Ministry of Economic Affairs and Climate Policy of the Netherlands

Eighth Netherlands National Communication Under The United Nations Framework Convention On Climate Change

Ministry of Economic Affairs and Climate Policy

CONTENT

1. EXECUTIVE SUMMARY

Introduction

This report presents the Eighth 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 Seventh National Communication. The National Communication includes also most information that needs to be reported in the fifth (and final) Biennial Report. Specific information that is required under the guidelines for Biennial Reports is included in the Annex IV.

National Circumstances relevant to greenhouse gas emissions and removals

The Netherlands is a constitutional monarchy. The legislative process is realised in a combined effort by the government and Parliament. Since 2017, the Ministry of Economic Affairs and Climate Policy (EZK) has been responsible for climate policy. Other ministries are responsible for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g. the Ministry of Infrastructure and Water Management is responsible for climate adaptation).

The Netherlands is a densely populated country. The population density increased between 1990 and 2021 from 439 to 519 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, which fell from 2.5 in 1990 to 2.3 in 2000 to 2.1 in 2021. In the same period, the number of households increased from 6.1 million in 1990 to 8.0 million in 2021, while the percentage of single-person households increased from 30% to 39% in 2021. As a result of these developments, there is a greater need for housing, and an increasing demand for land for the construction of new dwellings and infrastructure.

The Netherlands is a low-lying country situated in the delta of the rivers Rhine, IJssel and Meuse, with around 26% 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 33,671 km^2, of which 54% is used as

agricultural land. While the use of land for agriculture is decreasing, land use for settlements and infrastructure is increasing. Forest covers an area of 5,000 km^2.

The Netherlands is located in a so-called "temperate zone". Throughout the country, mean winter temperatures are about 4°C and mean summer temperatures are around 17°C. An increase of around 2°C has been measured in the Netherlands since 1961. The years 2014, 2018, and 2020 were the top three warmest years in the last 300 years.

The Gross Domestic Product (GDP) of the Netherlands was €763 billion in 2021 (based on 2015 prices). For its surface area, 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 goods to many countries throughout Europe.

Natural gas is traditionally a key energy source. In recent years, this has changed significantly: due to earthquakes in the main natural gas production region, production has been scaled back and the Netherlands has gone from being a net exporter to a net importer of natural gas. Most of the electricity used is also produced in the Netherlands; the import of electricity has been decreasing since 2013. From 1990 to 2020, the production of renewable electricity increased by a factor of 45-51, resulting in a share of 26% of total electricity consumption in 2021. The production of renewable electricity mainly takes place with wind turbines, which account for about half of total production.

Energy use peaked in 2004 with an energy use of 3461 petajoules (PJ), when ignoring the impact of cold and warm winters on the use of energy for space heating. Industry is the main user of energy in the Netherlands: about 35% of the nation's energy is used by industrial companies (see Figure 1.1). Industrial energy use has increased by almost 10% since 1990. Key industrial use is in the chemical and pharmaceutical industry; in 2021 this was responsible for 75% of industrial usage. In households, natural gas is 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 2021 natural gas consumption by households fell from 350 to 305 PJ. Energy consumption by the transport sector overall remained fairly consistent in the 2000-2021 period, with road transport being the category consuming the most energy and demonstrating the most fluctuation; as a result of the COVID-19 pandemic, energy consumption by road transport dropped by 14% between 2019 and 2020.

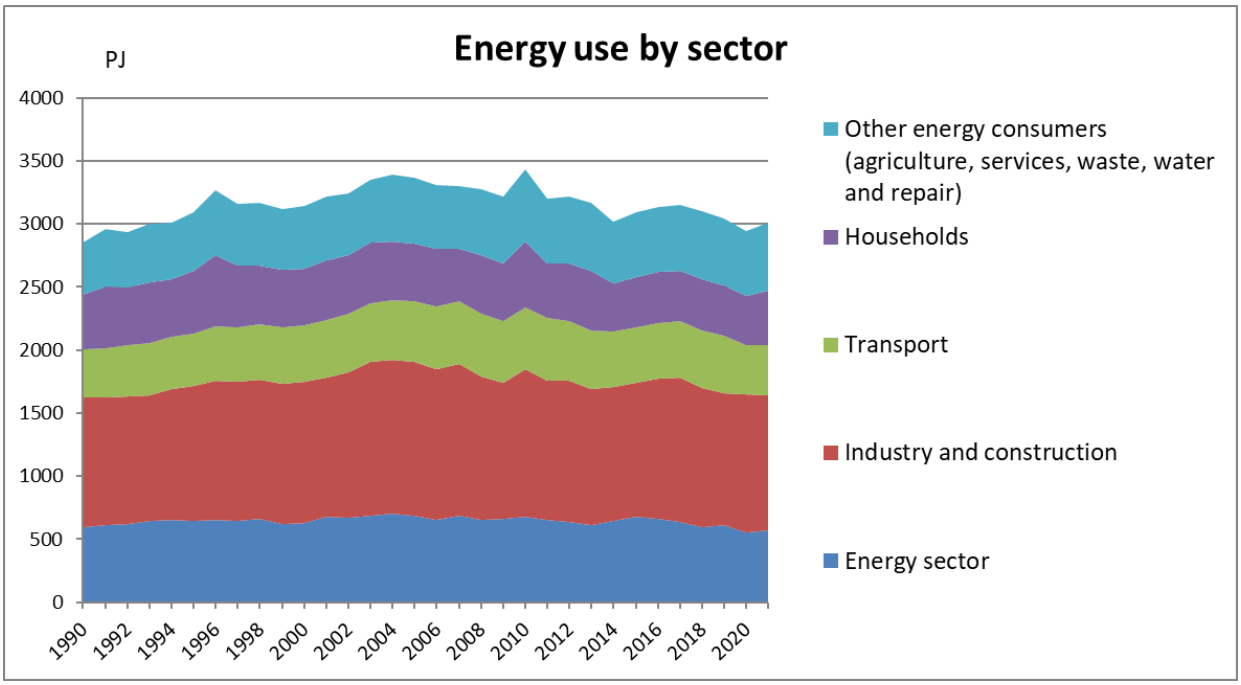


Figure 1.1. Energy use by national sectors 1990-2021 in PJ

Greenhouse gas (GHG) emissions and trends

In 2020, 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 164.32 Tg CO_2-eq. This figure is approximately 25.5% below the emissions in the base year of 1990 (220.5 Tg CO_2-eq).

Figure 1.2 shows the trends and contributions of the different gases in relation to the aggregated national emissions of greenhouse gases. In the period 1990–2020, emissions of carbon dioxide (CO_2) decreased by 15.0% (excluding LULUCF). Emissions of non-CO_2 GHGs, i.e. methane (CH_4), nitrous oxide (N_2O) and F-gases, decreased by 47%, 56% and 85%, respectively.

Emissions of LULUCF-related sources decreased by about 39% over the 1990-2020 period. The total amount of GHG emissions in the Netherlands in the year 2020 (including LULUCF) was 167.9 Tg CO_2-eq.

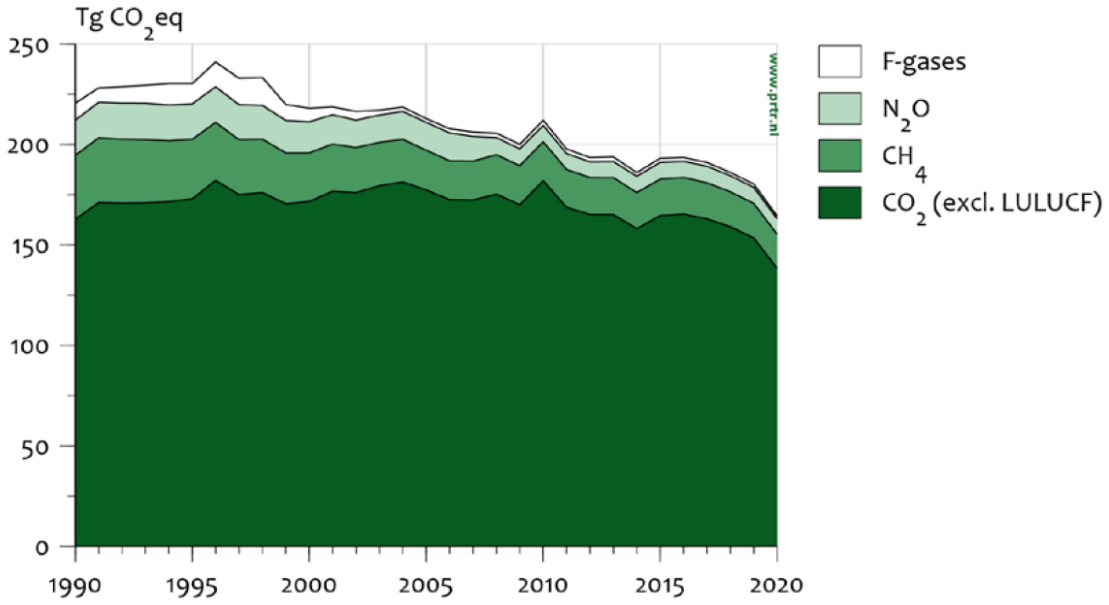


Figure 1.2: Greenhouse gas trends and emission levels, 1990–2020, in Tg CO_2-eq

The decrease in greenhouse gas emissions occurred despite a growing population and economy: since 1990 the trends of greenhouse gas emissions per capita and the greenhouse gas emissions intensity versus GDP is a decreasing one.

Since 2005 the Netherlands has a National System in place for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. The Netherlands Enterprise Agency (RVO) holds 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)

Since 1990, the Netherlands has implemented many policies and measures (PAMs) which have (had) a significant impact on greenhouse gas (GHG) 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 currently implemented or planned are described by sector and by GHG, in addition to cross-sectoral policies and measures. Here we present a selection of some key policies and measures.

The *National Climate Agreement*, concluded in June 2019, describes the actions to help achieve the Netherlands' national climate goals. The participating sectors are electricity,

industry, built environment, traffic and transport, and agriculture. This agreement can be regarded as the successor to the Agreement on Energy for Sustainable Growth ('Energy Agreement'), which served as the general policy framework in the 2013-2020 period, as was described in the previous National Communications.

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, with no further individual caps by country. Dutch companies participate in this *European Emission Trading System (ETS*), while national policies and measures also impact these companies' emissions.

Since 1996, an *Energy Tax* has been levied on electricity and natural gas. Its level depends on the consumer's energy consumption and specific agreements between the various sectors and the government. Relevant tariffs are updated annually. In addition, a sustainable energy surcharge (*ODE*) has been levied on electricity and natural gas consumed from the grid since 2013. The ODE was introduced to cover subsidies granted to produce renewable energy and/or to reduce CO_2-emissions. The ODE tariffs differentiate between levels of energy consumption and between types of users.

The government has encouraged the production of renewable energy for many years, mostly using feed-in premium schemes which have evolved over time. The current scheme is the so-called *SDE++* (Stimulation of Sustainable Energy Production and Climate Transition) incentive scheme. As of 2020, its focus has shifted towards GHG reduction in general, instead of renewable energy only. Improvements on this system are made on a yearly basis. Once a renewable energy production facility is in operation, a premium is to be paid 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, which have been increasing substantially in recent years. In 2011, the annual budget was set at €2 billion, while the allocated budget for 2022 now amounted to €13 billion.

Since 2021, a *National CO_2-pricing system for industry* has been in place. This CO_2-emission tax has been levied on industrial installations included in the EU ETS and on waste incinerators and facilities emitting large amounts of nitrous oxide (N_2O) that are not covered under the EU ETS. Industrial installations incur a carbon tax if their emissions exceed their baseline based on EU ETS benchmarks and a national reduction factor needed to reach the emission reduction target of 14.3 Mt CO_2-eq by 2030. This tax started at €30,48/tCO_2-eq in 2021 and increases by €10,87/tCO_2-eq annually for each year between 2021 – 2030, up to €128,71/tCO_2-eq in 2030.

In the transport sector, European and national policies are implemented. On the national level, policies are implemented promoting more efficient personal mobility, electrification of cars, efficient logistics and sustainable fuels. As an example, following the 2019 National Climate Agreement, many new national policies have been introduced to *further stimulate the uptake of zero-emission vehicles*. These include subsidy scheme not only for passenger cars ('SEPP'), but also for vans ('SEBA'), public busses ('SpUk-Zebus'), trucks ('AanZET') and zero-emission mobile machinery (SSEB) in the construction sector. To facilitate the uptake of zero-emission vehicles, charging and refuelling infrastructure is developed under national programmes stimulating infrastructure for alternative fuels (AFid) and the National Agenda on Charging Infrastructure (NAL).

A broad package of national policy instruments has been developed over many years for both new and existing buildings, which also implement European policy instruments such as the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED). In June 2022, the government announced a draft programme on *Accelerating Sustainability Measures in Renovating the Built Environment*. This programme should act as the national framework for policies in the built environment, aiming to reduce GHG emissions and dependency on natural gas. The programme operates in conjunction with the National Insulation Programme to insulate 2.5 million dwellings with poor energy performance scores by 2030 and the forthcoming program on hybrid-heat pumps to install 1 million hybrid-heat pumps in existing buildings by 2030. The EU Ecodesign Directive is the main policy instrument for appliances.

In relation to the agricultural sector, several policy instruments exist to stimulate emission reductions and/or to support farmers in implementing measures. Subsidy schemes are available, such as for sustainable stables and manure management (SBV) and for substituting artificial fertilisers with manure. In addition, there are several voluntary buy-out schemes for livestock-farmers as part of efforts to reduce phosphate and nitrogen emissions. On regional level, a combined policy approach for rural areas is used to decrease both GHG emissions and air pollutants, as well as to strengthen the quality of the natural environment and water. Provinces are required to publish their integrated plans to meet these targets within their territories by July 2023. The *Horticulture Energy Agreement*, in place since 2013, established a CO_2 ceiling for the greenhouse horticultural sector. Participants who exceed the emission limit, which decreases every year, incur a penalty. This system will remain in place until 2030. The horticultural sector aims to be carbon-neutral by 2040. This transition will be actively supported by the *Greenhouse as an Energy Source* programme, which forms part of the multi-year agreement on the energy transition in greenhouse horticulture.

Projections and the total effects of policies and measures

The projections described in this chapter are based on the National Climate and Energy Outlook 2022, which describes the most plausible developments based on the best available information about prices, markets, technology and policies in the Netherlands[1]. The Outlook distinguishes three different policy variants, which are based on the underlying principles of Dutch and European policy: the variant 'With Existing Measures' (WEM), the variant 'With Additional Measures' (WAM) and Variant "with scheduled measures" (WSM). All variants contain measures made binding by market participants, public organisations and other government bodies on or before the 1 May 2022. A variant 'Without Measures' is not included in the modelling. The variant "With Existing Measures" (WEM) encompasses currently implemented and adopted policies and measures as of 1 May 2022. In addition to all measures in the WEM variant, the variant "With Additional Measures" (WAM) encompasses planned policies and measures which have been published but not yet officially implemented by May 2022. The *Variant "with scheduled measures"* (WSM) also includes those planned policies and measures up to May 2022 which were *not* specific enough to be included in the modelling. This applies to many policies announced in the 2019 Climate Agreement and many parts of the so-called Fit-for-55 legislative proposals from the European Commission.

Based on existing policy (the WEM variant), greenhouse gas emissions are expected to fall to 122-128 Mt CO_2-eq by 2030. This is an emission reduction of 44-46% from 1990 levels (see Table 1.1). The WAM variant results in only slightly lower emissions

1 Please keep in mind that the projections are considered highly uncertain due to recent market developments.

Sector	1990	Estimate 2030
Electricity	39.6	7.5 – 12.9
Industry	86.4	40.8
Built environment	30.0	18.3
Mobility	32.2	28.9
Agriculture	33.1	23.3
Land use	5.7	3.7
Total (Mt)	227.0	122.5 – 127.9
Reduction since 1990		44% - 46%

Table 1.1 Projected GHG emissions in the WEM variant, by sector in Mt CO_2-eq

Based on the existing policies, projected emissions for the electricity sector are expected to drop sharply to 7.5-12.9 Mt CO_2-eq in 2030 due to the ban on the use of coal for electricity production. Due to a slightly higher electricity demand, emissions in the WAM variant are slightly higher. Annual emissions are expected to decrease further after 2030 to 6.2-11.6 Mt CO_2-eq and 7.9-13.4 in 2040 for the WEM and WAM variant, respectively.

For the industrial sector, emissions are projected to decrease further to 40.8 Mt CO_2-eq by 2030 with existing measures. Emissions of CO_2 are projected to decrease substantially to 36.5 Mt, while non-CO_2 emissions decrease modestly to 4.3 Mt CO_2-eq. CO_2 emissions are projected to largely be reduced by using Carbon Capture and Storage (CCS) in the chemical industry, refineries and waste incineration plants, amounting to around 9 Mt CO_2 in 2030, based on projects to be subsidised through the SDE++. Other important contributions to this decrease come from electrification and energy efficiency improvements.

In the built environment, projections are that CO_2 emissions will decrease as a result of declining gas use in the coming decade, mainly due to the installation of (hybrid) heatpumps, further insulation and the expansion of district heating. With existing measures, emissions are projected to amount to 18.3 Mt CO_2-eq in 2030.

It is expected that the demand for transport (of both goods and passengers) will continue to increase as a result of further economic growth. In the WEM variant, although energy consumption in this sector will remain relatively stable until 2030, emissions are projected to fall further to 28.9 Mt CO_2-eq in 2030 due to a swift increase of the share of electric vehicles and a growing share of biofuels. By 2040, emissions in this sector are projected to decrease further to 24.4 Mt CO_2-eq as a result of increasing electrification. In the WAM variant, emissions are projected to fall to 28.2 Mt CO_2-eq by 2030 and decrease

further to 19.8 Mt CO_2-eq by 2040. Compared to the WEM variant, busses and mobile machinery are electrified faster in the WAM variant. In addition, more efficient vehicles are sold in this variant due to increased European CO_2 performance standards.

For the agricultural sector, it is projected that emissions will decline to 23.3 Mt CO_2-eq by 2030. This projected decline is largely due to declining energy-related emissions to 5.7 and 5.6 Mt CO_2-eq in 2030 in the WEM and WAM variants respectively. High energy prices and a shift toward less energy-intensive crops are projected to result in lower natural gas consumption by the horticultural sector. The modestly increasing use of renewable energy also contributes to the decrease in emissions. The process-related agricultural emissions of methane and nitrous oxide have been decreasing steadily due to the reduced use of artificial fertiliser under the influence of manure policy, high natural gas prices and because fewer dairy cattle were grazing outdoors. In the projections, these trends are expected to continue. Additionally, animal numbers are expected to decrease, resulting in process-related emissions of 17.47 Mt CO_2-eq (in both the WEM and WAM variants) in 2030.

Projected net CO_2 emissions from LULUCF will decrease to nearly 3.7 Mt CO_2-eq in 2030 in both the WEM and WAM variants. It is expected that emissions from grassland will decrease as this area shrinks due to conversion to settlements and the implementation of policies aiming to reduce CO_2 emissions from peat soils. Forests, however, are expected to take up slightly more CO_2 as the result of policies on reforestation and nature development.

Vulnerability assessment, climate change impact and adaptation measures

The climate in the Netherlands is projected to undergo significant changes over the coming decades. The most pressing potential consequences are increasing heat stress, increasing flood risks due to both more extreme river discharge and sea level rise, drought, more frequent failure of vital infrastructure like 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, situated in a low-lying delta area intersected by four large rivers and with a high population density, give rise to climate change impacts that require risk assessments and decisions on timely and smart interventions. The experience of regional flooding in July 2021 caused by extreme rainfall, which resulted in significant loss of life in neighbouring countries and heavy damage in the Dutch province of Limburg, also clearly demonstrated

the importance of transnational cooperation in adapting to increasingly frequent extreme weather events.

From 2006 to 2011, the National Programme for Spatial Adaptation to Climate Change (ARK) was the central programme for adaptation in the Netherlands. Since 2010, the Dutch Delta Programme has been the main vehicle for climate change adaptation planning in the Netherlands. In the National Climate Adaptation Strategy 'Adapting with ambition' (2016) the scope was broadened beyond the water domain. The strategy of adaptation planning includes the effects of climate change within nine sectors: water and spatial management; nature; agriculture, horticulture and fisheries; health and welfare; recreation and tourism; infrastructure; IT and telecommunications; and public safety and security.

The National Climate Adaptation Strategy (NAS) is the precursor to a Climate Adaptation Implementation Programme which is currently being developed. Its goal is to mainstream 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 the role and responsibility of each stakeholder and to formulate an action plan in which each stakeholder assumes certain responsibilities.

Since the NAS was formulated in 2016, all Dutch regions have assessed their climate risks and various local, regional and national authorities have started addressing knowledge gaps and implementing adaptation measures regarding agriculture, nature, critical infrastructure, built environment and health. Awareness and commitment to climate change adaptation has also increased among a wide range of stakeholders through stakeholder consultations, stress tests, public dialogues and knowledge-sharing. In order to tackle challenges and gaps related to the implementation of adaptation, the NAS Implementation Programme for 2023–2030 will be developed in 2023 and the NAS will be fully updated in 2026, based on the update of climate scenarios (2023) and consequent climate risk analysis (2025).

The Netherlands Environmental Assessment Agency (PBL) developed a methodology to define the urgency of adaptation measures by looking at the degree of uncertainty, the probability and impact of climate effects, the adaptive capacity of the system at hand and the lifetime of the necessary investments. The resulting assessment has led to the identification of six urgent climate effects as the focus in the NAS; 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. PBL is currently working on an update of this risk assessment and the results will be made available in 2024 (regarding the current climate impact and risks) and 2025 (future impact and risks). The latter will be based on the revised climate scenarios that the Royal Netherlands Meteorological Institute (KNMI) will publish in 2023.

