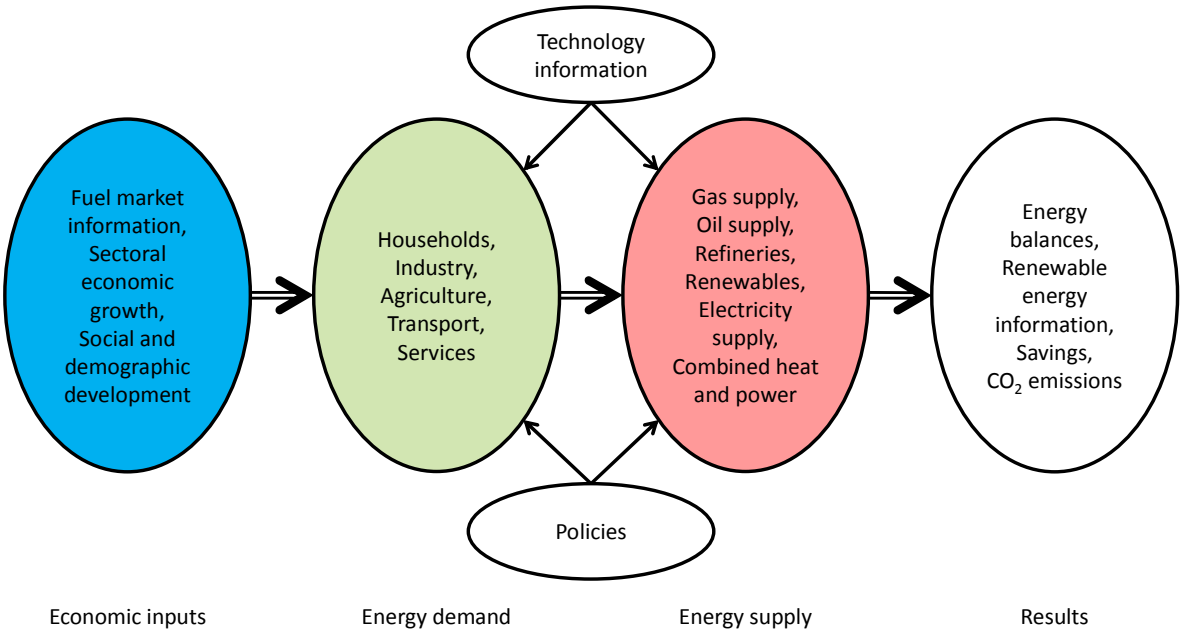
This annex briefly describes the modelling system for projections. In the Netherlands, a combination of modelling tools is used. The National Energy Outlook Modelling System (NEOMS) is the primary modelling suite, developed for over 20 years by Energy Research Centre of the Netherlands (ECN) and the Environmental Assessment Agency (PBL) for projections and policy evaluations.

National Energy Outlook Modelling System

NEOMS is a suite of models to simulate the various parts and sectors of the Dutch Energy System. Some constituent models have been developed in excel, some have been developed in AIMMS. Although the models differ in different ways, the general starting point is a detailed inventory of the existing portfolio of all energy consuming technologies in all sectors, calibrated to national statistics on energy demand and supply, investments, added value and data available from other sources (e.g. world market prices for oil, gas and coal from IEA and futures markets, monitoring of government programmes). Building on the drivers for developments in the energy system, such as economic growth, population growth and technological change - some as endogenous effort, some defined exogenously - the models simulate the development of the system, activity levels and the uptake of alternative technologies therein, taking into account consumer preferences and market behaviours and the impact of policies thereupon. Combining expected technology deployment and the demand for various products and energy services result in the final and primary energy consumption and CO_2-emission projections.

The results from NEOMS are used and/or complemented with the modelling of non-CO_2 emissions and non-energy related CO_2-emissions (LULUCF). This is done using sectoral models (agriculture and LULUCF) and spreadsheet tools (industry and other sectors).

NEOMS enables 12 energy models of ECN to exchange data and produce consistent and detailed results.

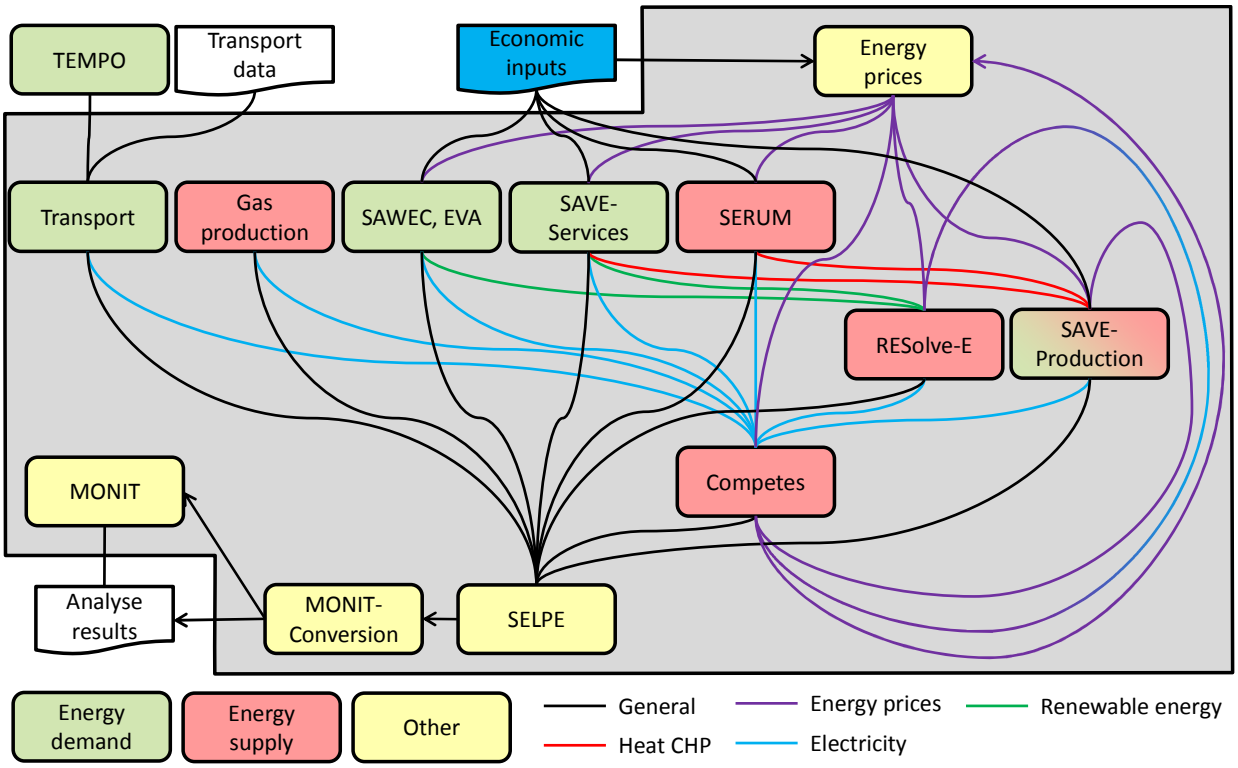


NEOMS enables ECN to calculate the energy use and the corresponding emissions for the Dutch energy system and for individual sectors. Detailed results include energy demand, supply, emissions, technology uptake, investments, costs, prices, policy impacts. The total system includes about 22 sub-sectors with all relevant technologies and fuels per sub-sector. Their CO_2 emissions are also calculated.

The NEOMS models currently cover the following sectors and their corresponding models:

- **Energy demand**
  - Industry and agriculture (SAVE-Production),
  - Service sector (SAVE-Services),
  - Households (SAWEC and EVA),
  - Transport (TEMPO and/or external inputs).
- **Energy supply**
  - Combined heat and power (SAVE-Production),
  - Electricity supply (Competes),
  - Refineries and oil supply (SERUM),
  - Renewables (RESolve-E),
  - Gas supply (Gas production).

The outputs of all the separate models are combined in a model of the total energy sector (SELPE) in which the validity and consistency of the energy system as a whole is verified. Ultimately, all the results feed into MONIT-Conversion, a tool which calculates the energy savings per sector and produces aggregated results for all kinds of analyses, for example for the presentation tool MONIT.



Energy demand

SAVE-Production (industry, agriculture and CHP)
SAVE-Production is a simulation model that calculates the energy demand of industry and agricultural sectors and the sectoral implementation of combined heat and power generation. The future energy demand is calculated based on the economic growth per subsector and measures taken.