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

The Netherlands' support for climate action in developing countries is an integral part of its international cooperation policy. The Policy Document for Foreign Trade and Development Cooperation 'Do what we do best' (2022) sets out the development and trade agenda, the overall aim of which is to address the root causes of poverty, terror, irregular migration and climate change, and to achieve the United Nations Sustainable Development Goals (SDGs). In addition, in 2022 the Netherlands developed a government International Climate Strategy to steer our climate diplomacy and international climate action.

The Netherlands will increase its investments in Official Development Assistance (ODA) with a focus on those themes in which our country has particular expertise, such as water, agriculture and sexual and reproductive health and rights. Climate change, gender and private-sector development are cross-cutting themes. Believing that Dutch knowledge and expertise can contribute to innovative solutions for some of the biggest challenges of our time, such as climate change, the Netherlands combines development cooperation with encouraging and supporting foreign trade and investments. In the field of development cooperation, the government will focus in particular on 22 countries in the Sahel, the Horn of Africa, the Middle East and North Africa. In 14 so-called "combination countries", the Netherlands will follow a combined trade and development cooperation approach with particular focus on sustainability and digitisation.

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. Over the 2019–2020 period, adaptation expenditures amounted to close to 32% of Dutch public climate finance (€377 million) and mitigation expenditures to more than 10% (€113 million). Most public climate finance supported cross-cutting activities (€698 million or

58%), mainly due to substantial contributions through multilateral organisations, in particular multilateral development banks.

The government will increase the ODA budget by €300 million in the period 2022 to 2024, and structurally by €500 million per year from 2025 onwards. In the coming years, the Netherlands will also invest considerably more in international climate action, having committed to a significant increase in climate finance (mobilised private and public) from €1.25 billion in 2021 to €1.80 billion in 2025. Public climate finance is almost completely in the form of grants and more than half of it will be spent on climate change adaptation, with a focus on the poorest and most vulnerable countries in the world. Additional budget will also be made available for major food shortages as a result of geopolitical conflicts and climate change.

The Netherlands mobilised €750 million in private climate finance in 2019 and another €523 million in 2020. It focuses on the mobilisation of blended and/or innovative finance through its private sector development portfolio, its cooperation with Multilateral Development Banks and FMO and through the development of specific funds tailored to public-private cooperation. In the new foreign trade and development cooperation strategy for the coming years, the Netherlands strives to further increase the mobilised private finance for climate, including by the development of a new climate fund.

On top of these commitments, the Netherlands supports innovative, interdisciplinary initiatives such as the Global Innovation Lab on Climate Finance to scale up private and innovative climate finance in developing countries and innovative programmes working on the lower end of the mobilisation scale, like the Mobilising More for Climate programme which combines local efforts to protect vulnerable ecosystems with the development of fundable business propositions to support the livelihoods of local stakeholders.

Research and systematic observation

Research activities in the Netherlands cover the climate system, impact and policy support, and implementation studies. These activities are characterised by intensive participation in international and European programmes, with the Dutch Research Council (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW) coordinating Dutch contributions to the international research arena and by clustering into a large national research network: the National Water and Climate Knowledge and Innovation Programme (NKWK).

Cooperation is assured through national and international clustering. The national research programmes actively seek private-sector participation and facilitate the dialogue between stakeholders from the 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. 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.

The Netherlands' research on climate change is well embedded in, acknowledged by and co-managed within the World Climate Research Programme (WCRP). The Royal Netherlands Meteorological Institute (KNMI) participates in the WCRP through its membership of the World Meteorological Organisation (WMO). 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 is mainly carried out by KNMI and by Utrecht University and research for Working Groups II and III by Wageningen University and Research (WUR) and the Netherlands Environmental Assessment Agency (PBL). Eighteen Dutch scientists contribute as lead authors or co-authors to the sixth IPCC assessment report and special reports in the sixth assessment cycle.

The COP23 in Bonn launched the Global Center on Adaptation (GCA). The GCA 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. The GCA 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).

The Netherlands actively participates in the various fields of climate-related monitoring, both nationally and in European and global programmes. These include atmospheric climate observation systems, such as those measuring atmospheric constituents; ocean climate observation systems; and terrestrial climate observation systems.

In the Netherlands, systematic observations of many climate parameters are carried out through a network of over 40 observation stations spread out over the country and the continental shelf attributable to the Netherlands. These observations are enhanced by

special observational programmes carried out at the Cabauw Experimental Site for Atmospheric Research (CESAR). At this site, a large set of instruments is operated to study the atmosphere and its interaction with the land surface. Three universities and five major research institutes work together in the CESAR project. It is the focal point of experimental atmospheric research in the Netherlands and is internationally connected through EU-funded research and transnational access programmes. It is also one of the selected certified stations for the GCOS Reference Upper-Air Network (GRUAN).

Under the auspices of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Netherlands participates in a number of Satellite Application Facilities (SAFs) 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 in the European Space Agency (ESA)'s Climate Change Initiative (CCI). The initiative is ESA's response to the need for climate-quality satellite data. Its aim is to realise 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 databases required by UNFCCC.

Education, training and public awareness

There is a high-level mandate for education, training and public awareness with regards to climate in the Netherlands. In summary, Dutch general policy is to promote education, training and public awareness aimed at integrating sustainability in the curricula of all levels of education; fostering the network of initiatives, organisations and educational institutions that work on education for sustainable development; funding organisations that contribute to increasing awareness of climate change; organising events to build momentum and create partnerships. In the implementation of these actions, working with youths is a cross-cutting aim.

The national Education for Sustainable Development (ESD) programme DuurzaamDoor (Continue Sustainably, established in 2004), more specifically in the ensuing Leren voor Morgen network implementation is dedicated to SDG 4.7 on 'education for sustainable development and global citizenship education.' In addition, there are several ad hoc projects and initiatives, mainly at the instigation of NGOs. A more long-term incorporation of this goal into Dutch curricula will need to take into account the freedom

of education, which means that individual schools and teachers bear the brunt of responsibility. As a consequence, Dutch strategy is mainly based on the organisation of networks (including education networks) on the subject of sustainability, the development of education projects, teacher training and the sharing of best practices. The idea is to inspire, rather than compel.

In 2021, the Ministries of Agriculture, Nature and Food Quality (LNV), Economic Affairs and Climate Policy (EZK), the Interior and Kingdom Relations (BZK), Infrastructure and Water Management (IenW) and the Ministry of Education, Culture & Science (OCW) took the initiative to set up an interdepartmental Sustainable Schools task force. The focus of the task force is on cooperation in areas where the themes of young people, sustainability and education intersect, which makes it a unique partnership. This task force is a framework which aims to work in an integrated fashion and through interdisciplinary cooperation between all actors in and outside of schools to facilitate the desired support for pupils and teachers in order to achieve sustainability in education in the broadest sense.

As a working method, the task force has adopted the Whole School Approach (WSA). The WSA offers schools and educational institutions a framework to give systemic shape to addressing sustainability challenges in the context of education, combining the school's vision on education, business operations, curriculum (the content of its education), expertise and environs. WSA is a tool that is used globally to embed the Sustainable Development Goals in education. The international WSA conference in March 2022, held in partnership with UNECE's ESD network, was immediately followed by a national conference. At this national conference, delegates shared lessons learned at the international conference and the ministries and education professionals held presentations to map out the current situation in the Netherlands. The conference also saw the presentation of studies into administrative support for sustainable schools (conducted by the Dutch Environmental Education Foundation, SME) and into support in the education sector for sustainability in education (conducted by Oberon).

To inspire even more citizens and organisations to become active for a better climate, the Ministry of Economic Affairs and Climate Policy initiated the National Climate Week event in 2021. The aim of the National Climate Week is to show, together, what we can achieve as a country and how we can make the Netherlands greener. The 2021 edition saw the registration of 142 climate mayors: citizens who have made strides in the area of sustainability and are able and willing to serve as an example to others. In addition, there were 68 climate supporters: businesses and organisations that want to share the

narrative of their sustainability efforts. Finally, there were many events – both locally and nationally, internally and externally – to get people involved in the movement. In the first week of November 2022, a second Climate week was organised.

In 2020, we launched the Young Climate Ambassadors of the Future programme. As part of this programme, eight young people from various groups and with diverse backgrounds attend a one-year training course designed to inspire and provide them with a toolkit to become climate ambassadors. Content-specific monthly sessions alternate with work on personal projects. This way, young people are encouraged to develop their own ideas and to inform and motivate the people around them to think along and take action.

Within its activities and efforts in the field of education, training and public awareness, the Netherlands also implements the (amended) New Delhi work programme and is well prepared for the implementation of the new work programme on Article 6 of the UNFCCC as agreed in Glasgow in November 2021. Activities also include special initiatives for young people, as well as regional cooperation actions and activities aimed at international education, training and capacity building.

Current governance is defined by the legal framework of the Climate Act (Klimaatwet). In 2019, further detailing and implementation of the agreements to achieve the target of the governance of the Climate Agreement was entrusted to the participating parties. These parties bear primary responsibility for effective implementation of the agreements reached and are jointly responsible for implementing their part of the Climate Agreement. Sector-specific implementation committees are set up under the supervision of the relevant ministers, either built on existing structures or integrated in the new coalitions that rose during the Climate Agreement discussions. In addition to the Sector-specific implementation committees, there is a Voortgangsoverleg van het Klimaatakkoord (Progress meeting of the Climate Agreement), which has the following two tasks: coherence (connection, coordination, harmonisation and knowledge sharing) around the most important implementation processes that affect several sectors; and functioning as a platform to permanently connect the community of the Climate Agreement and to organise a platform for dialogue.

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. Under the UNFCCC (Convention and KP), reporting is required only for the European part of the Kingdom, hereinafter 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 and the 12 provinces and the municipalities, of which there were 345 as of 1 January 2022 (CBS, 2022a). 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 execution of the legislative process is a joint 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 in 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.

Since 2017, the Ministry of Economic Affairs and Climate Policy (EZK) has been responsible for climate policy. Other ministries are responsible for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g. the Ministry of Infrastructure and Water Management 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 the 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 1990–2021 period saw a population increase in the Netherlands from 14.9 million to around 17.5 million inhabitants (Table 2.1). Annual growth fluctuates, but since 2000 it has been falling: the growth rate was 0.8% in 1980, 1990 and 2000 but, fell to 0.4% in 2020. The lowest figure was recorded in 2006 (0.15%). In the coming years, a further decrease in growth is expected; population growth could even approach zero by 2050 (Figure 2.2).

			1950	1960	1970	1980	1990	2000	2010	2020	2021
Population	Total population	number	10,026,773	11,417,254	12,957,621	14,091,014	14,892,574	15,863,950	16,574,989	17,407,585	17,475,415
Private households	Total private households	x 1,000	2,535	3,171	3,986	5,006	6,061	6,801	7,386	7,998	8,043
	One-person households		245	387	679	1,085	1,813	2,272	2,670	3,080	3,097
	Multi-person households		2,290	2,784	3,307	3,921	4,249	4,529	4,717	4,918	4,946
	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	80,810	67,830	--
	Total population growth, rat	o/oo	17	12	13	8	8	8	5	4	--
Population density	Population density	number	309	352	384	415	439	468	491	517	519

Table 2.1 Key population figures (CBS, 2021a)[2]

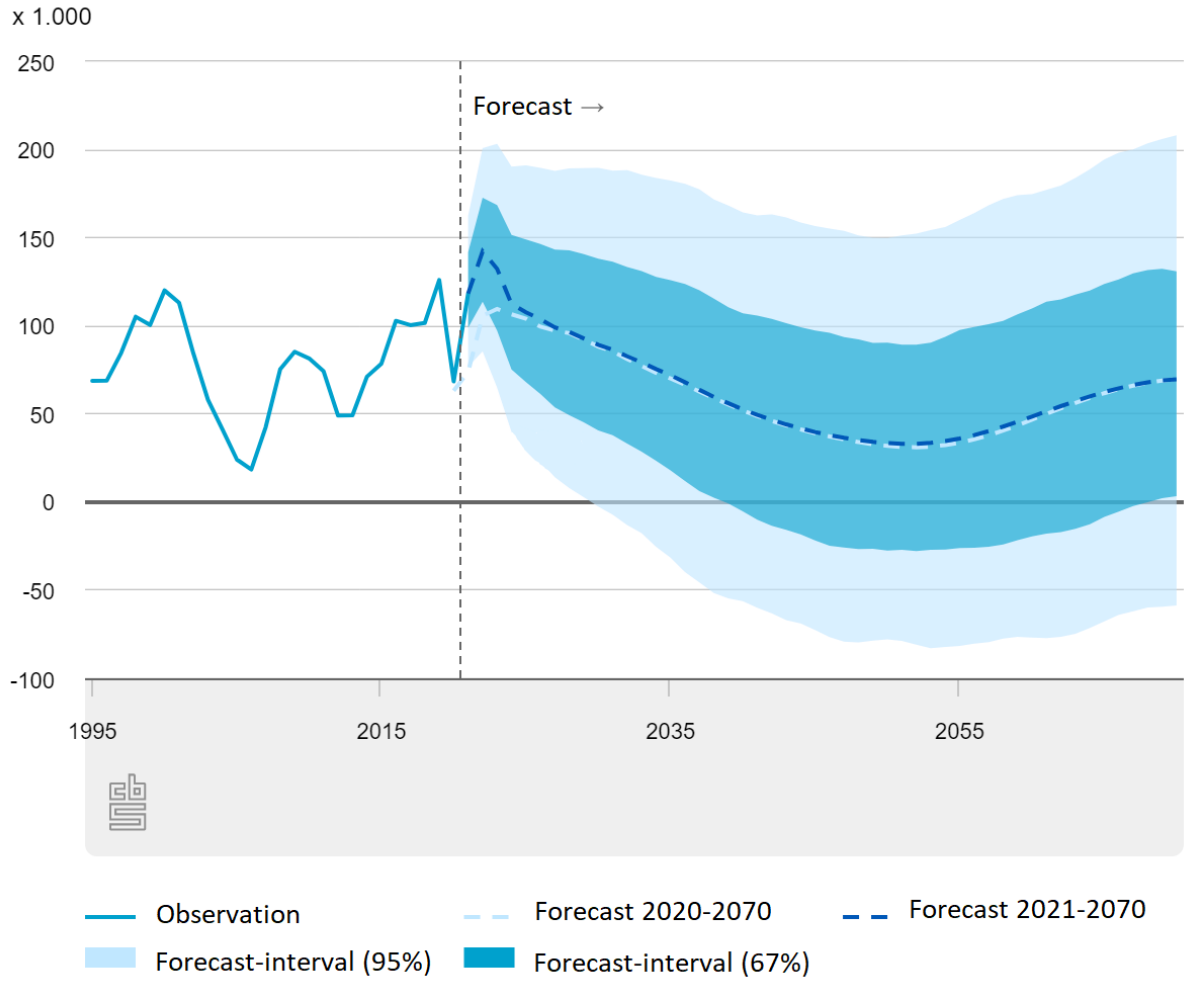


Figure 2.2 Population growth and forecast 1995-2070 (CBS, 2021b)[3]

The Netherlands is a densely populated country. The population density increased between 1990 and 2021 from 439 to 519 persons per km^2. A further important

2 CBS, 2021a, Population; Key Figures
https://opendata.cbs.nl/statline/#/CBS/en/dataset/37296eng/table?dl=6ABEC
3 CBS, 2021b, Kernprognose 2021-2070: Bevolkingsgroei trekt weer aan [Core forecast 2021-2070: Population growth picking up again]
https://www.cbs.nl/nl-nl/longread/statistische-trends/2021/kernprognose-2021-2070-bevolkingsgroei-trekt-weer-aan?onepage=true#c-4--Ontwikkeling-van-de-bevolking

demographic factor influencing the pressure on the environment is a decrease in the number of persons per household. This figure fell from 2.5 in 1990 to 2.3 in 2000 to 2.1 in 2021. The number of households increased from 6.1 million in 1990 to 8.0 million in 2021, while the percentage of single-person households increased from 30% to 39% (CBS, 2021a). The significant increase in single-person households is illustrated in Figure 2.3. As a result of this development, there is a greater need for housing, and an increasing demand for land for the construction of new dwellings and infrastructure.

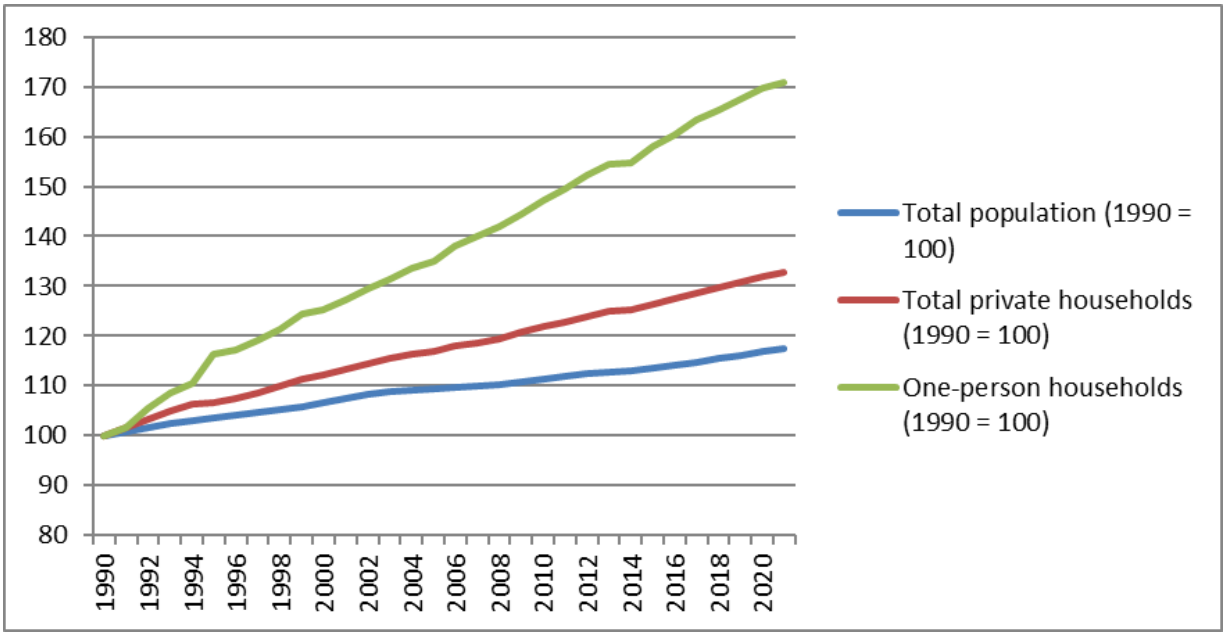


Figure 2.3 Changes in population and number of households between 1990 and 2021 (CBS, 2021a)

2.3 Geographic profile

The Netherlands is a low-lying country situated in the delta of the rivers Rhine, IJssel and Meuse. Around 26% of the country's land is 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 that are 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 2015. The land surface covers 33,671 km^2 in total (CBS, 2018[4]).

Although agricultural land is decreasing, it is still the main use of land; about 54% (22000 km^2) of the total land area consists of agricultural land. Forest covers an area of 5000 km^2 and wetland around 8000km^2. The use of land for settlement has increased over time: in 1990 4000 km^2 of land were used for settlement and in 2015 this figure was 6000 km^2. The population density is highest in the "Randstad" (a cluster of relatively large 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). This is illustrated in Figure 2.5[5].

Figure 2.4 Key elements of the Netherlands' geographic profile

4 CBS, 2018, Land use; all categories, municipalities
https://opendata.cbs.nl/statline/#/CBS/en/dataset/70262eng/table?dl=16EE8
5CLO, 2020a, Bevolkingsgroei, 2015-2020
https://www.clo.nl/indicatoren/nl2102-bevolkingsgroei-nederland-

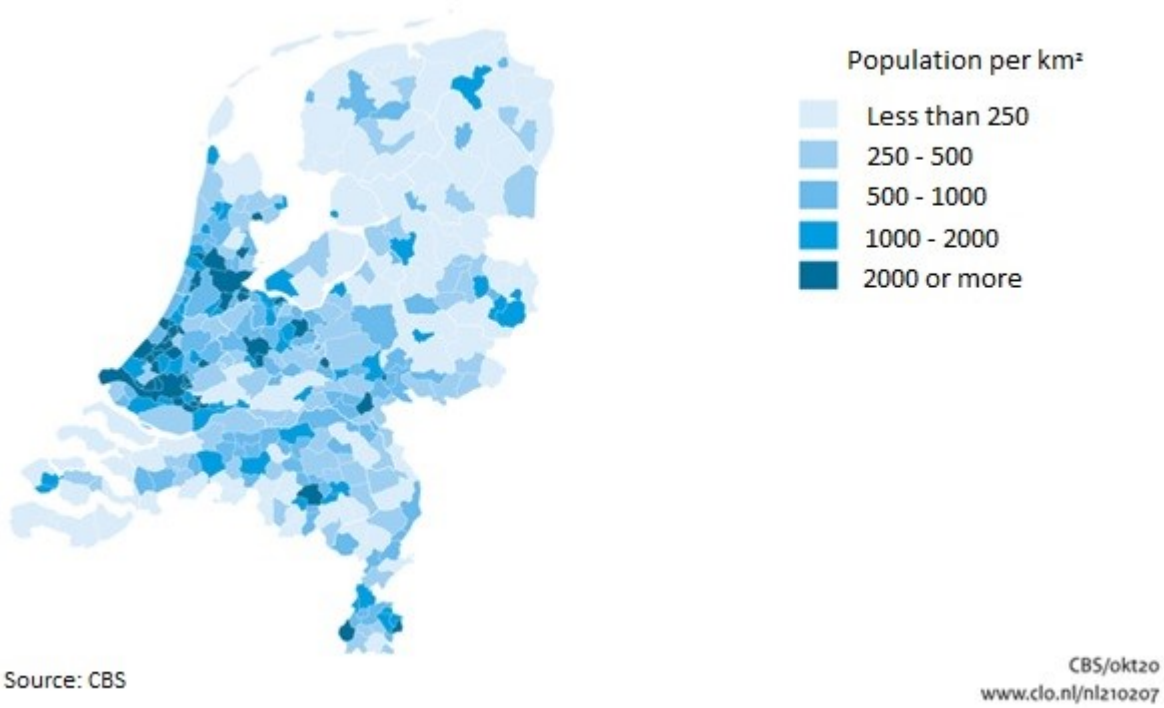


Figure 2.5 Population map of the Netherlands 2020 (CLO, 2020a)

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 in other areas at the same latitude. The 30-year annual average temperature at the centre of the country is 10.4°C, while the mean annual average at 52°N is close to 4°C. Besides this larger scale maritime – or rather oceanic – effect, the adjacent North Sea also has an (albeit minor) effect. This results in marked gradients in most climatological elements within the first few dozen kilometres from the coast. Inland gradients are generally small. Several climatological characteristics of the coastal and inland climate of the Netherlands are compared in Table 2.2.