SAVE-Services (services sector)
SAVE-Services is a simulation model for the services sector. Based on the economic growth per subsector and the measures taken, the model calculates the future gas and electricity demand.

SAWEC (households)
SAWEC is a simulation model for households that calculates the building-related energy use of houses, for example natural gas, electricity, district heating and oil products. Based on a stock database, SAWEC calculates the effects of all kinds of measures. The model can accurately simulate historic energy-related trends dating back to 1985 and uses the same algorithm to project future developments towards 2040.

EVA (households)
EVA uses a detailed stock database to calculate the national electricity use of household appliances. EVA offers a detailed view on the impact of changes in the penetration of appliances and autonomous or policy driven changes in energy consumption.

Transport
The transport model is a tool to incorporate the results of the ECN model TEMPO and externally provided data into the databases of NEOMS. This enables the other models to use these data for their calculations.

Energy Supply

Competes (electricity supply)
Competes is used to calculate the centralised electricity production.
Based on the Dutch sectoral electricity demand, hourly electricity production from intermittent renewables and sectoral implementation of combined heat and power, the remaining demand is covered by Competes, taking into account the merit order of the supply curve of centralised electricity generators and electricity trade with the neighbouring countries. Competes also provides the commodity prices for electricity.

SERUM (refineries and oil supply)
SERUM is an optimization model for the Dutch oil refining sector. Based on expectations about the demand for oil products, environmental measures and crude properties, SERUM calculates the required crude intake, the required refining configuration and the energy use for the whole process. Based on energy use and energy carriers, emission developments are calculated.

RESolve-E (renewables)
The aim of the RESolve-E model is to provide data about the total renewable energy production (excluding biofuels). For the renewable energy production that is eligible to receive a subsidy via the SDE subsidy scheme, the SDE budget constitutes a ceiling for the total production. Because renewable energy can contribute to realising the energy performance coefficient standards for new buildings, the renewable energy production of SAWEC and SAVE-Services serve as input for RESolve-E.

Gas production (gas supply)
In this model, the supply of natural gas is calculated based on the availability of natural gas in the 'Groningen' gas field, and the other onshore as well as the offshore fields. Exogenous assumptions are made about the volume for gas storage and export. If demand exceeds this production, natural gas will be imported. The model calculates the amount of energy needed for production, storage and transport as well as losses in the grid.

Other models and tools in NEOMS

Energy prices
The energy prices tool provides electricity and gas prices for the different sectors as defined in NEOMS. These data can be used by the NEOMS models.

SELPE (validity and consistency check)
SELPE is an optimisation model that is used to model the entire Dutch energy sector. Most of the constraints are set by the above-mentioned models. The aim of this model is to check the feasibility and consistency of the outcomes of the other models, for example verifying that the total electricity demand does not exceed the electricity supply.

MONIT-Conversion (aggregation tool)
The output of the SELPE model is very detailed. MONIT-Conversion can aggregate its results into any format needed by the user. The output is made available to MONIT, and can also be made available to external parties. Another function of this tool is to calculate the energy efficiency indicators.

MONIT (presentation tool)
This tool is used to present the combined results of the models in such a way that they can be used in all kinds of reports, together with historic data. Some of the results are also available on the Internet (http://monitweb.energie.nl/).

ANNEX 3 SUMMARY OF REPORTING OF THE SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2, OF THE KYOTO PROTOCOL IN THE NC7

Information reported under Article 7, paragraph 2	**NC6 section**
National systems in accordance with Article 5, paragraph 1	3.3. (C) Description of the National System
National registries	3.4. (D) National Registry
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	5.6. (D) Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17
Policies and measures in accordance with Article 2	4.3. (B) Policies and measures and their effects
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	4.3. (B) Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures
Information under Article 10	
Art 10a	3.3. (C) Description of the National System
Art 10b	4.3. (B) Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures and 6.3 (C) Adaptation measures
Art 10c	7.4. (D) Activities relating to technology transfer
Art 10d	8. Research and Systematic Observation 8.3. (C) Systematic observations
Art 10e	9. Education, Training and Public Awareness
Financial resources (Annex II only)	7.2. (A) Provision of new and additional resources 7.2. (B) Assistance to developing countries that are particularly vulnerable to climate change 7.5. (E) Provision of financial resources under article 11 of the Kyoto Protocol

ANNEX 4 ENERGY BALANCES

Energy balance 2000 (including temperature correction based on degree days method)

Energy balance 2015 (including temperature correction based on degree days method)

Energy balance 2020 WEM

Energy balance 2020 WAM

Energy balance 2030 WEM

Energy balance 2030 WAM

Energy balance 2000 (including temperature correction based on degree days method)

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	472	1193	771	163	264	51	518	2659	179	330	33	543	3202
Coal	0	93	8	0	0	0	0	93	0	232	0	232	325
Oil	3	455	420	2	9	0	512	981	155	34	0	189	1170
of which biofuel	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural gas	379	414	227	133	149	3	0	1078	33	376	30	439	1517
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	41	0	41	41
Electricity	72	126	33	12	94	-1	6	308	-1	-242	3	-240	68
Heat	8	95	80	15	12	-5	0	125	-8	-117	0	-125	0
Biomass (excl. biogas)	10	3	0	0	0	26	0	39	0	4	0	4	43
Biogas	0	1	0	0	1	3	0	4	0	1	0	1	5
Energy from other sources	0	5	4	0	0	26	0	31	0	0	0	0	32
Non-energy use	0	494	460	0	2	0	3	498					498
Coal	0	5	4	0	0	0	0	5					5
Oil	0	387	354	0	2	0	3	391					391
Natural gas	0	102	102	0	0	0	0	102					102
Final electricity consumption	72	147	44	15	97	7	6	344	9	18	3	30	374

source: NEV, 2017

Energy balance 2015 (including temperature correction based on degree days method)

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	394	1153	818	140	262	65	493	2507	184	360	33	577	3085
Coal	0	99	0	0	0	0	0	99	0	362	0	362	461
Oil	2	549	536	1	-2	0	485	1035	121	21	0	141	1176
of which biofuel	0	0	0	0	0	0	13	13	0	0	0	0	13
Natural gas	289	315	180	128	127	3	2	863	54	250	26	329	1192
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	39	0	39	39
Electricity	82	110	39	-3	120	-6	6	310	2	-258	7	-248	61
Heat	13	67	59	6	6	-21	0	71	1	-69	0	-68	4
Biomass (excl. biogas)	9	5	0	3	10	49	0	76	7	13	0	20	96
Biogas	0	2	0	5	0	5	0	13	0	1	0	1	14
Energy from other sources	0	5	4	0	0	35	0	40	0	1	0	1	41
Non-energy use	0	539	527	0	1	0	2	542					543
Coal	0	0	0	0	0	0	0	0					0
Oil	0	452	440	0	1	0	2	455					455
Natural gas	0	87	87	0	0	0	0	87					87
Final electricity consumption	82	124	45	31	121	8	6	372	9	20	7	36	408

source: NEV, 2017

Energy balance 2020 WEM

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	370	1193	857	145	253	64	492	2517	186	249	42	477	2995
Coal	0	112	2	0	0	0	0	113	0	239	0	239	352
Oil	2	597	585	1	3	0	482	1085	108	0	0	108	1194
of which biofuel	0	0	0	0	0	0	35	35	0	0	0	0	35
Natural gas	253	277	159	113	118	3	2	767	58	168	36	262	1029
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	43	0	43	43
Electricity	77	116	42	9	116	-6	8	321	8	-192	6	-178	143
Heat	19	74	66	11	14	-20	0	96	0	-75	0	-75	21
Biomass (excl. biogas)	19	13	2	4	2	45	0	83	0	66	0	66	148
Biogas	0	5	0	7	0	5	0	17	0	0	0	0	17
Energy from other sources	0	0	0	0	0	36	0	36	12	0	0	12	49
Non-energy use	0	565	563	0	0	0	2	567					567
Coal	0	2	1	0	0	0	0	2					2
Oil	0	474	473	0	0	0	2	476					476
Natural gas	0	89	89	0	0	0	0	89					89
Final electricity consumption	77	125	45	33	117	8	8	368	11	19	7	37	405