	De Kooy (coastal station)	Twente Airbase (inland)
Mean temperature (°C)		
- January / July	4.0 / 17.5	2.8 / 18.1
Mean daily temperature amplitude (°C)		
- January / July	4.3 / 6.7	5.3 / 11.5
Mean relative humidity (%)		
- January / July	87.8 / 79.4	87.1 / 76
Mean annual duration of sunshine (hr)	1,878	1,685
Mean annual wind speed at 10m h (m/s)	5.6	3.5
Mean precipitation (mm)		
- Annual	786.6	784.3
- Driest/wettest month	34.9 / 96.5	43.7 / 79.4

Table 2.2 Some climatological data for De Kooy (coastal station) and Twente Air Base (around 150 km from the coast), based on observations during the 1991-2020 period (KNMI, 2022[6])

Throughout the country, mean winter temperatures are about 4°C and mean summer temperatures are around 17°C. Coastal regions have more hours of sunshine than inland regions and a relatively narrow annual and diurnal temperature range. An increase of around 2°C has been measured in the Netherlands since 1961 (KNMI, 2022). The years 2014, 2018, and 2020 were the top three warmest years in the last 300 years, with an average temperature of 11.7°C; the average for the 1991-2020 period was 10.4°C. Accordingly, there was also a drop in the annual number of so-called "heating degree-days" (HDD), which is an indicator of the demand for spatial heating. This number of heating degree days has fallen sharply, from an average of 3,206 around 1950 to 2,676 over the last ten years, a decrease of 17% (PBL, et al., 2022). Mean monthly precipitation exhibits a prominent annual cycle; the driest months are March, April and May and the wettest are October and December. The local variation in mean annual precipitation deviates by no more than 16% from the national mean of 805 mm (KNMI, 2022).

More information about climatic effects and events can be found in Section 6.1.

6 KNMI, 2022, Klimaatviewer
https://www.knmi.nl/klimaat-viewer/grafieken-tabellen/

2.5 Economic profile

Changes in GDP

The Gross Domestic Product (GDP) of the Netherlands was €470 billion in 1995 and €763 billion in 2021 (based on 2015 prices). Expressed in terms of the current prices, the GDP in 2021 was €856 billion with a resulting GDP per capita of over €49 thousand. 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 following years. The impact of the COVID-19 pandemic initially caused a significant decline in the GDP in 2020, resulting in a decrease of 3.9%. This was followed by a relatively swift rebound in 2021, with growth of 4.9% being recorded. The same trend can be seen in Figure 2.7, which shows the annual change in GDP compared to the previous year (2015 prices).

Figure 2.8 shows the contribution to GDP by the main industries (current prices).

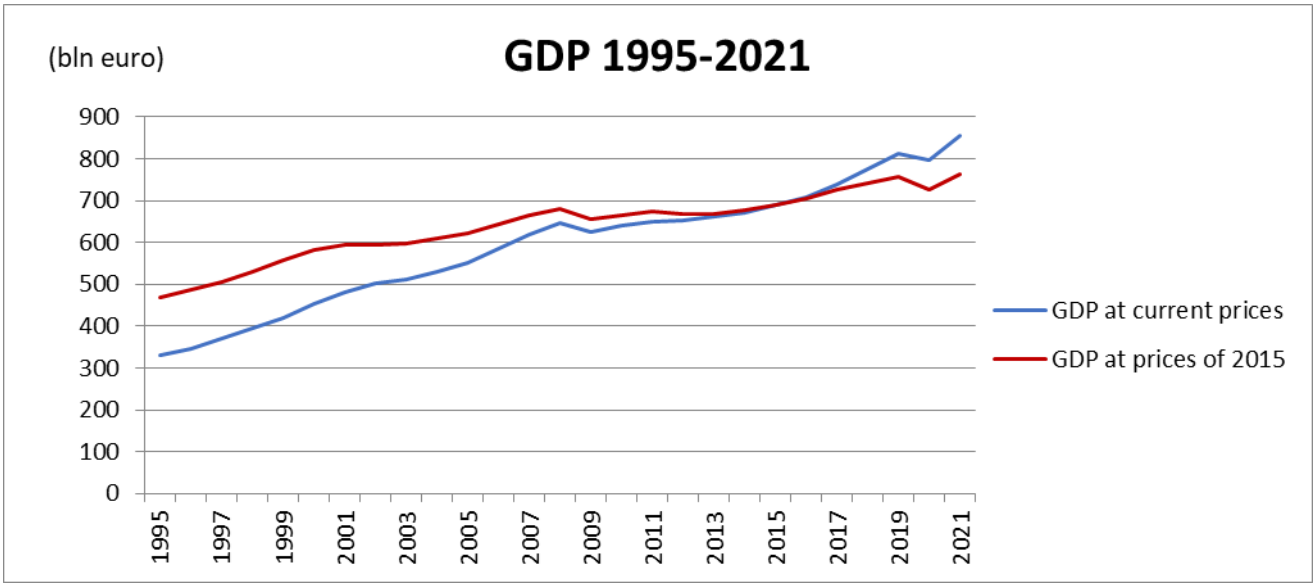


Figure 2.6 Gross Domestic Product 1995-2021 (CBS, 2022b[7])

7 CBS, 2022b Approaches of domestic product (GDP); National Accounts https://opendata.cbs.nl/statline/#/CBS/en/dataset/84087ENG/table?ts=1654608057344

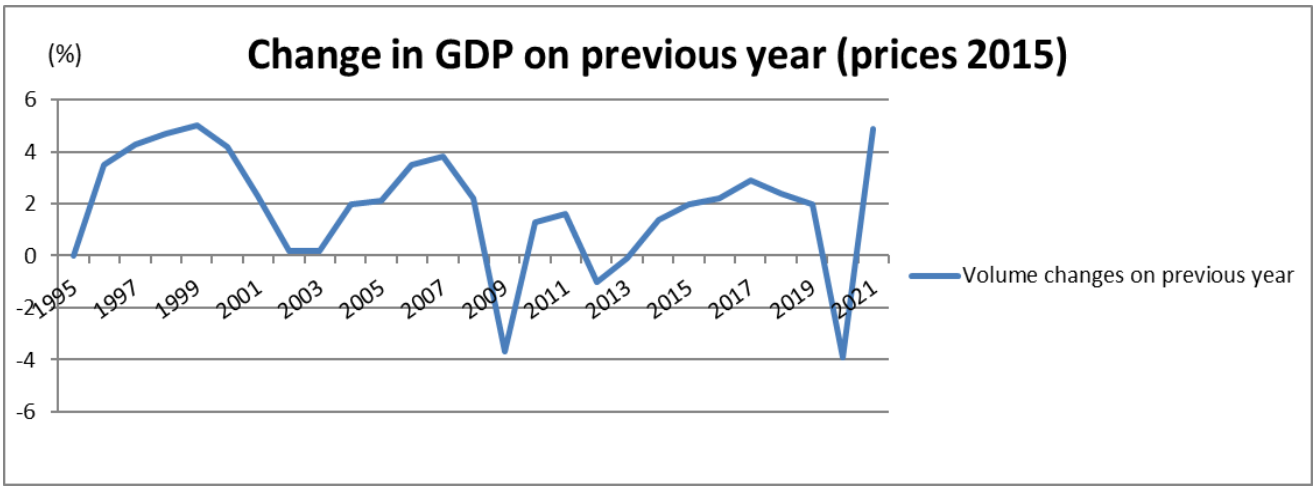


Figure 2.7 Change in GDP in the 1995-2021 period (CBS, 2022b)

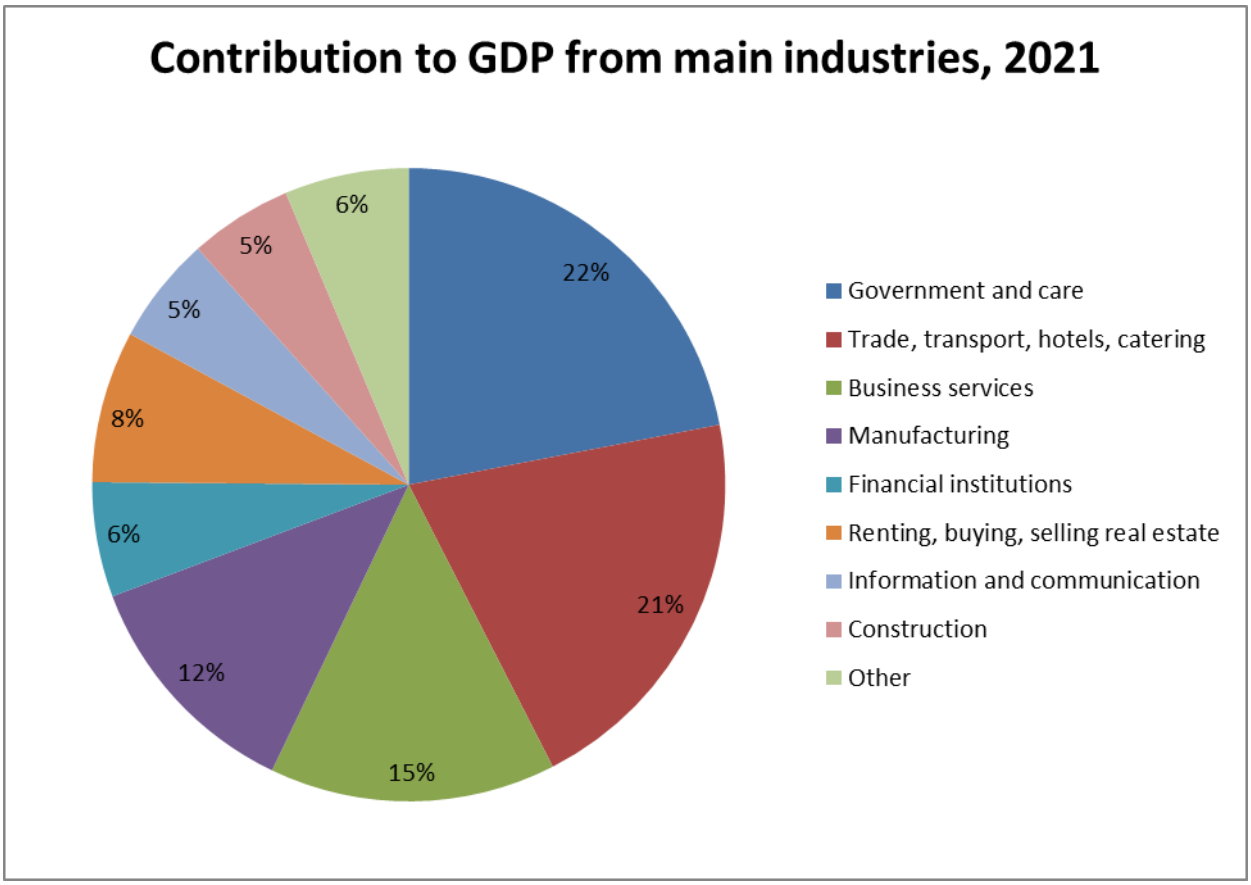


Figure 2.8 Contribution to GDP by the main industries in 2021 (current prices) (CBS, 2022b)

Imports and exports

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.

Overall, the Netherlands has been a net exporter for many years. Sectors which sell relatively large amounts of their goods 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 thereafter and the import and export value of goods surged again. Since 2012, the import value has increased by 35% to €527 billion in 2021; the export value grew by 37% to €587 billion (CBS, 2022c)[8].

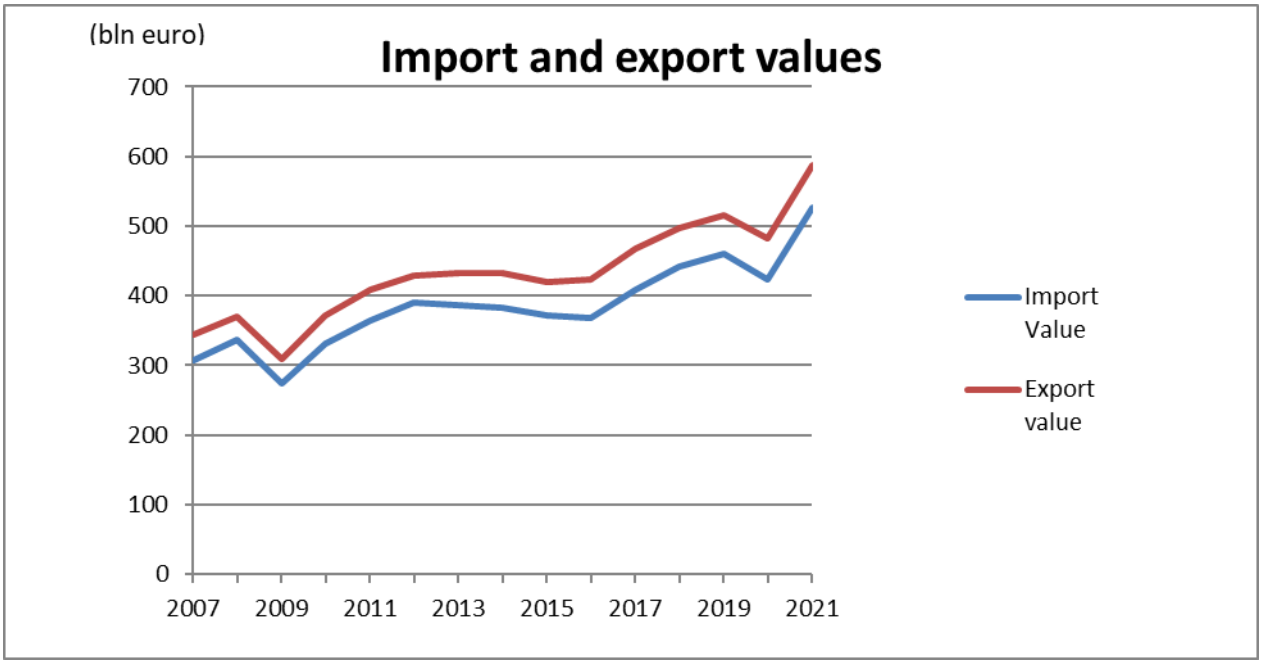


Figure 2.9 Changes in import and export values in the 2007-2021 period (CBS, 2022d[9])

In 2021, machinery and transport equipment accounted for nearly one-third of the value of goods imported to the Netherlands. Fossil fuels and chemical products had a share of around 15% each. The bulk of goods imports to the Netherlands (52%) originated from outside the European Union (EU). Goods from Germany accounted for by far the highest import value, followed by goods from China, Belgium and the United States, although these lagged far behind goods from Germany (see Figure 2.10).

Overall, a large portion (29%) of the export value of goods in 2021 consisted of machines and transport equipment. Chemical products accounted for 19% of the export

8CBS, 2022c, International trade; import and export value, SITC (3 digits), countries https://opendata.cbs.nl/#/CBS/en/dataset/83926ENG/table?dl=6C2ED
9CBS, 2022d, International trade; import and export values, key figures https://opendata.cbs.nl/#/CBS/en/dataset/70017eng/table?dl=6D8A8

value and food and live animals and mineral fuels both accounted for 12%. Of all goods that were produced in the Netherlands, food and live animals made the biggest contribution relative to the export value. In terms of re-exports, the value of machines and transport equipment was the highest.

Most of the value of exports of Dutch goods remains within the European Union: in 2021 this figure was over 65%. The single most important destination is Germany, where the export value was nearly €135 billion. Other EU countries were the second, third and fourth most important destinations. The value of exports to these individual countries is, however, significantly lower than that of exports to Germany. The United States is the most important non-EU destination (see Figure 2.11; CBS, 2022c).

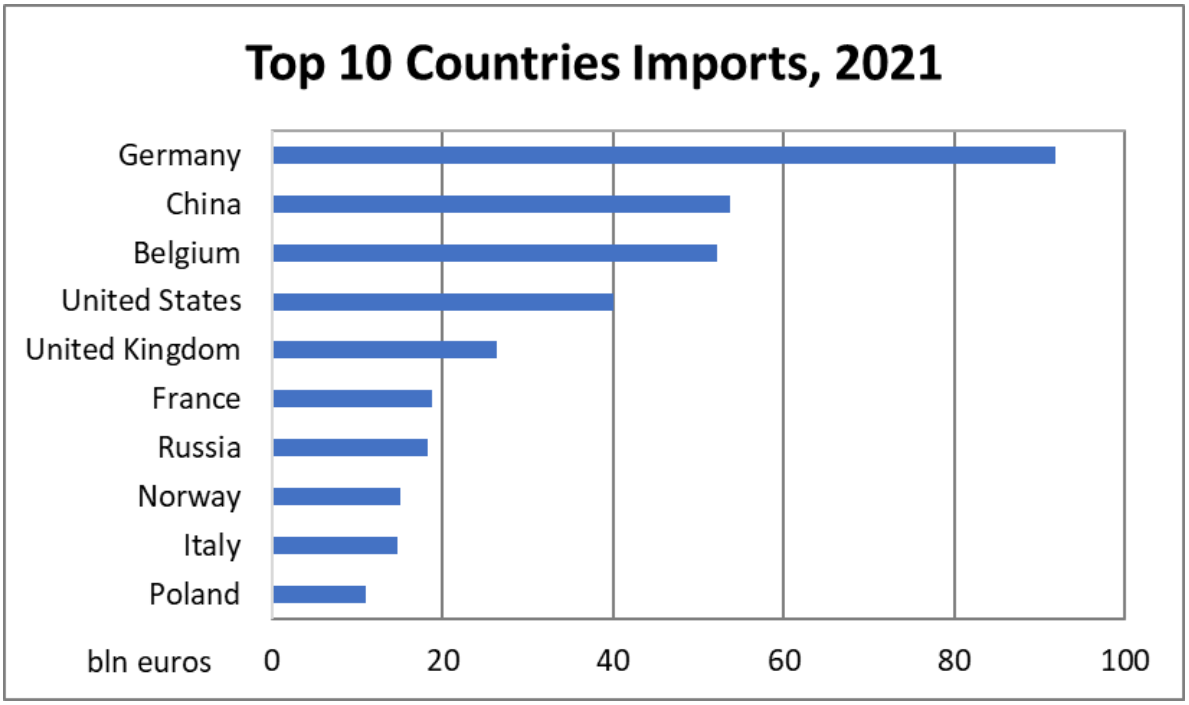


Figure 2.10 Top 10 countries in terms of imports, 2021, 2021 (CBS, 2022c)

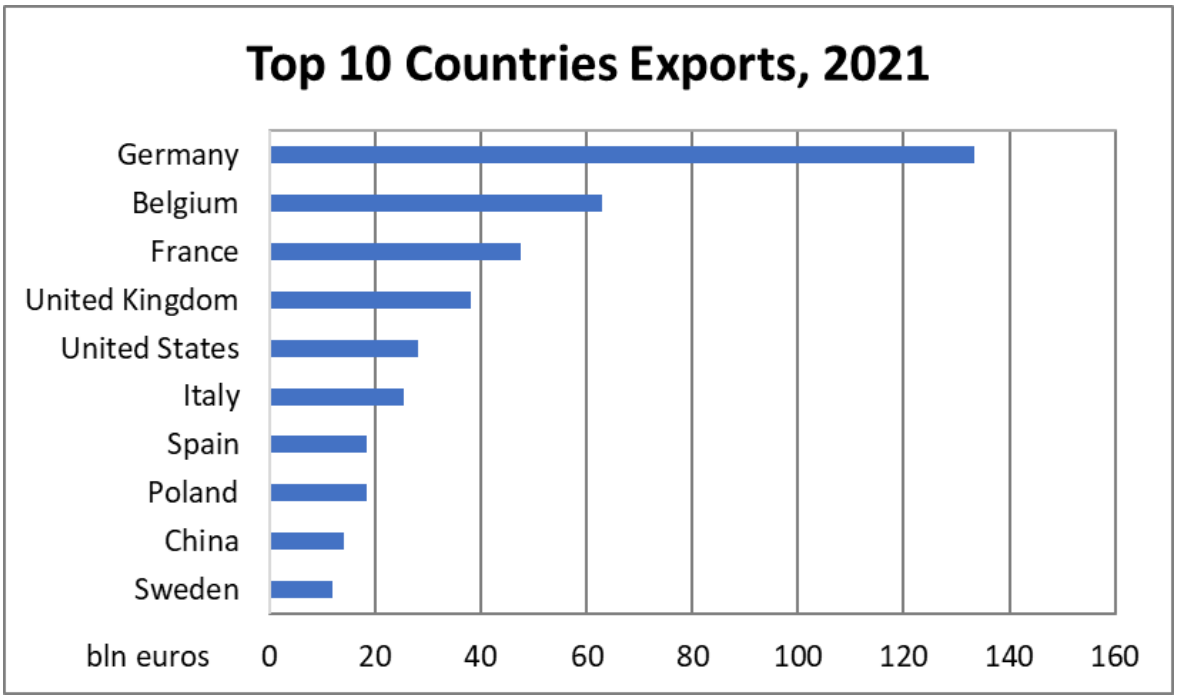


Figure 2.11 Top 10 countries in terms of exports, 2021 (CBS, 2022c)

Important role for the transport sector

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

Household consumption

Private consumption increased by 39% during the 1995-2021 period (2015 prices), but hardly any growth has been recorded since 2002. Private consumption has stagnated, due in part to the economic crisis (see Figure 2.12). Recently, household consumption has begun to rise slightly again. As a result of the COVID-19 pandemic, private consumption dropped sharply in the first half of 2020, but subsequently rebounded.

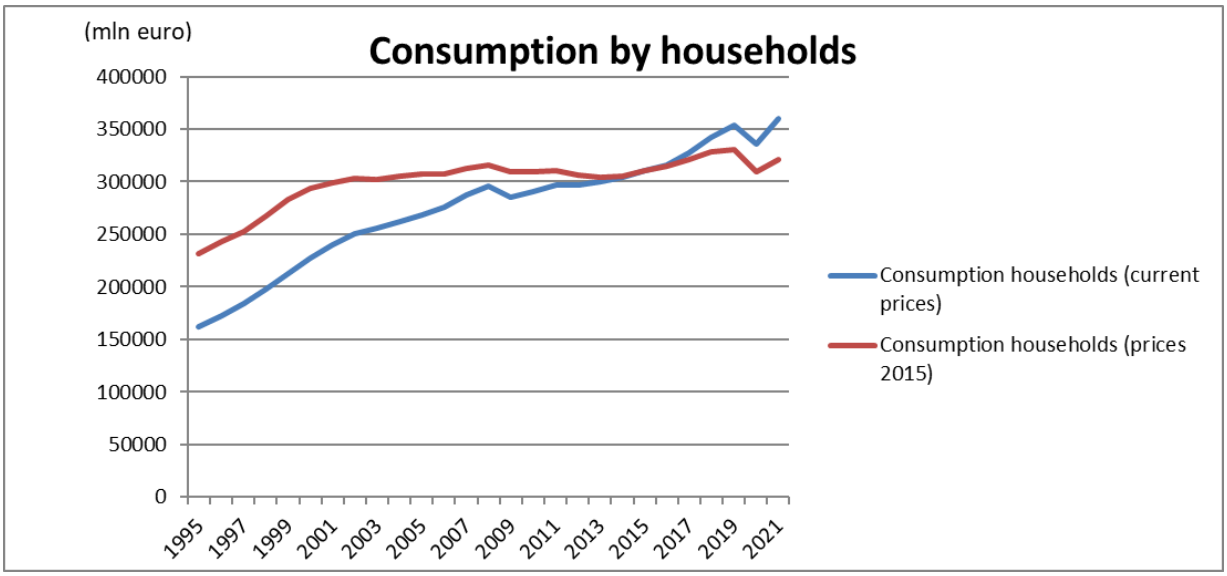


Figure 2.12 Private consumption in the 1995-2021 period (CBS, 2022e[10])

2.6 Energy profile

In this section, trends and developments in the energy supply are described, broken down into the sub-topics of primary energy use, gas supply, electricity supply and refineries, after which the developments in energy consumption and prices are discussed. Natural gas is traditionally a key energy source. In recent years this changed significantly: due to earthquakes in the main natural gas production region, the production has been scaled back and the Netherlands has gone from being from a net exporter to a net importer of natural gas.

Another main development is the progress in the preparation of offshore wind farms. In 2021, 2.5 GW was installed and in use, but preparations are underway to achieve a capacity of 21 GW by 2030.

This chapter describes the developments until 2021 but recent developments have led to additional uncertainties. The geopolitical tensions in 2022 have led to more scarcity in energy and raw materials and will no doubt have substantial effects on future developments in the energy production, imports, exports, consumption and prices.

10CBS, 2022e, GDP, output and expenditures; value, Quarterly National Accounts https://opendata.cbs.nl/statline/#/CBS/en/dataset/84105ENG/table?dl=6AD12

2.6.1 Primary energy use

Primary energy use has declined slightly: from 3,394 PJ in 2004 to 3,051 PJ in 2021 (see Figure 2.13). Natural gas has made the biggest contribution to this (more details about natural gas production in Section 2.6.2). In addition to natural gas, oil and petroleum products accounted for a stable relative share of 37% in 2021. These are mainly used in the mobility sector and petrochemical industry. Other primary energy sources are renewables, nuclear and coal; Figure 2.14 illustrates the energy mix in 2021.

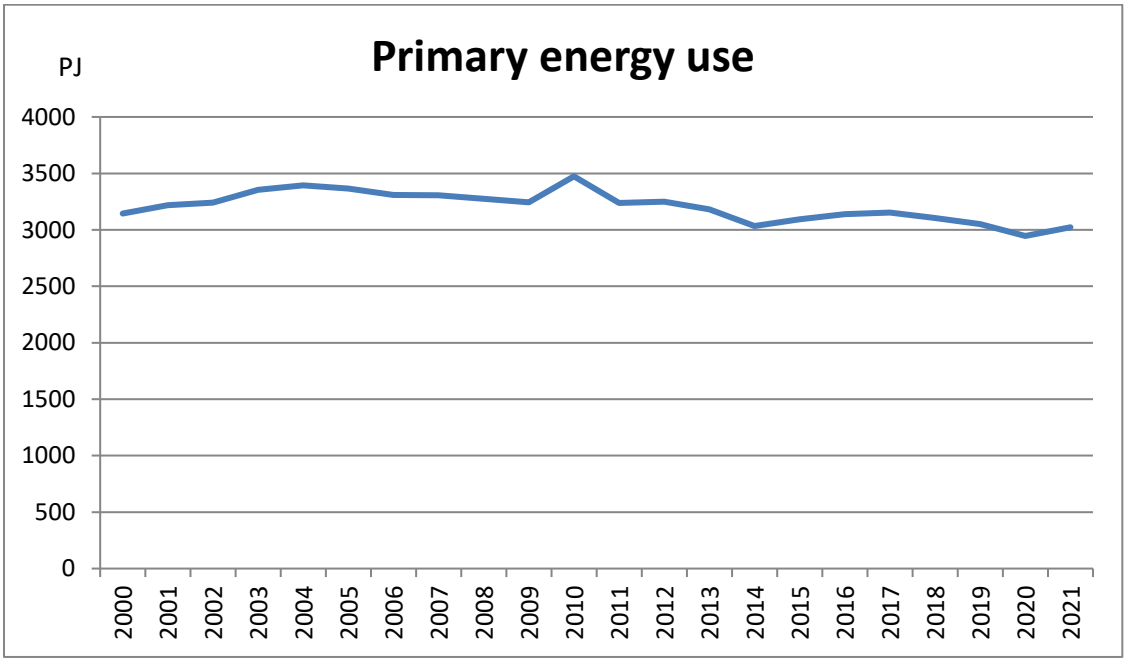


Figure 2.13 Primary energy use (PBL, et al., 2022)

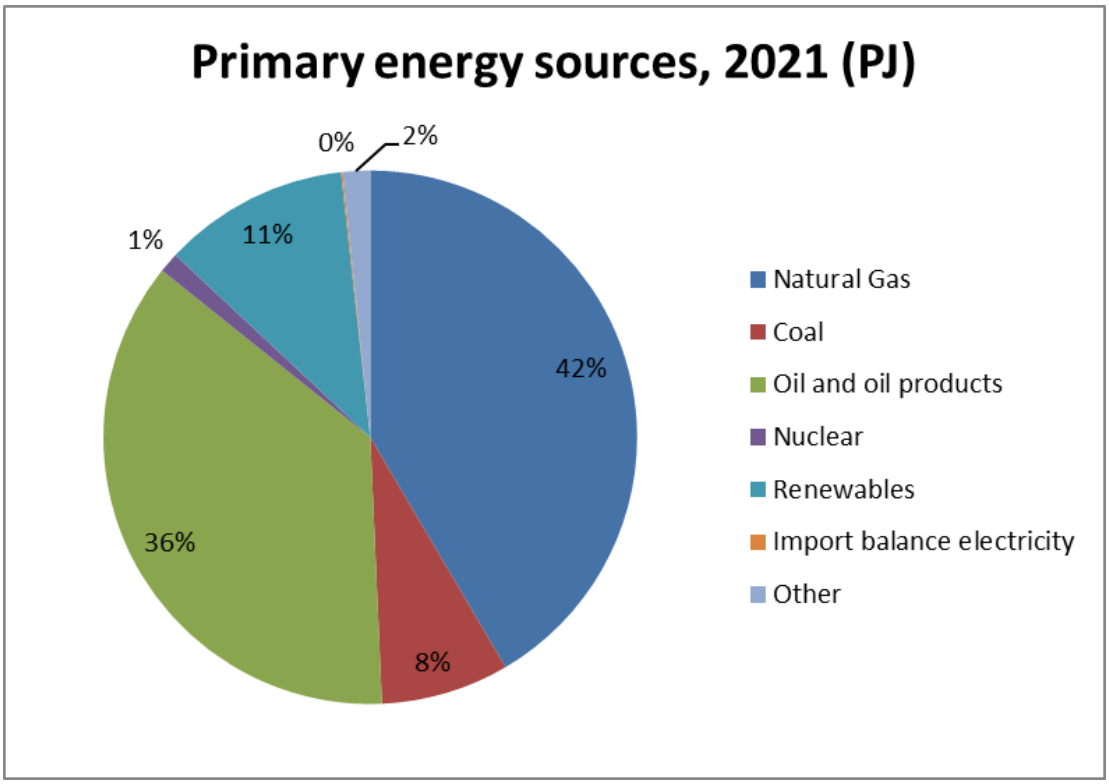


Figure 2.14 Primary energy sources (PBL, et al., 2022)

2.6.2 Gas production

One relevant 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 (which uses natural gas as chemical feedstock). The country's many refineries have also contributed significantly to this large industrial sector.
Between 1990 and 2013, the production of natural gas was relatively stable around 2500 PJ (see Figure 2.15; CBS, 2022f[11]), but since then there has been a sharp drop in production. The reason for this was the decision to scale back the gas production field in Groningen (in the north of the Netherlands), which had caused several earthquakes in the region, the strongest of which measured 3.4 on the Richter Scale. In order to reduce the risk of more severe earthquakes occurring and to improve the security of the inhabitants of the Groningen area, gas extraction from this field has been reduced significantly (87% from 2013 to 2020). The further reduction in extraction meant that by 2018 the Netherlands went from being a net exporter to a net importer of natural gas.

11 CBS, 2022f, Energy balance sheet; supply, transformation and consumption https://opendata.cbs.nl/statline/#/CBS/en/dataset/83140eng/table

To enable the phasing out of low caloric gas production in Groningen, measures are being taken to produce low caloric gas from high caloric gas and to switch large-scale consumers to the use of high-calorific gas.

In 2018 the government decided to phase out the gas production from this Groningen gas field completely. However, the recent developments in Ukraine have led to a politically unstable situation that is impacting the gas supply. Only if the (geo)political circumstances allow it, will the Groningen field be closed completely in 2023 or 2024. As a result of these developments, the natural gas revenues for the Dutch Treasury have dropped from a record high of €15 billion in 2013 to €2.6 billion in 2021 (CBS, 2022g[12]). "Green gas" generation has also started in recent years. This gas is generated from biomass, upgraded to natural gas quality and injected into the natural gas grid. Since 2011, liquid natural gas (LNG) has also been imported, via the port of Rotterdam, from countries including Algeria, Qatar and Trinidad & Tobago.

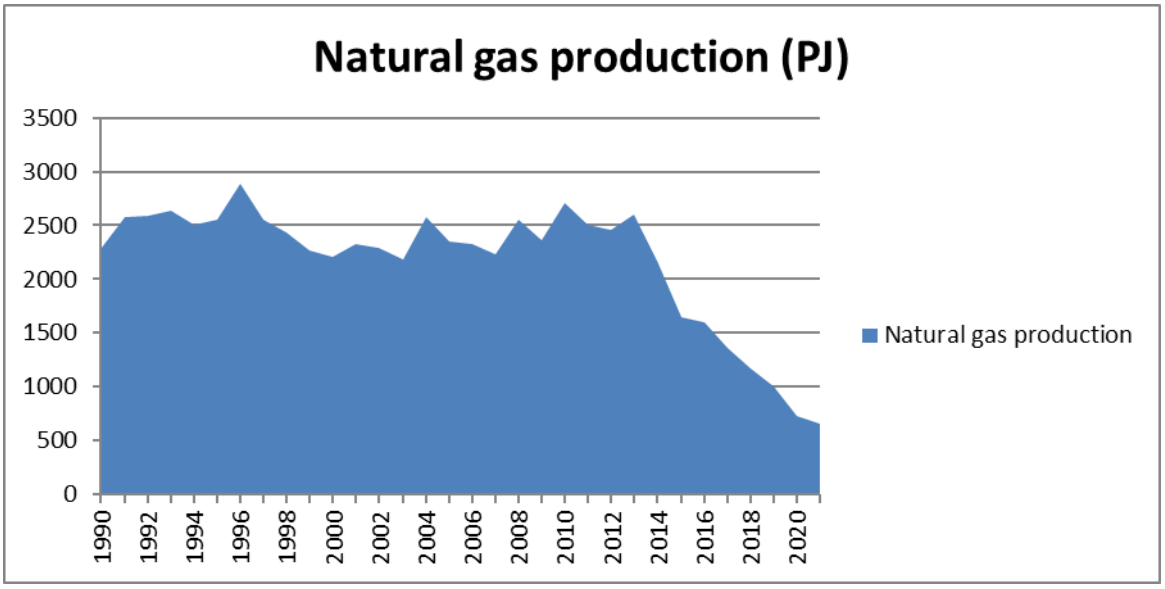


Figure 2.15 Natural gas production in the Netherlands (CBS, 2022f)

2.6.3 Electricity production

Since 1990, the increase in electricity consumption was "countered" mainly 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

12 CBS, 2022g, Government Finance Statistics; key figures
https://opendata.cbs.nl/statline/#/CBS/en/dataset/84114ENG/table?dl=6B1DE

onwards, resulting in less fuel consumption for power generation compared to separate generation of electricity and heat.

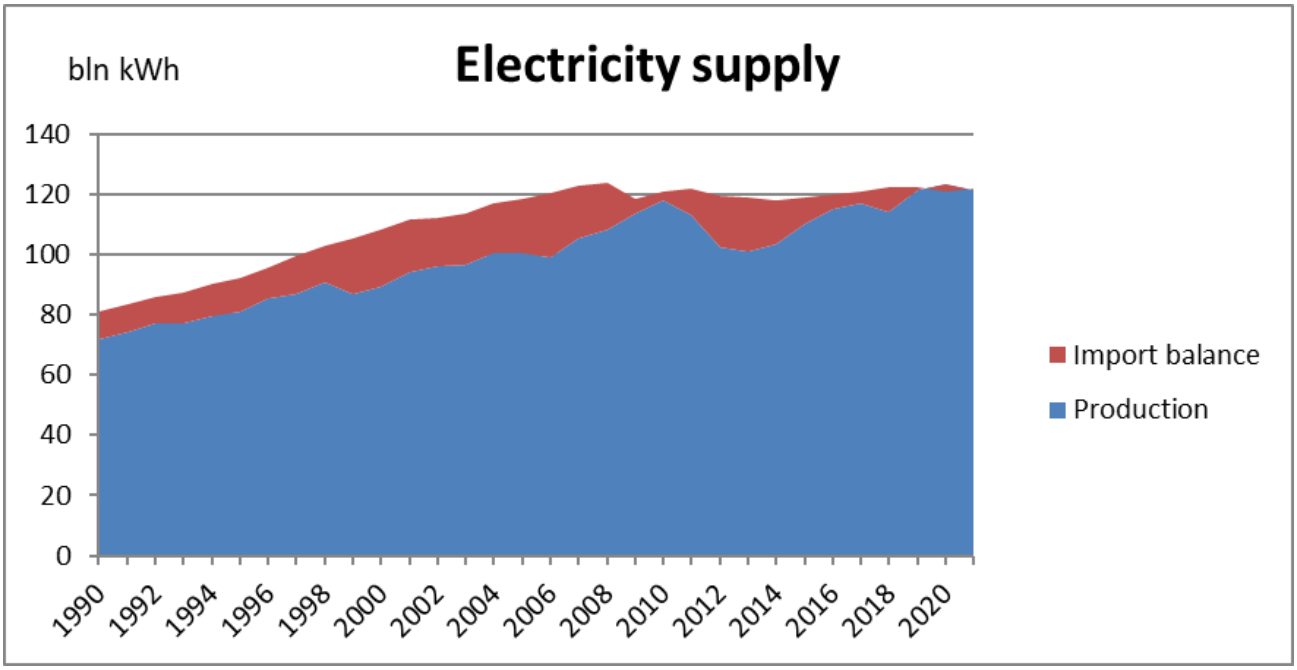


Figure 2.16 Supply of electricity (CLO, 2022a)

Figure 2.16 (CLO, 2022a[13]) gives an overview of the electricity supply in the Netherlands during the 1990-2021 period. The supply of electricity is calculated as the sum of all domestic production plus the balance between electricity imports and electricity exports.

Since around 1999, the liberalisation of the European electricity market has resulted in higher net imports of electricity. In 2013, electricity imports reached their highest level ever 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 quantities of electricity were 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 within Germany. Imports also include electricity produced by hydro power in Norway.

The electricity supply has developed along similar lines since 2013. Production has increased while imports have declined. As a result, a relatively larger quantity of electricity produced in the Netherlands was consumed, at the expense of imports of electricity produced abroad. Domestic electricity production rose by 20% between 2013

13 CLO, 2022a, Supply and consumption of electricity, 1990-2021
https://www.clo.nl/indicatoren/nl0020-aanbod-en-verbruik-van-elektriciteit?ond=20881

and 2021 and reached a record level of 445PJ in 2020. In 2021, this production was split evenly between powerplants (51%) and decentralised installations in industry, agriculture, and healthcare (49%) (CLO, 2022b[14]). The balance between electricity imports and exports (imports minus exports) has declined to nearly 0 since 2013, with 2020 as an exceptional year in which net exports of electricity were recorded instead of imports. The import and export of electricity in the Netherlands was approximately in balance in 2021. The estimate of Dutch electricity production is subject to great uncertainty, because electricity imports and exports are highly dependent on developments abroad and the prices of fuel and CO_2 (PBL, et al. 2022).

Production of renewable electricity

During the 1990–2020 period, the production of renewable electricity increased by a factor of 45-51, resulting in a share of 26% of total electricity consumption in 2020 (see Figure 2.17; CLO, 2021c[15]). By 2021, the production increased further to 30-34%(CBS, 2022h[16]). The production of renewable electricity mainly takes place with wind turbines; they account for about half of the total production.[17]. Wind turbines are still mainly located on land, although in recent years the offshore wind capacity in the Dutch part of the North Sea has been increasing rapidly. The completion of the Borssele offshore wind farm in Zeeland alone was responsible for an increase of 1.5 GW in capacity. By 2021, seven wind farms with a total capacity of 2.5 GW were in operation (see Table 2.3) and this figure is set to increase over the coming years. At the beginning of 2022, the Dutch Government raised the offshore wind energy target from 11.5 to around 21 GW by 2030 (EZK, 2022[18]). By then, offshore wind farms will supply 16% of the Netherlands's energy requirement and 75% of the electricity needs (based on the current electricity consumption).

In recent years, the installed capacity of onshore wind energy increased from 3.0 GW in 2015 to 5.2 GW in 2021.

14 CLO, 2022b, Gross electricity production and use of energy carriers, 1998-2021
https://www.clo.nl/indicatoren/nl0019-inzet-energiedragers-en-bruto-elektriciteitsproductie
15 CLO, 2021c, Consumption of renewable energy 1990-2020
https://www.clo.nl/indicatoren/nl0385-verbruik-van-hernieuwbare-energie
16 Percentage depends on the biomass criteria in the EU Renewable Energy Directive II
17 CBS, 2022h, https://longreads.cbs.nl/hernieuwbare-energie-in-nederland-2021/algemene-overzichten/
18 EZK, 2022 https://www.rijksoverheid.nl/documenten/kamerstukken/2022/06/10/aanvullende-routekaart-windenergie-op-zee-2030

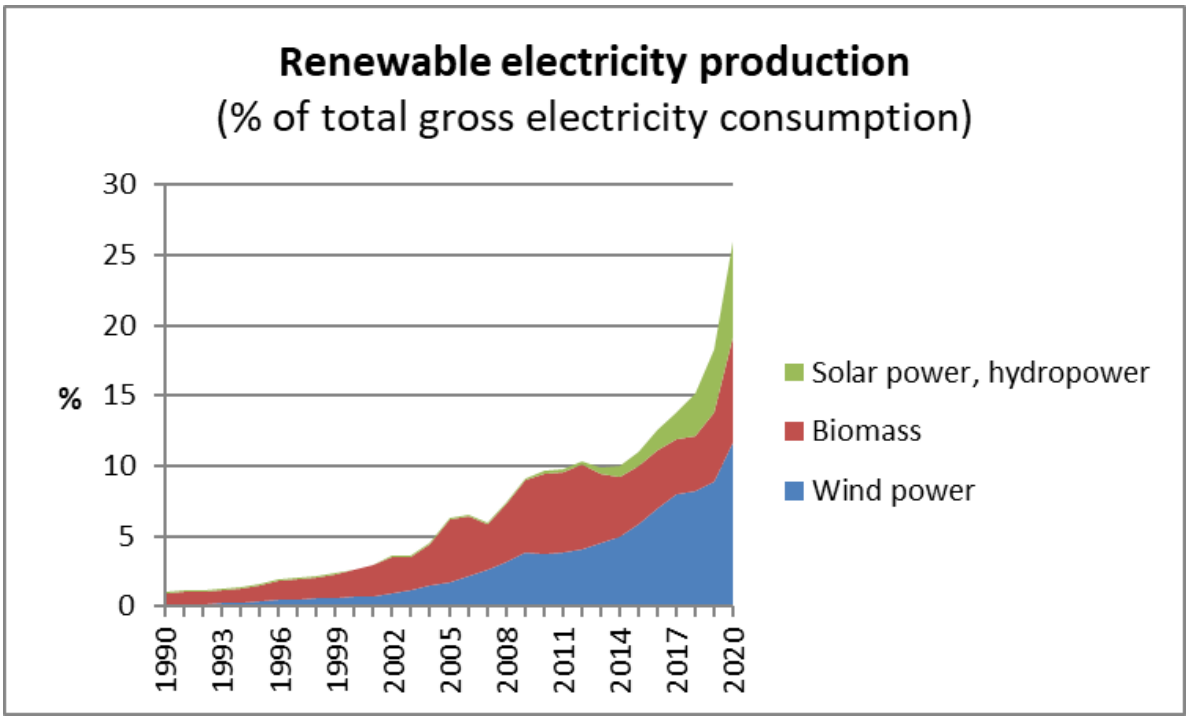


Figure 2.17 Contribution of renewable electricity to electricity use 1990-2020 (CLO, 2021c)

Name wind farm	Number of wind turbines	Capacity (MW)	In operation since
Borssele V	2	19	2021
Borssele I and II	94	752	2020
Borssele III and IV	77	731.5	2020
Gemini Windpark	150	600	2017
Luchterduinen	43	129	2015
Prinses Amaliawindpark	60	120	2008
Egmond aan Zee OWEZ	36	108	2007
Total	462	2459.5	

Table 2.3 Offshore wind farms in operation in the Netherlands (Source: RVO, 2021[19])

The total installed capacity of solar power shows a steep increasing trend: it grew 13 GW between 2015 and 2021 and now totals 14.4 GW (CBS, 2022i[20]). In 2021, 60% of this capacity came from large-scale installations (>15 KW). In recent years, the rapid growth

19 RVO, 2021, Windparken op de Noordzee
https://www.rvo.nl/subsidies-financiering/windenergie-op-zee/actieve-windparken
20 CBS 2022i, Hernieuwbare energie; zonnestroom, windenergie, RES-regio
https://opendata.cbs.nl/statline/#/CBS/nl/dataset/85004NED/table?ts=1629458736156

of sustainable sources (such as solar fields) created bottlenecks due to the limited net capacities in some regions.