source: NEV, 2017

Energy balance 2020 WAM

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	367	1186	850	145	249	63	492	2503	186	249	42	477	2981
Coal	0	114	2	0	0	0	0	114	0	240	0	240	354
Oil	2	597	585	1	3	0	482	1085	108	0	0	108	1194
of which biofuel	0	0	0	0	0	0	41	41	0	0	0	0	41
Natural gas	248	267	151	113	116	2	2	749	58	163	36	257	1006
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	43	0	43	43
Electricity	78	115	42	9	114	-6	8	318	8	-190	6	-176	142
Heat	21	73	66	11	13	-20	0	98	0	-74	0	-74	24
Biomass (excl. biogas)	19	15	4	4	2	45	0	85	0	68	0	68	152
Biogas	0	5	0	7	0	5	0	18	0	0	0	0	18
Energy from other sources	0	0	0	0	0	36	0	36	12	0	0	12	49
Non-energy use	0	565	563	0	0	0	2	567					567
Coal	0	2	1	0	0	0	0	2					2
Oil	0	474	473	0	0	0	2	476					476
Natural gas	0	89	89	0	0	0	0	89					89
Final electricity consumption	78	123	44	33	115	8	8	366	11	19	7	37	402

source: NEV, 2017

Energy balance 2030 WEM

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	354	1202	872	133	237	64	505	2496	170	207	24	401	2896
Coal	0	113	2	0	0	0	0	114	0	213	0	213	326
Oil	1	627	616	0	3	0	492	1125	105	0	0	105	1230
of which biofuel	0	0	0	0	0	0	35	35	0	0	0	0	35
Natural gas	226	288	179	74	98	2	5	692	45	71	21	137	830
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	42	0	42	42
Electricity	82	119	42	19	115	-5	8	340	7	-134	3	-124	216
Heat	25	37	31	15	17	-20	0	75	0	-34	0	-34	41
Biomass (excl. biogas)	19	11	3	9	3	43	0	84	0	49	0	49	134
Biogas	0	6	0	16	0	7	0	28	0	0	0	0	28
Energy from other sources	0	0	0	0	0	37	0	37	13	0	0	13	50
Non-energy use	0	588	587	0	0	0	2	591					591
Coal	0	2	1	0	0	0	0	2					2
Oil	0	495	494	0	0	0	2	497					497
Natural gas	0	91	91	0	0	0	0	91					91
Final electricity consumption	82	122	43	34	115	9	8	371	11	21	3	35	406

source: NEV, 2017

Energy balance 2030 WAM

(PJ)	Residential	Industry	of which chemical industry	Agriculture and horticulture (excl. mobile machines)	Commercial and public services	Water and waste sector	Transport (incl. mobile machines and fisheries)	Total final consumption	Refineries	Electricity production	Oil and gas extraction	Total energy sector	Total
Total	342	1193	863	132	229	64	485	2445	170	191	24	385	2829
Coal	0	118	2	0	0	0	0	118	0	216	0	216	334
Oil	1	627	616	0	3	0	466	1099	105	0	0	105	1205
of which biofuel	0	0	0	0	0	0	33	33	0	0	0	0	33
Natural gas	215	280	170	73	90	2	5	665	45	70	21	136	801
Heat from nuclear energy	0	0	0	0	0	0	0	0	0	42	0	42	42
Electricity	76	117	39	20	113	-5	13	334	7	-123	3	-113	221
Heat	30	37	31	14	19	-20	-1	79	0	-35	0	-35	44
Biomass (excl. biogas)	19	11	6	10	3	43	0	87	0	22	0	22	108
Biogas	0	3	0	14	0	6	0	23	0	0	0	0	23
Energy from other sources	0	0	0	0	0	37	1	39	13	0	0	13	51
Non-energy use	0	588	587	0	0	0	2	591					591
Coal	0	2	1	0	0	0	0	2					2
Oil	0	495	494	0	0	0	2	497					497
Natural gas	0	91	91	0	0	0	0	91					91
Final electricity consumption	76	119	40	34	113	9	13	364	11	21	3	35	399

source: NEV, 2017

ANNEX 5 OVERVIEW OF CLIMATE TRENDS IN THE NETHERLANDS

Annex 5 is a separate file attached to the Seventh Netherlands National Communication under the UNFCCC. The four diagrams from figure 6.7 are shown on A3 format, for a better readability when printed.

This annex contains the following diagrams:

- Figure 6.7a: Overview of climate trends in the Netherlands: Temperatures are rising
- Figure 6.7b: Overview of climate trends in the Netherlands: precipitation is increasing
- Figure 6.7c: Overview of climate trends in the Netherlands: periods of drought are increasing in summer
- Figure 6.7d: Overview of climate trends in the Netherlands: the sea level is rising

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