2.6.4 Refineries

The Netherlands has six large refineries, five of which are 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 reaching 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%.

2.6.5 Energy consumption

During the 1990-2019 period, energy consumption in the Netherlands increased by 7%, reaching a maximum of 3,475 PJ in 2010, while this figure was 3047 PJ in 2019 (CLO, 2021a[21]). As presented in Figure 2.18, this increase occurred primarily in the period up to 2005-2006 and in the use of natural gas and in oil products. Coal was mainly used for the generation of electricity, while natural gas had wide range of applications as a raw material, for electricity production, heating, transport, etc. The peak in natural gas use in 1996 and 2010 was related to the additional gas use due to cold winters.

Total energy consumption has fallen sharply since 2010, primarily as a result of a steep drop in natural gas consumption. This drop is related to a large extent 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 in 2013-2015 the use of coal initially increased by more than a third, but has declined significantly since. In 2020, the use of coal for electricity production was low because of the low natural gas prices at that time.

21 CLO, 2021a, Energy use by energy carrier
http://www.clo.nl/indicatoren/nl0054-energieverbruik-per-energiedrager-?ond=20881

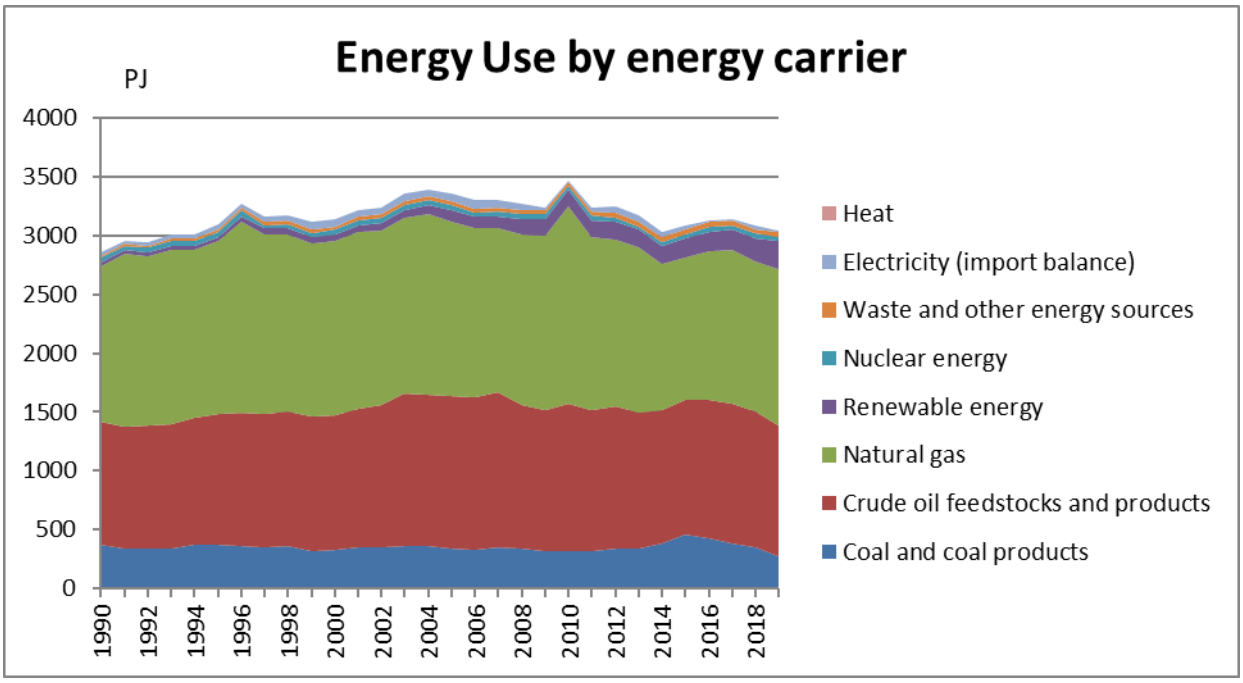


Figure 2.18 Energy use by energy carrier 1990–2019 (CLO, 2021a)

Renewable energy

The use of renewable energy (for heat, electricity and transport) increased in the 1990s to a limited degree: in 1990 1.1% of the energy used was from renewable energy sources and in 2000 this figure was 1.6% (see Figure 2.19, CLO, 2021b[22]). Since the start of the new millennium, the share of renewable energy has risen gradually, from 1.6% in 2000 to 11.1% in 2020 (220 PJ), or on average 0.5% per year. This growth is 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.

Nearly 55% of renewable energy originates from biomass, which concerns the production of electricity and heat in waste incineration plants, the use of biomass in the production of electricity and bio-fuels for transport. Wind energy is the second biggest source at 23%, while solar power accounts for 14%. There has been a steep upward trend in the production of both solar and wind energy (see Section 2.6.3 on renewable electricity production).

22 CLO, 2021b Renewable energy use 1990-2020
http://www.clo.nl/indicatoren/nl0385-verbruik-van-hernieuwbare-energie?ond=20881

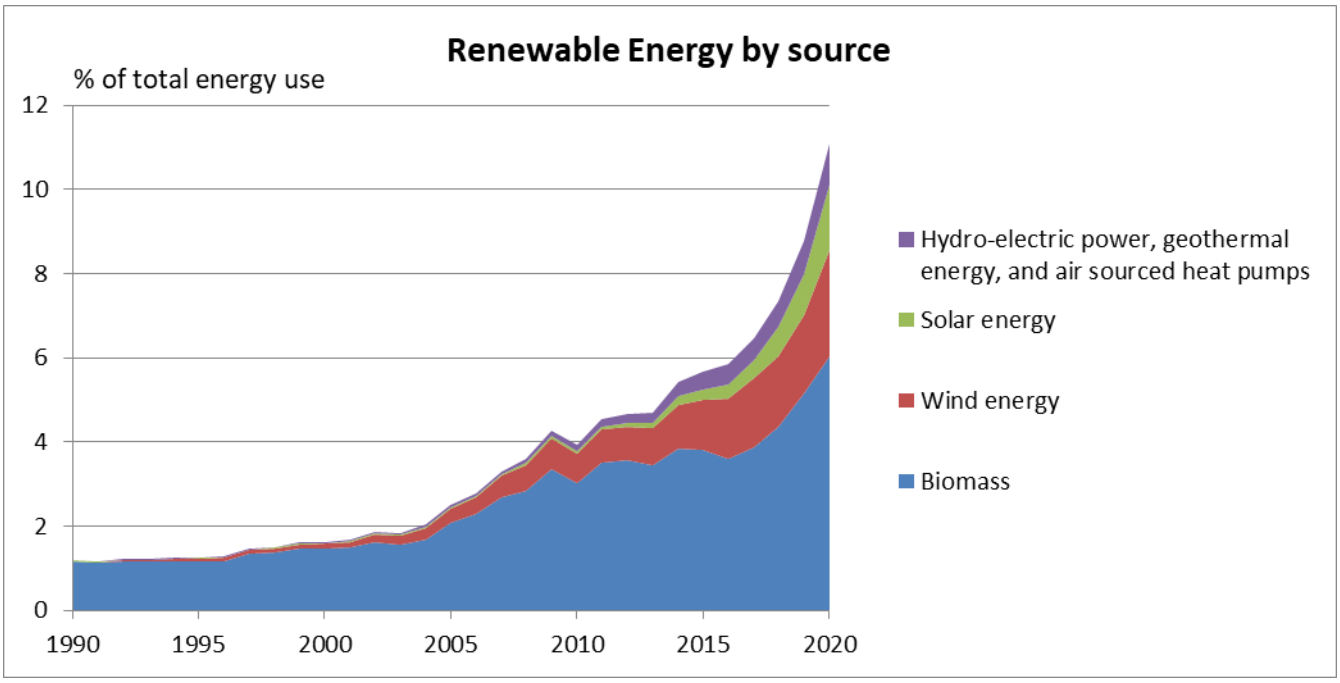


Figure 2.19 Contribution of renewable energy to energy use 1990–2020 (Source: CLO, 2021b)

Energy use by sector

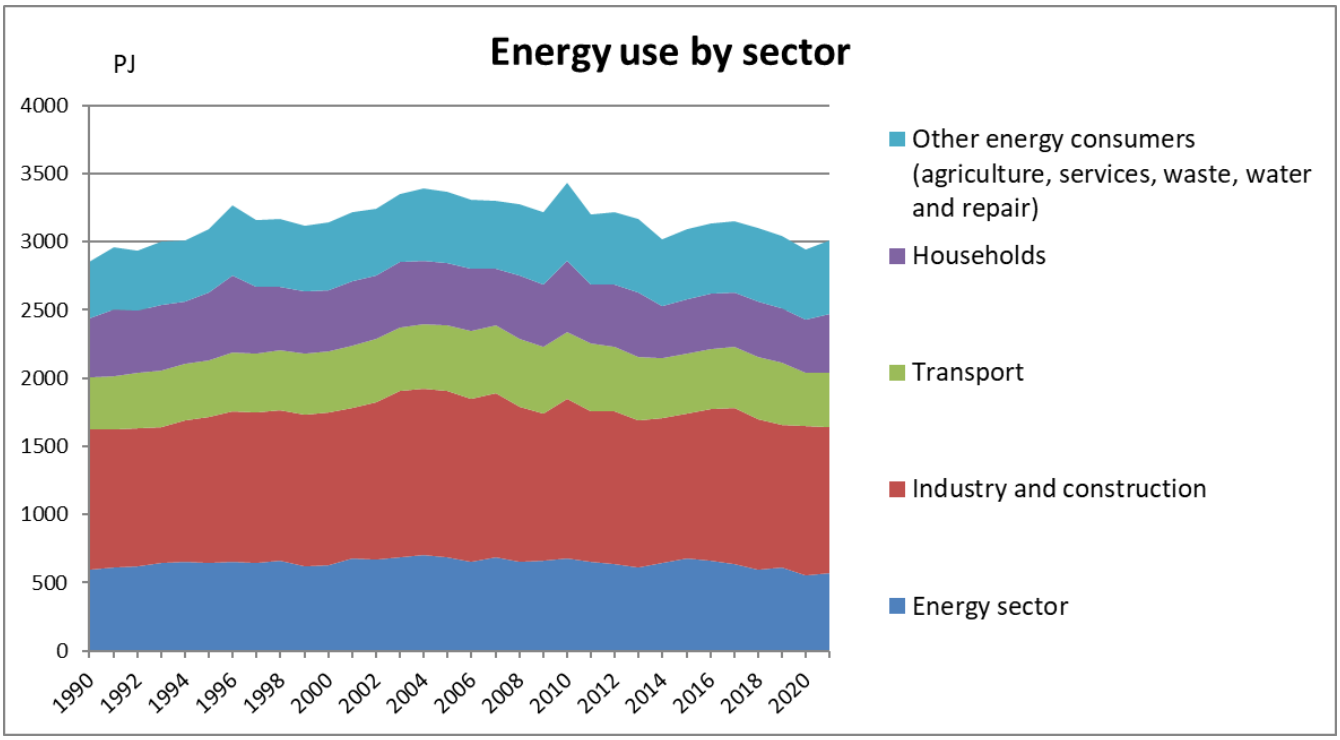


Figure 2.20 Energy use by national sectors 1990-2021 (Source: CBS, 2022j[23])

23 CBS, 2022j, Energy balance sheet; supply and consumption, sector https://opendata.cbs.nl/statline/#/CBS/en/dataset/83989ENG/table?dl=6B062

Industry

Industry is the main user of energy in the Netherlands: about 35% of the nation's energy is used by industrial companies (see Figure 2.20). The total energy use has increased by almost 10% since 1990. The key industrial use is in the chemical and pharmaceutical industry; in 2021 this was responsible for three quarters (75%) of industrial usage. Energy usage in this industrial sector increased by 19% between 1990 and 2010, but has since decreased by 5%. By comparison, other industrial sectors saw a 5% increase in energy use between 1990 and 2010, and a subsequent decrease of 20%. The importance of the chemical and pharmaceutical industry 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 petroleum products has increased by almost 27%. 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 2021 was as follows:

- Food and tobacco 8%
- Iron and steel 4%
- Building materials 2%

Detailed information on contributions by various industrial sectors to greenhouse gas emissions, can be found in the National Inventory Report 2022 (Ruyssenaars et al, 2022) [24]

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 2021 natural gas consumption fell from 350 to 305 petajoules (PJ). In Figure 2.21, the impact of the harsh winters in 1996 and 2010 can clearly be seen. During the same period, the consumption of heat from district heating rose from 5 PJ to 13 PJ. During the 1990s electricity consumption rose by approximately 2% per year, but the increase has since then levelled off to 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 older ones. New lighting, white goods (major domestic appliances) and other appliances that fall under European Ecodesign requirements use less electricity than their older counterparts.

24 Ruyssenaars et al, 2022
https://unfccc.int/sites/default/files/resource/nld-2022-nir-14apr22.zip

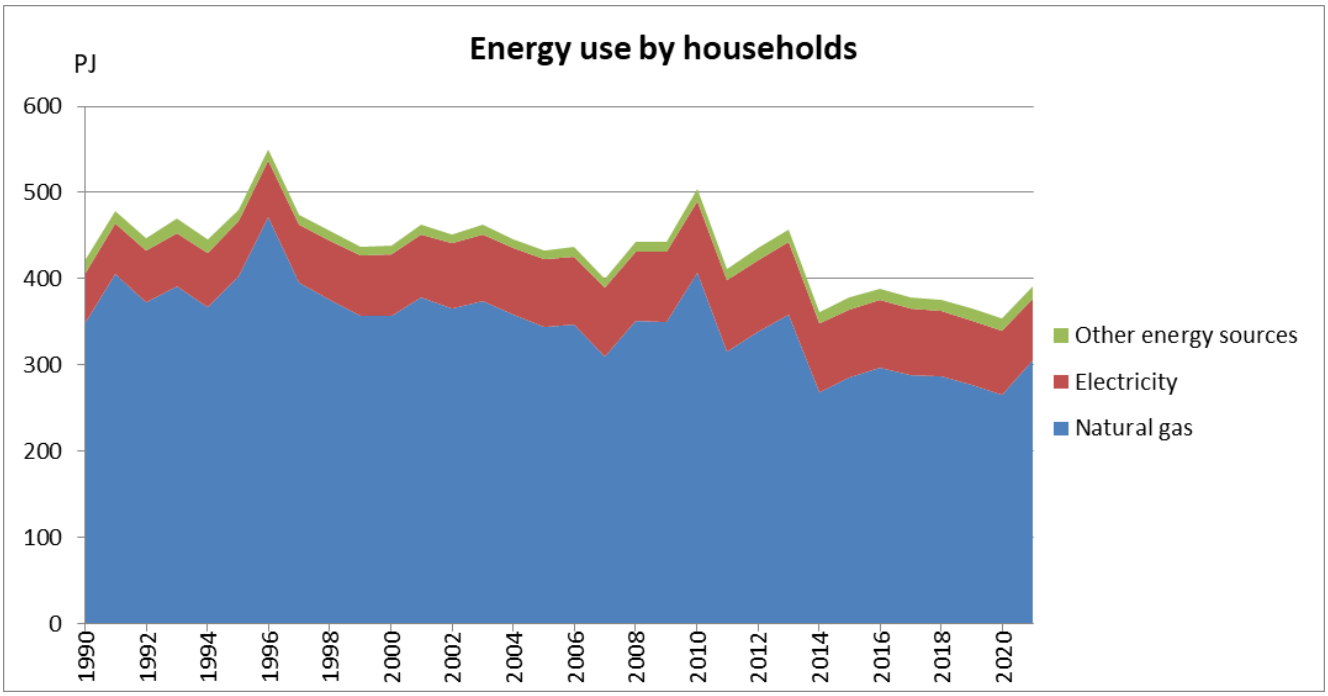


Figure 2.21 Household energy use 1990-2021 (CBS, 2022j)

Transport

Energy consumption by the transport sector remained fairly consistent in the 2000-2021 period, with road transport being the category consuming the most energy and demonstrating the most fluctuation (see Figure 2.22 and 2.23; CBS, 2022j). 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. As a result of the COVID-19 pandemic, energy consumption by road transport dropped by 14% between 2019 and 2020. Both aviation and shipping saw a decrease of 25% in energy consumption between 2019 and 2020, with consumption by rail transport dropping 6%.

In 2020, the consumption of petrol, diesel and LPG in transport were at their lowest level since 2000. Due to regulations, the use of biofuels (mainly compressed natural gas) and electricity in road transport has increased significantly since 2011, with CNG accounting for 2.7 PJ and electricity for 1.7 PJ in 2020 (CBS, 2022k)[25].

The energy used for shipping fluctuated significantly in the 2000-2021 period, increasing from 10.2 PJ in 2000 to 15.3 PJ in 2011 before dropping to 11.7 PJ in 2019. After a drop

25 CBS, 2022k, Hoeveel brandstof verbruikt het Nederlandse wegvervoer? https://www.cbs.nl/nl-nl/visualisaties/verkeer-en-vervoer/uitstoot-en-brandstofverbruik/brandstofverbruik-wegvervoer

to 8.8 PJ in 2020, the energy used by the shipping industry rose slowly again to 9.8 PJ in 2021 (CBS, 2022j).

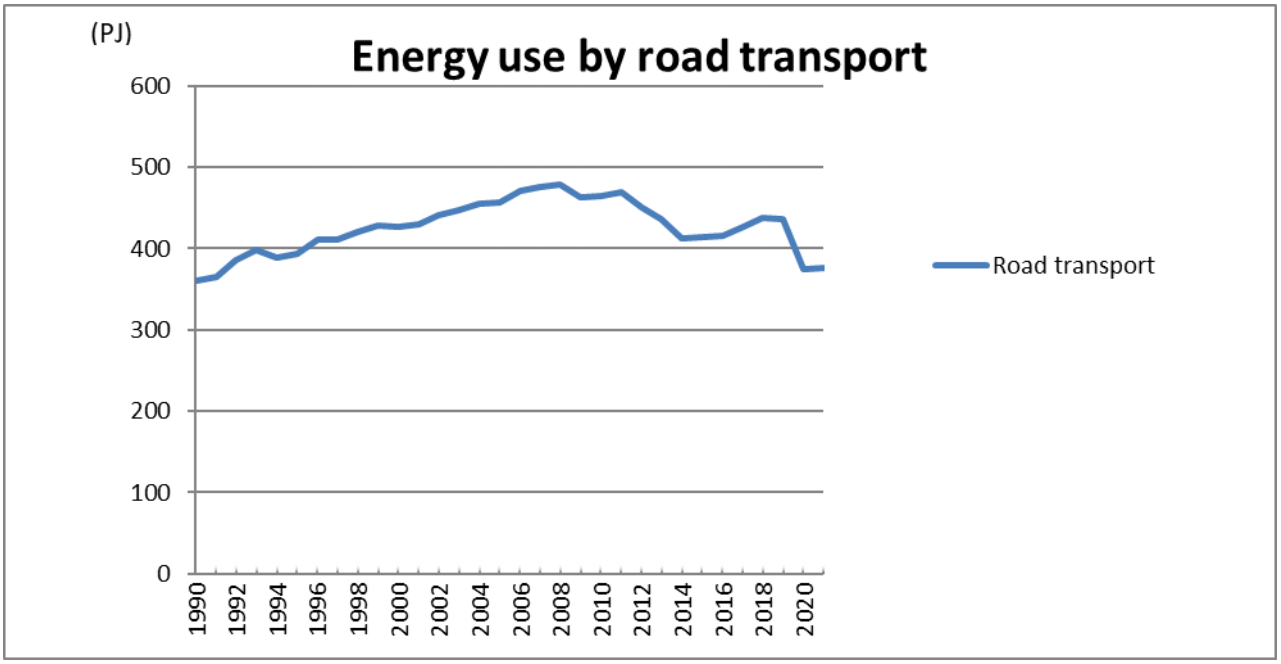


Figure 2.22 Energy use by road transport (CBS, 2022j)

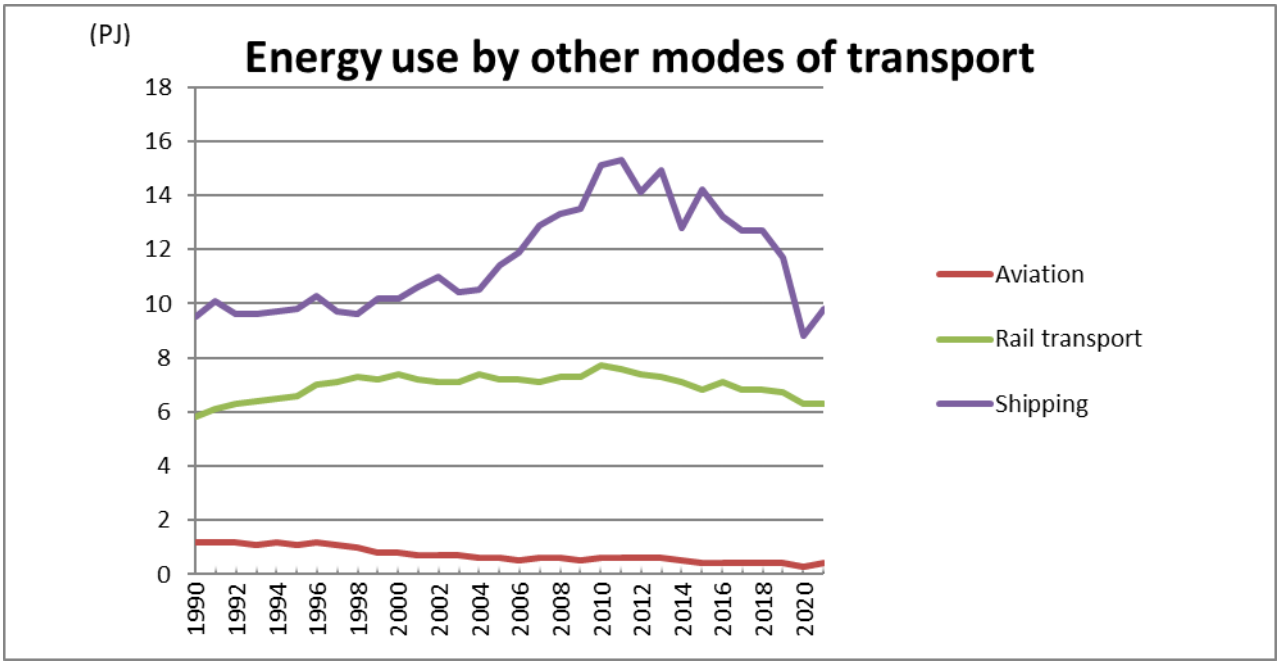


Figure 2.23 Energy use by other modes of transport (CBS, 2022j)

Other energy consumers

The rest of the energy is used by public and commercial buildings, services and agriculture. As in other sectors, energy use has increased since 1990, reaching 535 PJ in

2021 (see Figure 2.20; CBS, 2022j). The energy use by the service sector increased by 52% in 2021, compared to 1990.

While there have been slight fluctuations in energy use in the agricultural sector over the past thirty years, it has remained relatively stable since 1990. Most of the energy used by horticulture, which is the biggest consumer, concerns the use of natural gas for heating. This natural gas use is related to the outside temperature so more is used in cold years, like 1996 and 2010, when gas use exceeded 150 PJ. Natural gas is not only used for heating greenhouses, but also for the generation of electricity with combined heat and power (CHPs) and gas motors. In the 2005-2009 period in particular, the number of gas motors increased. As a result of this development, electricity use completely changed: after 2005 the sector became a net exporter of electricity, although the amount of exports have declined by almost 50% since 2010, due to the change in market conditions and the reduction of the total land area used by horticulture farms (LEI, 2017[26]).

2.6.6 Energy prices

The Consumer Price Index (CPI) is used to measure consumer price inflation. For energy it reflects changes in the prices of natural gas and electricity for household consumption (see Figure 2.24; CBS, 2022l[27]). Since 2000, household energy bills have increased by an average of 4.3% per year until 2021, with an average inflation rate of 1.9% per annum. With the increase in energy from raw materials, there was a significant increase in the consumer price between 2016 and 2019. As a result of the COVID-19 pandemic, the electricity CPI saw a sharp drop to pre-2000 levels, which affected the energy CPI. However, both rebounded quickly thereafter. By contrast, the gas CPI rose steadily during the 2014-2021 period.

The developments and geopolitical tensions in 2022 have led to scarcity in energy and raw materials. The energy prices have increased significantly since and, as in the rest of Europe, measures are being taken to combat and prevent the energy poverty and inflation that has been caused by these developments. At the moment of writing, the major turbulence in these markets makes predicting future trends of energy prices highly uncertain.

26 LEI, 2017 Energiemonitor van de Nederlandse glastuinbouw 2016
https://www.kasalsenergiebron.nl/content/research/Energiemonitor_Nederlandse_glastuinbouw_2016.pdf
27 CBS, 2022l, Consumer Price Index (CPI)
https://opendata.cbs.nl/statline/#/CBS/en/dataset/83131ENG/table?dl=6B290

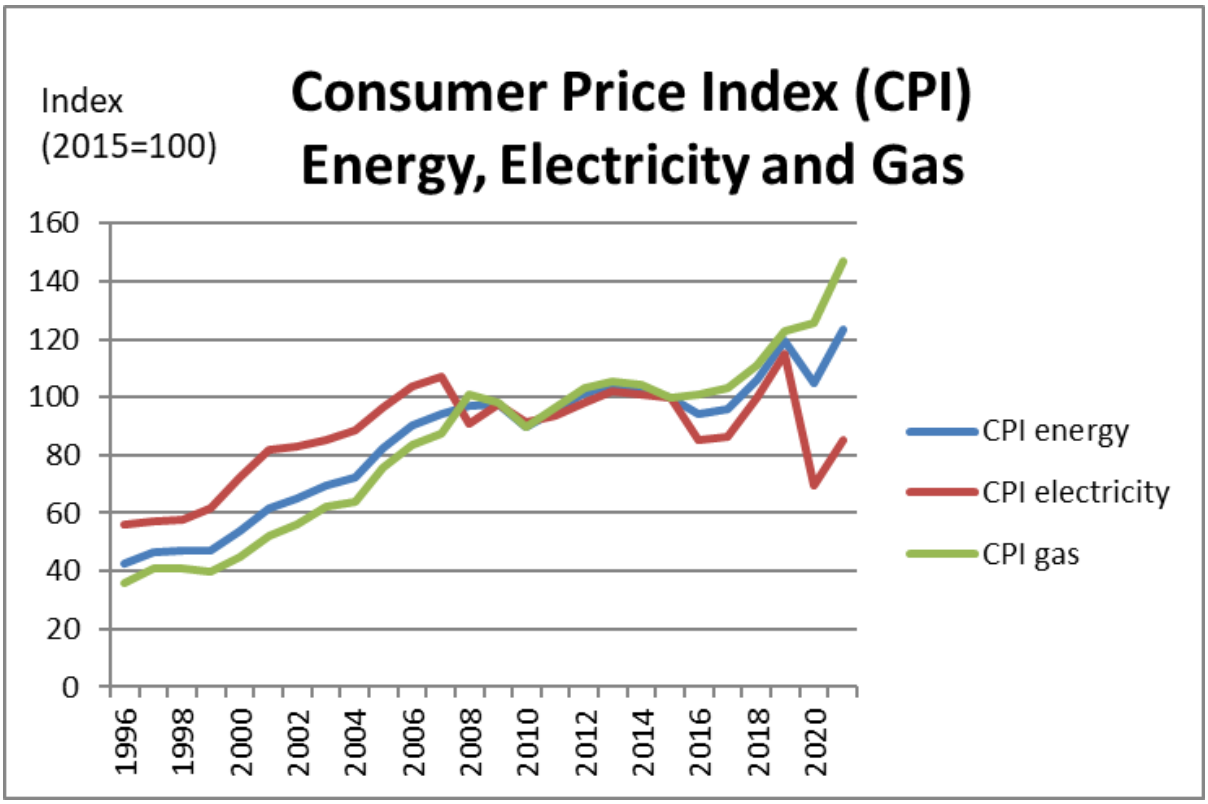


Figure 2.24 Consumer price index energy, 1995–2021 (CBS, 2022l)

Electricity price

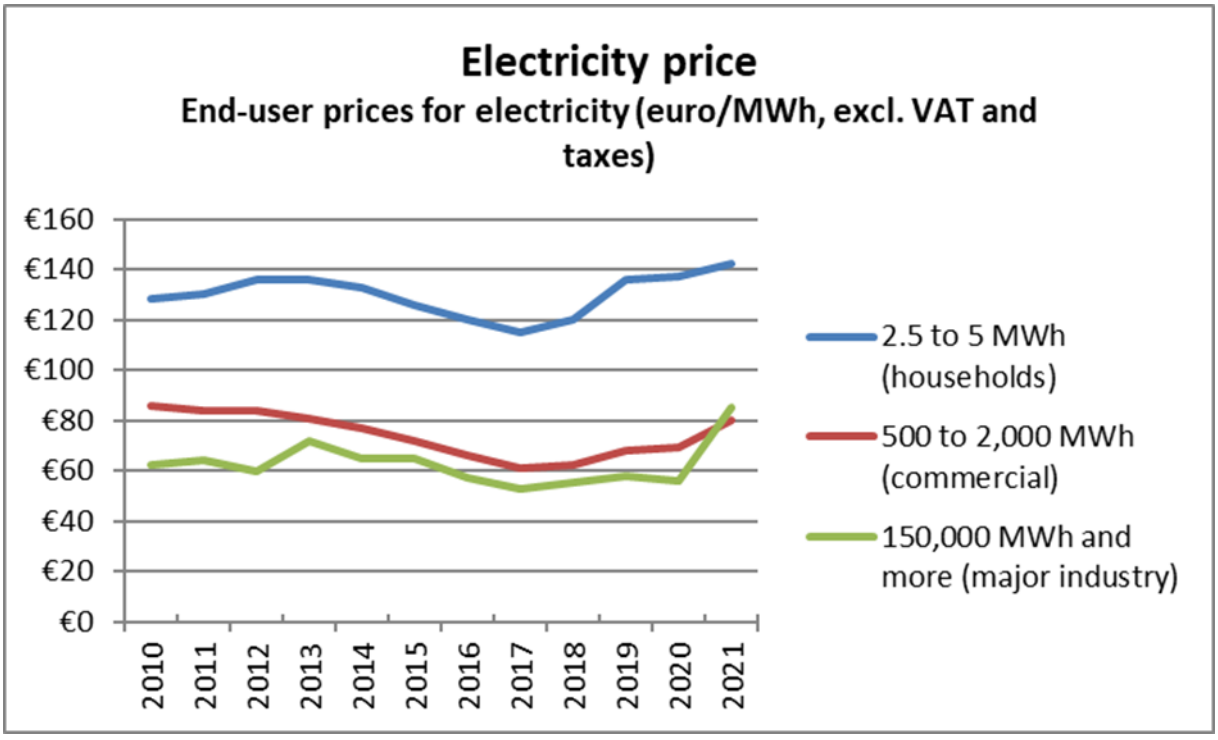


Figure 2.25 Consumer prices for electricity, excluding taxes, 2010–2021 (CLO, 2022c)

Figure 2.25 shows the changes in the electricity price in the 2010-2021 period (CLO, 2022c[28]). The electricity price depends on the prices for oil, coal and natural gas, among other things. 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 big 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,* which 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, the transport costs for household users have been dependent 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.

Natural gas price

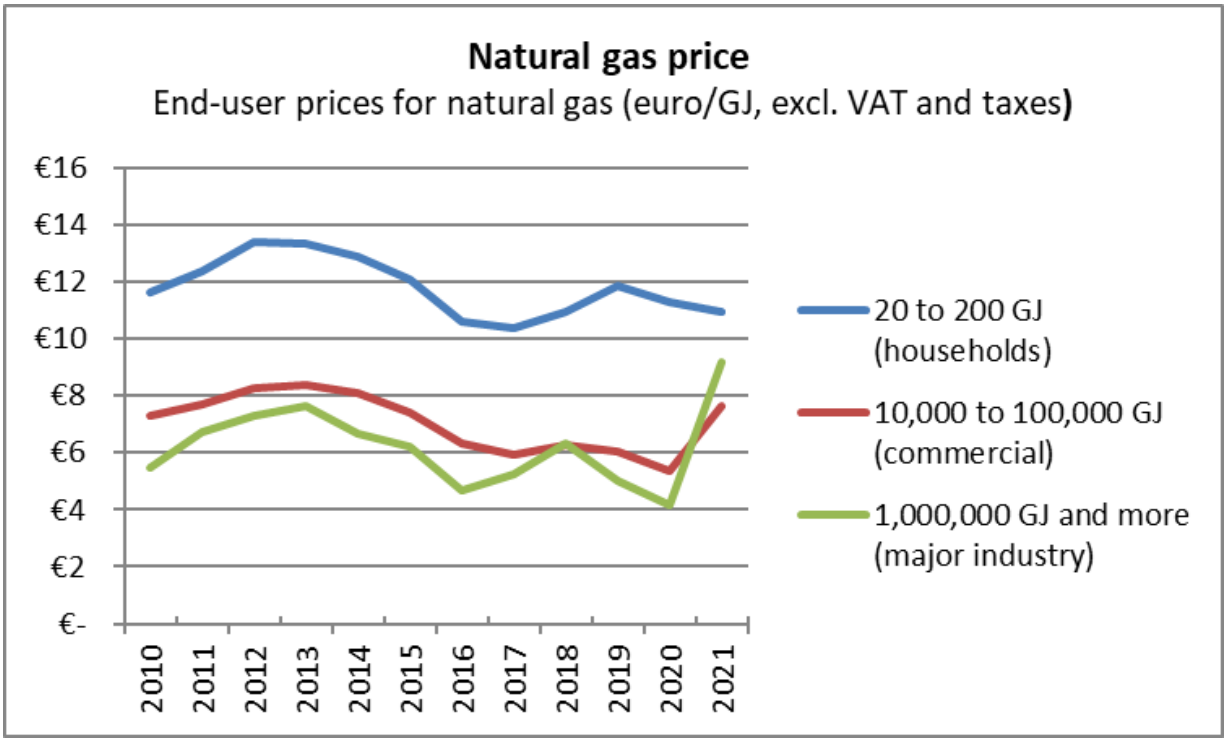


Figure 2.26 Consumer prices for natural gas, excluding taxes, 2010–2021 (CLO, 2022c)

28 CLO, 2022c, Energy prices for single energy carriers, 2010-2021
https://www.clo.nl/indicatoren/nl0554-energieprijzen-en-wereldolieprijs-?ond=20881

Figure 2.26 shows the changes in the natural gas price between 2010 and 2021 (CLO, 2022c[29]). In general, the natural gas price more or less follows the price of crude oil. The global tensions and scarcity in 2022 are causing record high prices at the time of writing, which makes predicting the future trend very uncertain.

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 largest airport in the Netherlands. Figure 2.27 shows some facts and figures concerning Schiphol in 2021. Schiphol handled 88% of all air passengers and 93% of all air freight in the Netherlands (see Table 2.4; CBS, 2022m[30]). The four smaller airports handle the rest of the passengers and freight.

Schiphol is one of Europe's largest airports in terms of the number of transport movements and number of passengers. In 2021, Schiphol was significantly impacted by ongoing COVID-19 travel restrictions, particularly in the first half of the year. However, by the peak summer season Schiphol was the busiest airport in Europe with respect to the number of passengers, and passenger volume continued to approach pre-COVID-19 numbers (Royal Schiphol Group, 2022[31]). Total cargo volumes increased 15.7% year-on-year to 1.67 million tonnes, making Schiphol one of Europe's top five cargo hubs (Royal Schiphol Group, 2022).

29 CLO, 2022c, Energy prices for single energy carriers, 2010-2021
https://www.clo.nl/indicatoren/nl0554-energieprijzen-en-wereldolieprijs-?ond=20881
30 CBS, 2022m, Aviation figures
https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37478hvv/table?dl=6B2E2
31 Royal Schiphol Group, 2022, Annual Report 2021
https://www.jaarverslagschiphol.nl/xmlpages/resources/TXP/Schiphol_web_2021/pdf/Schiphol_Annual_Report_2021.pdf

Figure 2.27 2021 facts and figures concerning Amsterdam Airport Schiphol (Royal Schiphol Group, 2022)

Airports	**Flights**	**Passengers**	**Cargo**
	number	number	tonnes
Amsterdam Airport Schiphol	266,956	25,490,810	1,667,304
Rotterdam The Hague Airport	8,307	755,395	-
Eindhoven Airport	20,524	2,698,424	-
Maastricht Aachen Airport	6,601	97,646	127,994
Groningen Airport Eelde	674	27,260	-
Total	303,062	29,069,535	1,795,298

Table 2.4 2021 aviation figures (Source: CBS, 2022m)

Goods transport to and from the Netherlands

Since 1998, freight transport has grown by over 23%. Maritime transport and rail transport have seen the biggest increases. Most goods are transported by road (CLO, 2022d[32]).

In 2020, nearly 45% of goods transport in Dutch territory took place by road (see Figure 2.28 and Figure 2.29). 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. Other modes of transport followed the same pattern. Nearly two-thirds of all transported goods involved cross-border transport. In 2020, maritime transport and inland shipping accounted for 31% and 17% of goods transport, respectively. The high percentage of maritime transport is largely due to the Port of Rotterdam, one of Europe's the biggest ports.

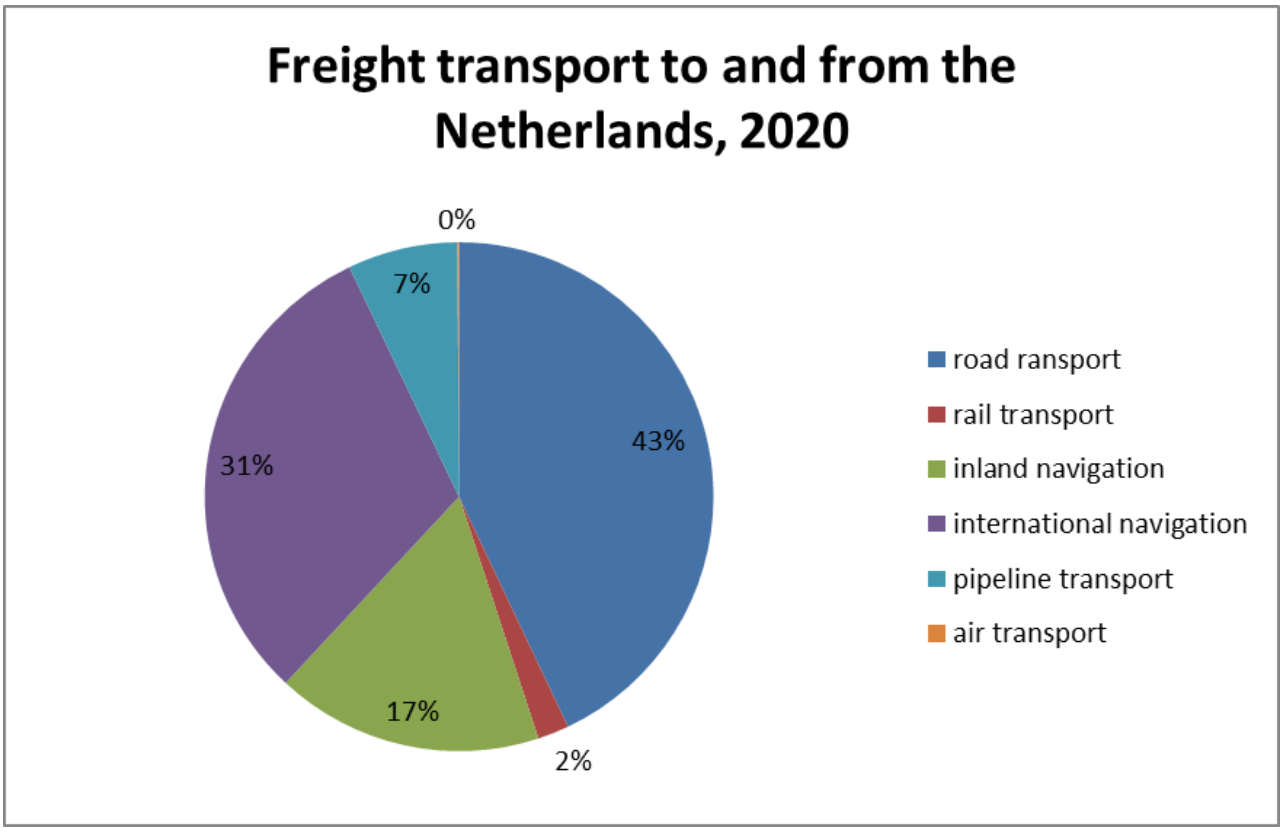


Figure 2.28 Freight transport to and from the Netherlands in 2020 (CLO, 2022d)

32 CLO, 2022d, Goods transport to and from the Netherlands, 1998-2020
http://www.clo.nl/indicatoren/nl0025-vervoersprestaties-goederenvervoer?ond=20897

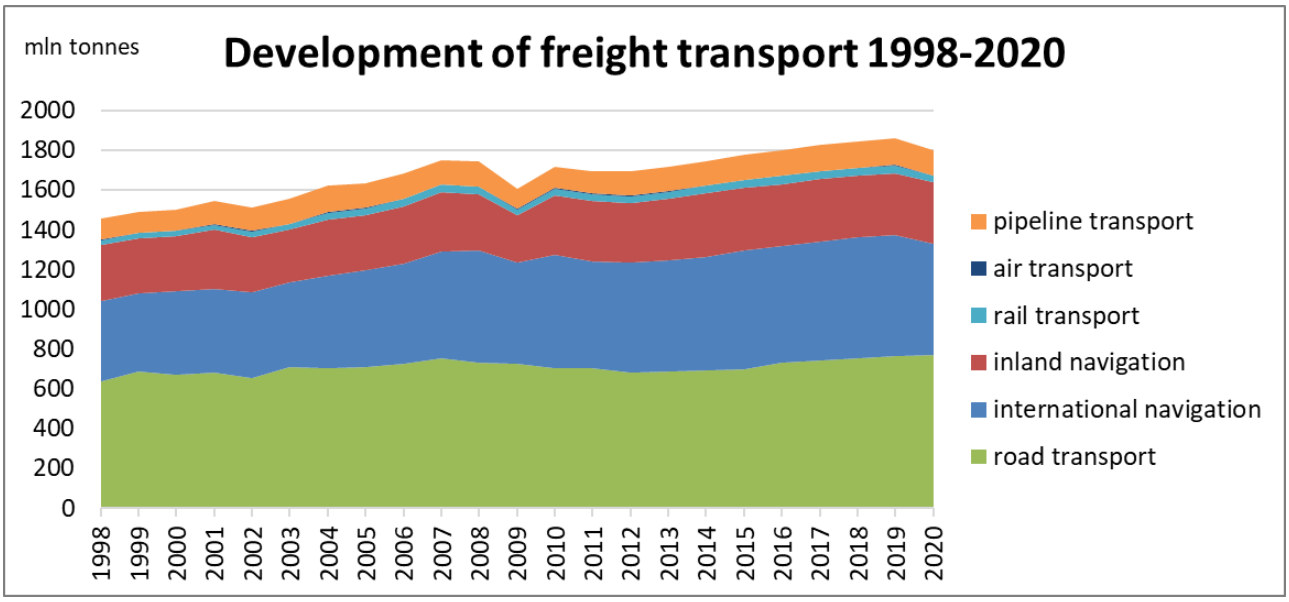


Figure 2.29 Changes in freight transport to the Netherlands 1998-2020 (CLO, 2022d)

Table 2.5 shows some more details in relation to changes in road transport (CBS, 2022n[33]). Due to the economic crisis, the amount of freight transported fell from 2007 onwards by 10%, but the amount of freight has been increasing again over the past few years.

year	transported freight (1000 tonnes)	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

33 CBS, 2022n, Road transport; key figures
https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83077ned/table?dl=69D7E

year	transported freight (1000 tonnes)	freight-tonne kilometres (x mln)	vehicle kilometres (mln km)
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	656,417	67,785	7,423
2017	665,992	67,532	7,202
2018	680,169	68,906	7,366
2019	688,739	68,922	7,293
2020	684,241	67,592	7,377
2021	701,805	70,227	7,743

Table 2.5 Changes in road transport (CBS, 2022n)

Passenger transport

In 2020, some 152 billion passenger kilometres were travelled (see Figure 2.30; CBS, 2022o[34]), a decrease of 31% compared to 2019, caused by the effects of the COVID-19 pandemic. In 2020 the majority (over 69%) of these passenger kilometres were travelled by private car. Public transport accounted for 8%, with a 60% decrease in passenger kilometres compared to 2019. The share of rail transport was 6%, with other forms of public transport accounting for the remaining 2%. Nearly 10% of passenger kilometres were travelled by bicycle.

Figure 2.31 shows the changes passenger kilometres travelled by motor vehicle since 1990. Until 2005, there was an increase of average 1.3% but after 2005 the increase levelled off at around 0.3% per year. Between 2014 and 2019, passenger kilometres increased by over 6%, and subsequently dropped in 2020 due to COVID-19 restrictions.

34 CBS, 2022o, Total transport performance in the Netherlands
https://opendata.cbs.nl/statline/#/CBS/en/dataset/84687ENG/table?dl=69816

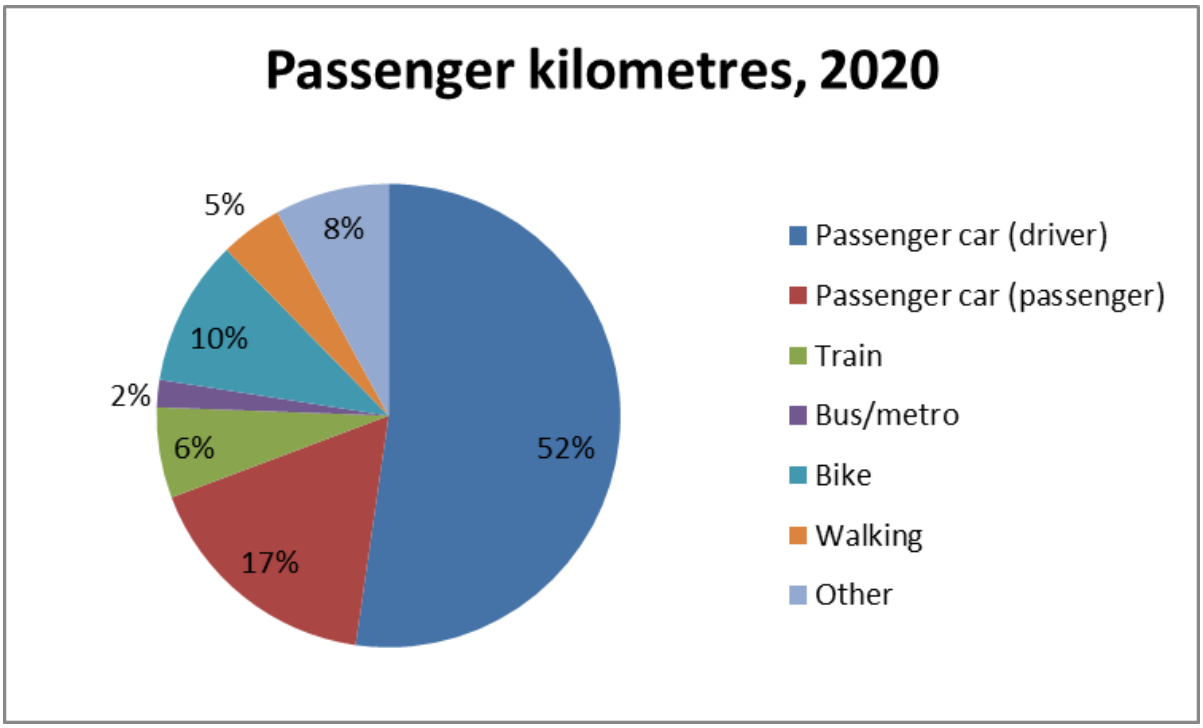


Figure 2.30 Passenger kilometres in 2020 (CBS, 2022o)

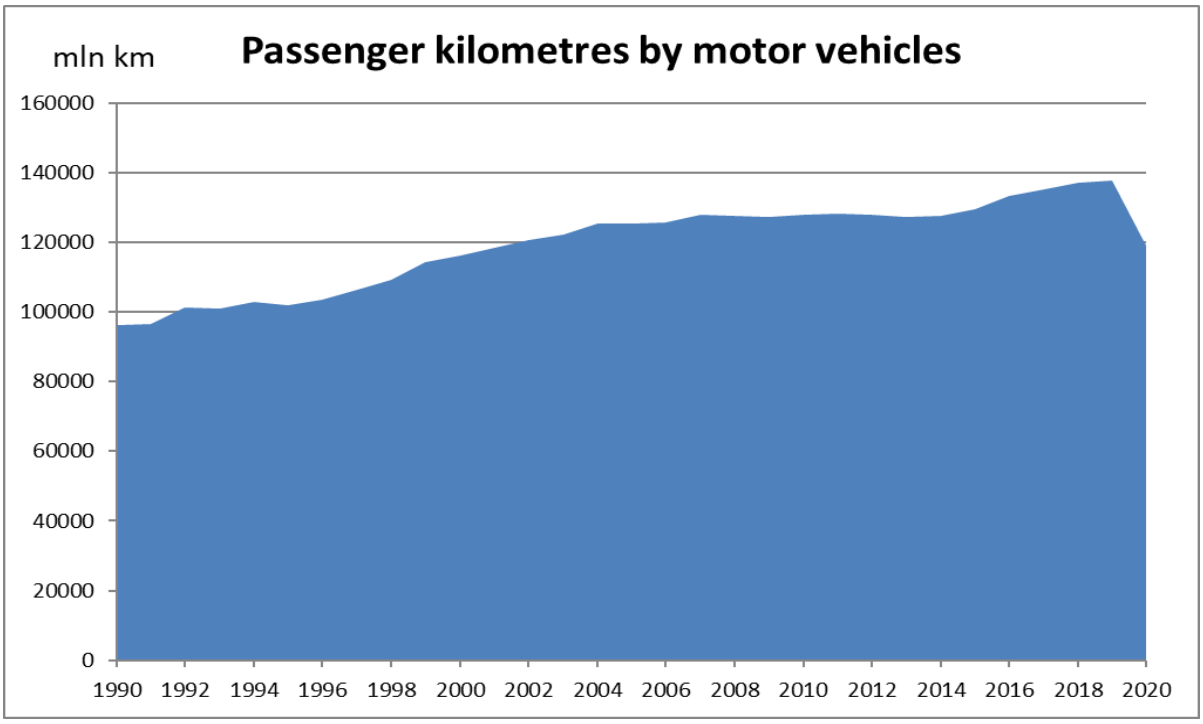


Figure 2.31 Passenger kilometres by motor vehicle since 1990 (CBS, 2022p[35])

35 CBS, 2022p, Traffic performance motor vehicles
https://opendata.cbs.nl/statline/#/CBS/en/dataset/80302ENG/table?dl=69855

2.8 Industry

Compared to other EU countries, the industrial structure of the Netherlands is relatively energy-intensive in terms of energy use per euro of 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 or Denmark. Since 2013, the mining and quarrying industries have seen a sharp decline in production (70%) (2015 prices; CBS, 2022q[36]). This is related to the phasing out of low caloric gas production in Groningen. Overall, production across all other industries grew by 8%, with the manufacturing industry growing the most (24%). The effects of the economic and financial crisis are clearly visible in Figure 2.32, as are the effects of the COVID-19 pandemic on the production of electricity and gas in 2020.

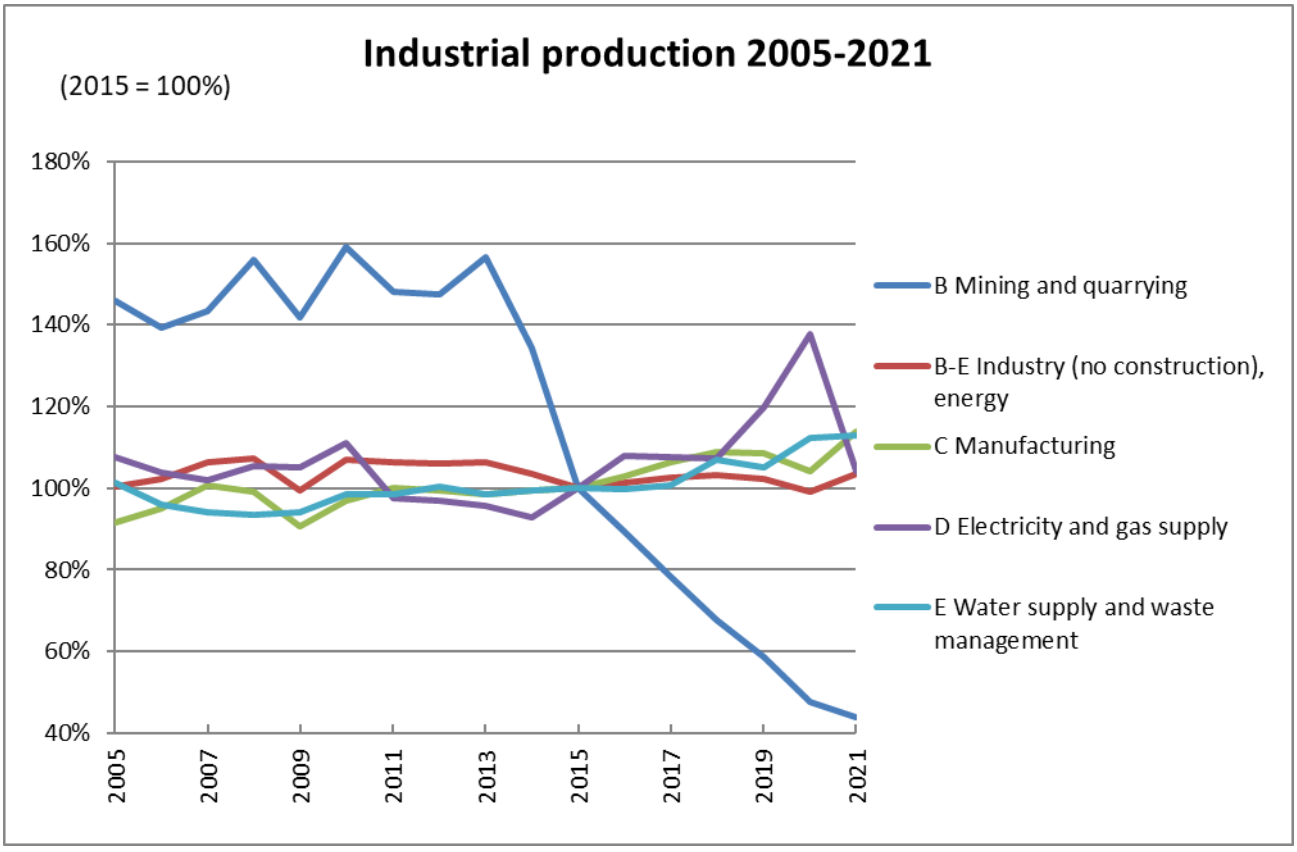


Figure 2.32 Industrial production 2005–2021 (Source: CBS, 2022q)

36 CBS, 2022q, Industry; production and sales, changes and index, 2015=100
https://opendata.cbs.nl/statline/#/CBS/en/dataset/83838ENG/table?dl=6B68E

2.9 Waste

The total amount of waste produced in 2020 (excluding polluted soil, dredging sludge and animal manure) amounted to 59 million tonnes. Figure 2.33 (CLO, 2020b[37]) shows that, despite population growth and economic development, waste production remained fairly stable at around 60 million tonnes during the 2000-2020 period. Governmental policies aimed at decoupling GDP growth and waste production have thus clearly been successful.

Between 1990 and 2020, the rate of waste reuse (i.e. recycling and the use of waste for energy production) increased from 62% to 93% of the total amount (Figure 2.33). This included half of residential and office waste, most industrial waste and almost all demolition waste. Nearly all waste products from agriculture and coal-fired power plants were recycled. In 2020, approximately 4.0 million tonnes were not reused or recycled, of which residential waste accounted for the largest share, followed by office waste. In 2020, some 1.1 million tonnes of waste were disposed of in landfill sites; in 1990 this figure was around fourteen times higher (13.9 million tonnes). Around 10% of this waste consisted of degradable carbon, leading to methane emissions (a few Mt CO_2-eq). The residual waste that is not reused or disposed of in landfill is incinerated; after an increase in the volume of waste incinerated in the 1990s, quantities 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 "waste reuse". Therefore, the amount of waste that is reported under the category "incineration" has been further reduced; in 2020 only 2.0 million tonnes were incinerated.

The amounts of waste dumped at landfill sites have been substantially reduced as a result of the government's waste management policy. This focuses first and foremost on prevention. Reuse and waste incineration with energy recovery are next in line in terms of priority. The separation of waste streams at the source for recycling purposes is a key factor, in particular for the recycling of paper and glass, as well as garden and food wastes (compost).

37 CLO, 2020b, Waste generation and treatment, 1985-2018
https://www.clo.nl/en/indicators/en0204-waste-generation-and-treatment

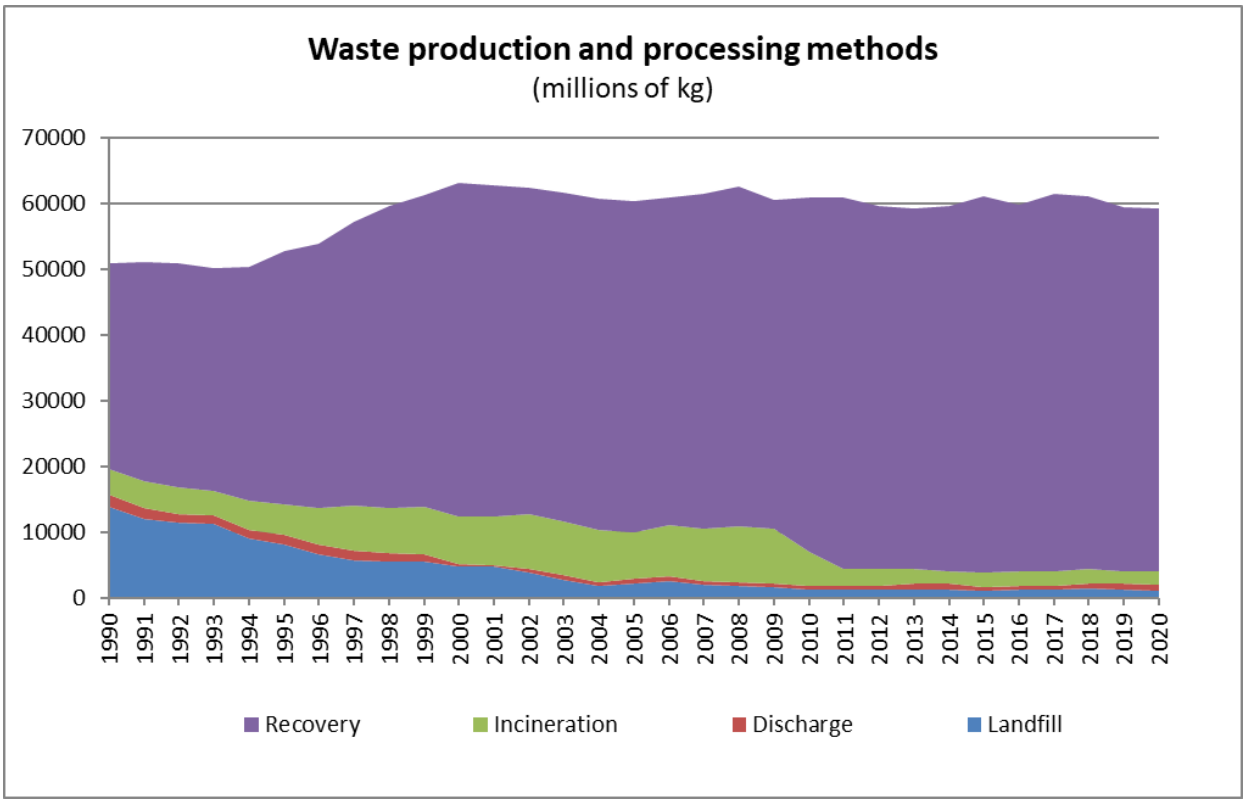


Figure 2.33 Waste production and processing methods 1990–2020 (CLO, 2020b)

2.10 Building stock and urban structure

2.10.1 Housing stock and energy labels

As of 1 January 2022, there were 8.0 million homes in the Netherlands. That represented an increase of 35% compared to 1 January 1990. Between 1990 and 2021, 2.4 million dwellings were built and more than 394 thousand were demolished (see Figure 2.34; CBS, 2022r[38]).

38 CBS, 2022r, Housing supply; stock and mutations from 1921
https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82235ned/table?dl=6B6D4

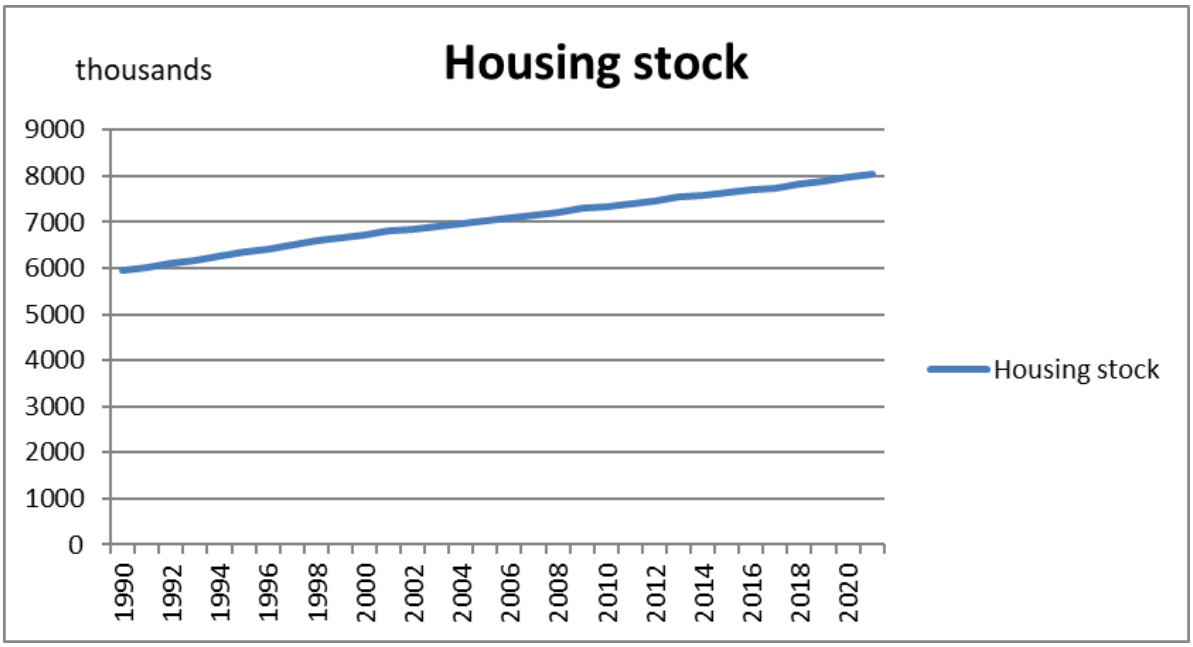


Figure 2.34 Housing stock in the Netherlands 1990–2021 (CBS, 2022r)

Over the entire period an average of over 77,000 homes were built per year. However, as is shown in Figure 2.35, this figure has declined over time. In the 1990s, the average number of new homes built per year was 92,000. The number of new dwellings built each year in the Netherlands decreased during the 1998-2003 period but rose to nearly 88,000 in 2009. Then, as a result of the financial and economic crisis, production plummeted to only 61,000 new homes in 2010. This decrease continued until 2014 (45,170). Since then, the number of new homes built each year has started to increase again, reaching 71,221 in 2021.

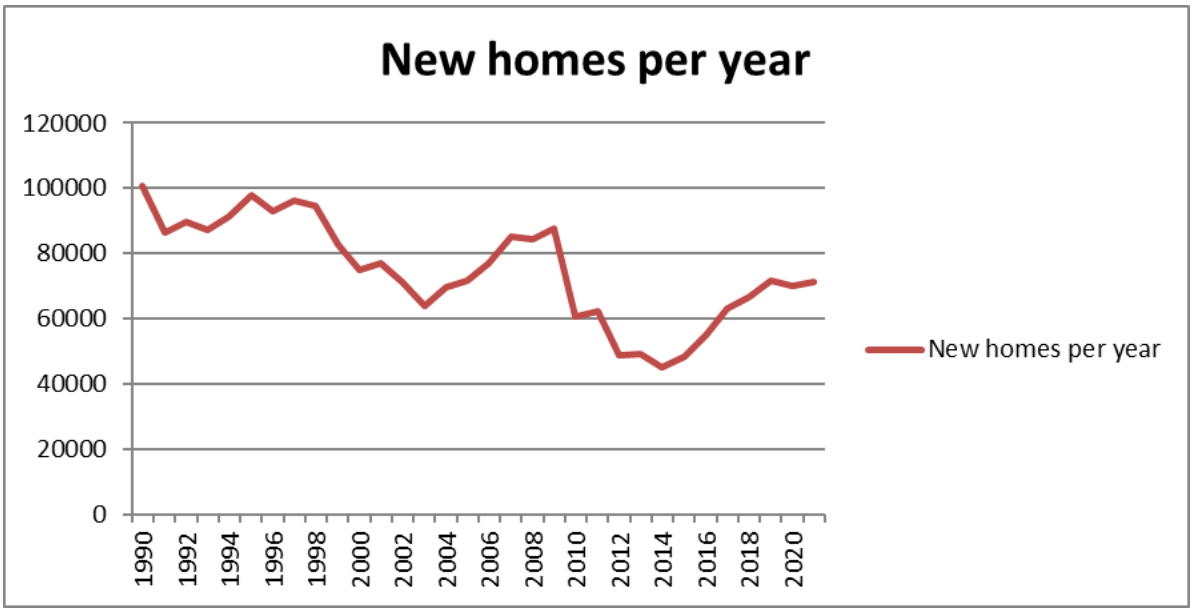


Figure 2.35 Changes in numbers of new homes per year (CBS, 2022r)

An energy label for homes and buildings was implemented in 2007. This label gives an overall impression of a home's energy efficiency. Of the more than 7.9 million homes in the Netherlands, as of 1 January 2020 around 3.8 million had an energy label (CLO, 2020c[39]). This corresponds to 48% of the total housing stock. Multi-family dwellings are more likely to have a label (64%) than single-family dwellings (40%).

The majority of homes have an A or C label (23% and 28%); see Figure 2.36. Around 39% of the housing stock consists of highly energy-efficient homes (A and B labels). A significant number of energy labels were issued in 2009, when a large number of housing associations had their housing stock assessed. 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. Since 2015, a great many new labels have been issued annually (see Figure 2.37). 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 2010, 20% of new labels issued were green (A or B); in 2019, this figure was 47%. The proportion of the energy-inefficient labels E, F and G declined from 25% in 2010 to 16% in 2019. Issued labels are not representative of the entire housing stock. There are still over four million houses, 52%, which do not have an official energy label. In most cases, energy labels are issued for newly built or rental properties.

39 CLO, 2020c, Energy labels of homes, 2010-2019
https://www.clo.nl/indicatoren/nl0556-energielabels-woningen?i=9-53

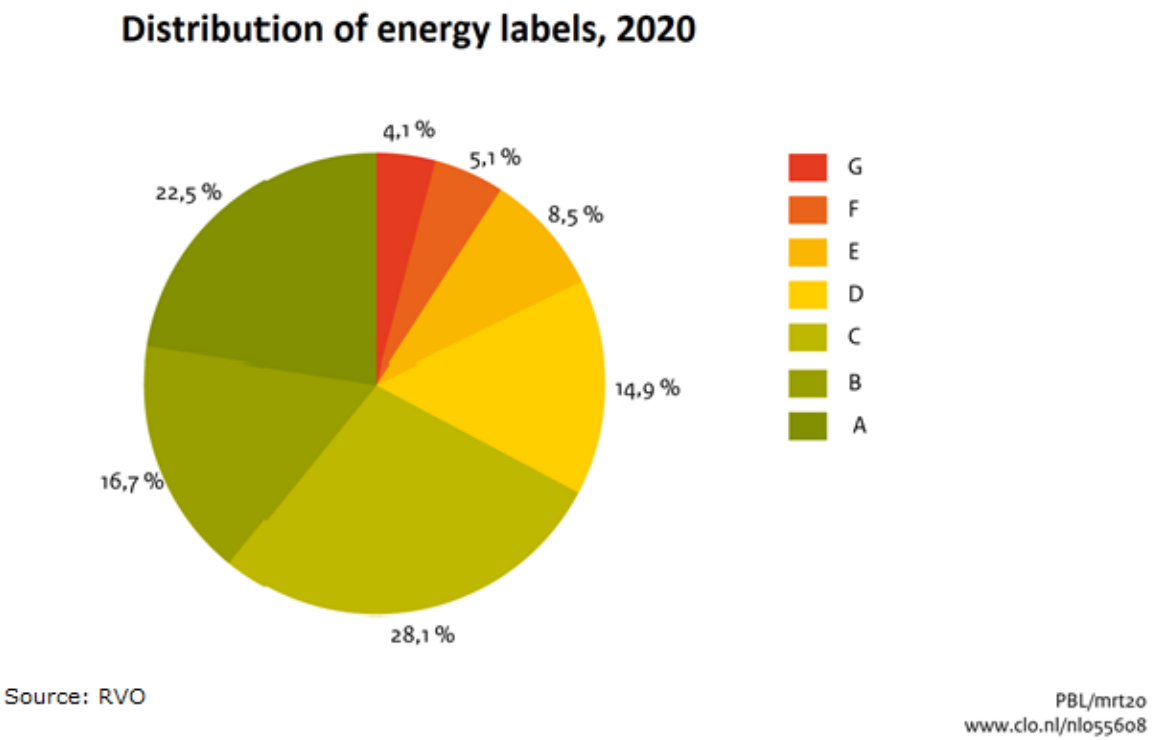


Figure 2.36 Distribution of energy labels, 2020 (CLO, 2020c)

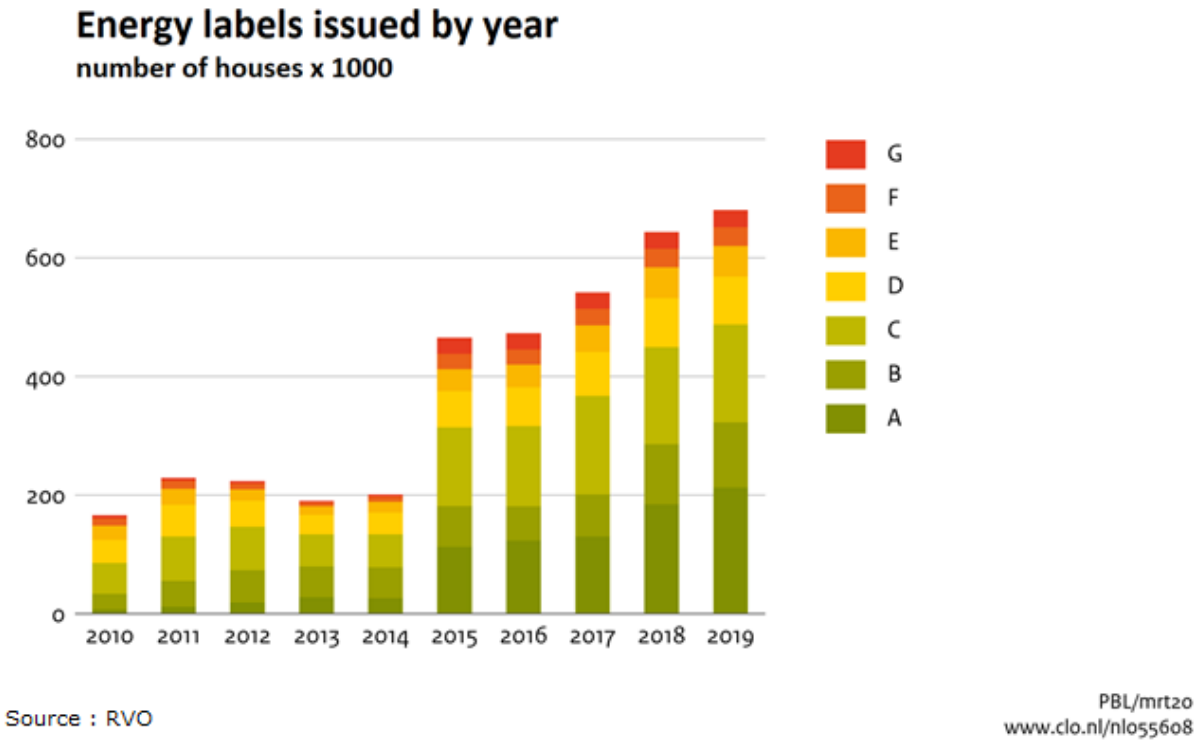


Figure 2.37 Number of energy labels issued per year, 2010-2019 (CLO, 2020c)

2.10.2 Other buildings

At the end of 2020 about 1.2 million non-residential buildings were in use in the Netherlands. This includes buildings for industrial use, offices, shops, premises of healthcare providers, education institutions and sport and recreation facilities. See Figure 2.38 for a breakdown of these categories as a percentage of the total number of buildings in the non-residential building stock.

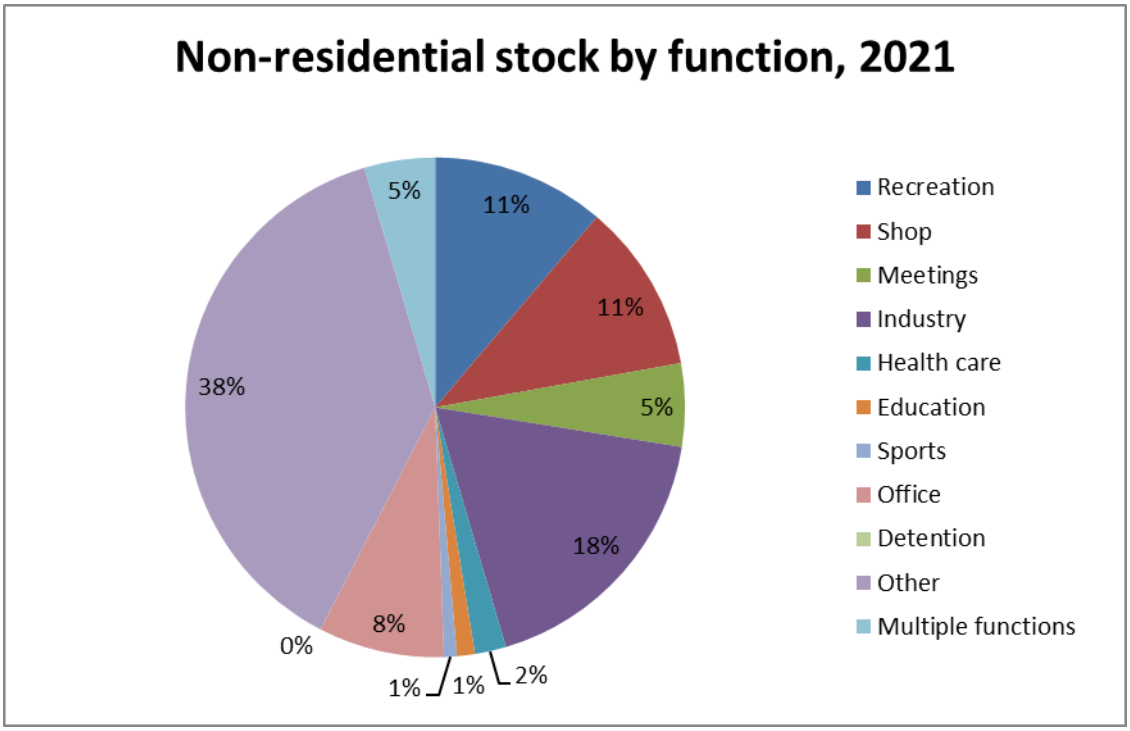


Figure 2.38 Non-residential stock by function, 2021 (CBS, 2021c[40])

As of 1 January 2022 approximately 40% of all non-residential buildings with an energy label obligation had such a label, indicating the energy efficiency of the building. This is estimated to encompass 75% of the building area. This obligation does not apply to certain smaller buildings and monuments. Figure 2.39 shows a breakdown of the labels per building function.

40 CBS, 2021c, Dwellings and non-residential stock; changes, utility function, regions https://opendata.cbs.nl/#/CBS/en/dataset/81955ENG/table?dl=6DBCB

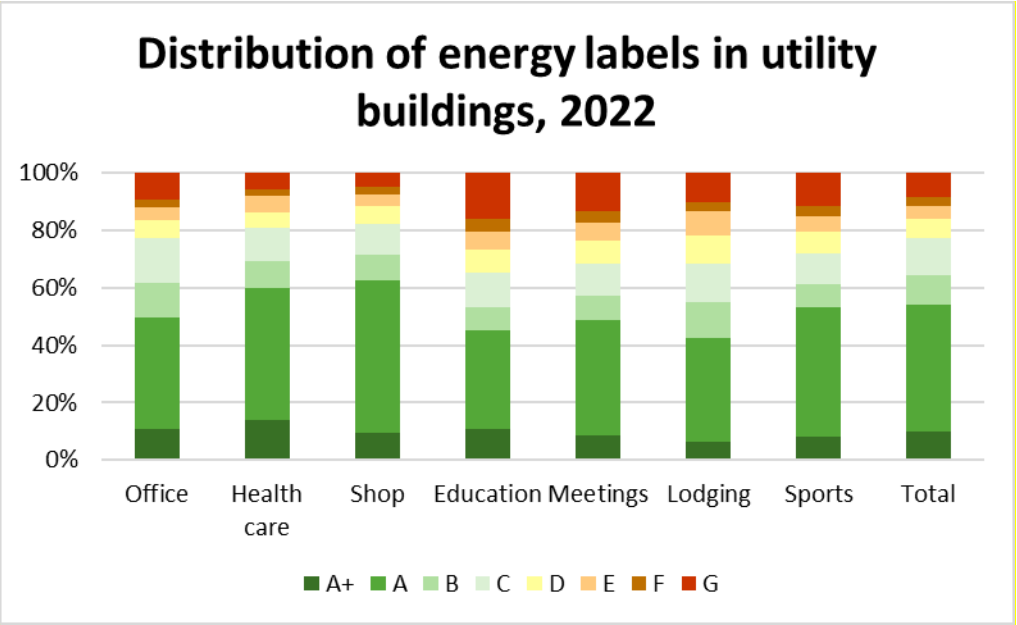


Figure 2.39 Distribution of energy labels in utility buildings, 2022 (RVO, 2022a[41])

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 proportion of horticulture in total agricultural production has been increasing. The amount of fuel consumed by the greenhouse horticultural sector is comparable to the 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 2021 there were over 52 thousand farms and horticultural enterprises in the Netherlands (see Figure 2.40; CBS, 2022s[42]). Of these companies, 27% were dairy farms and 21% were arable farms. In 2000, 24% were dairy farms and 15% were arable farms. In the 2000-2021 period, the total number of farms decreased by 47%. The total land area used by the agricultural sector dropped by 8% during the same period (see Figure 2.41).

Dairy farming is the only subsector in which the total land area used has increased since 2000 (2%). All other subsectors saw a reduction in the total land area used, particularly

41 RVO, 2022a, Dashboard Klimaatbeleid
https://dashboardklimaatbeleid.nl/viewer
42 CBS, 2022s, Agriculture; economic size by size class, business type
https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80785ned/table?dl=6B764

pig farms, poultry farms, and other cattle, which fell by 46%, 27% and 25%, respectively.

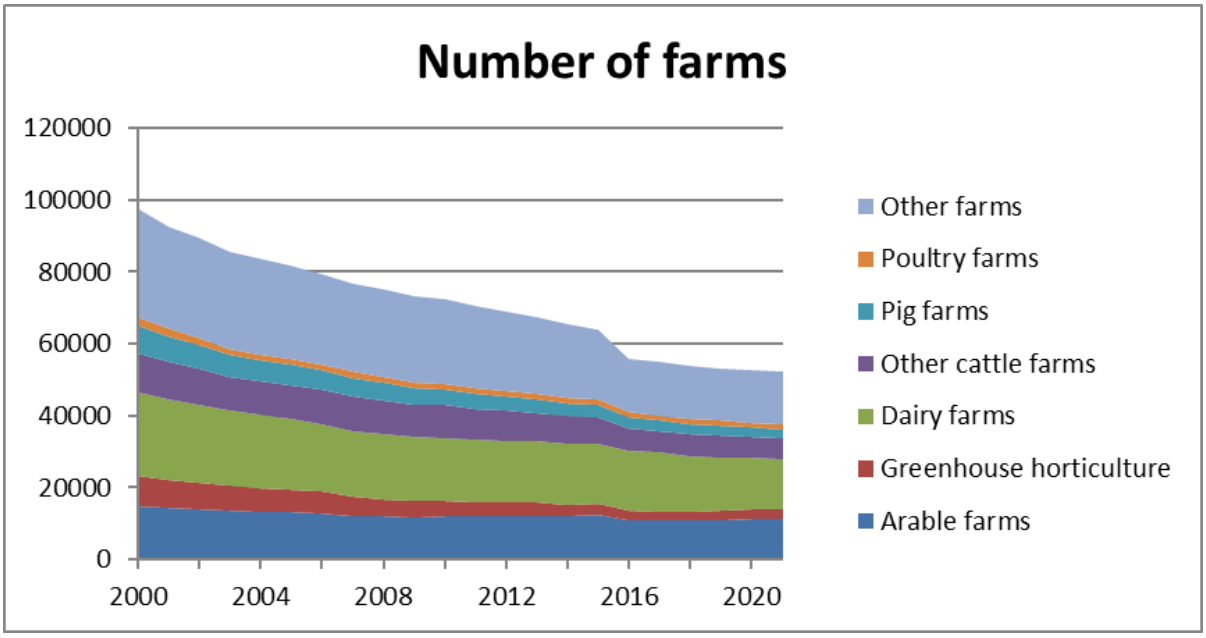


Figure 2.40 Number of farms, 2000-2021 (CBS, 2022s)

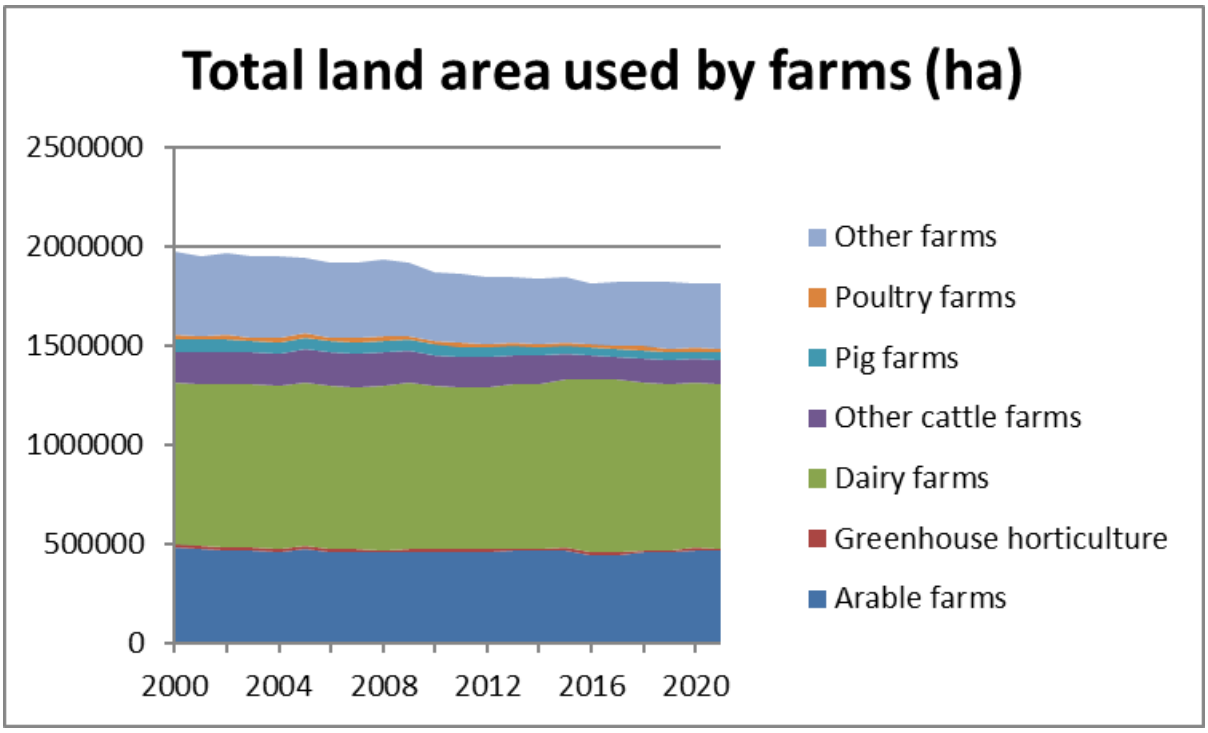


Figure 2.41 Total land area used by farms, 2000-2021 (CBS, 2022s)

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. The

surface spreading of manure and the required manure injection and incorporation into the soil were banned by legislation concerning ammonia emissions. 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 a raw material for energy production (fermentation, biogas).

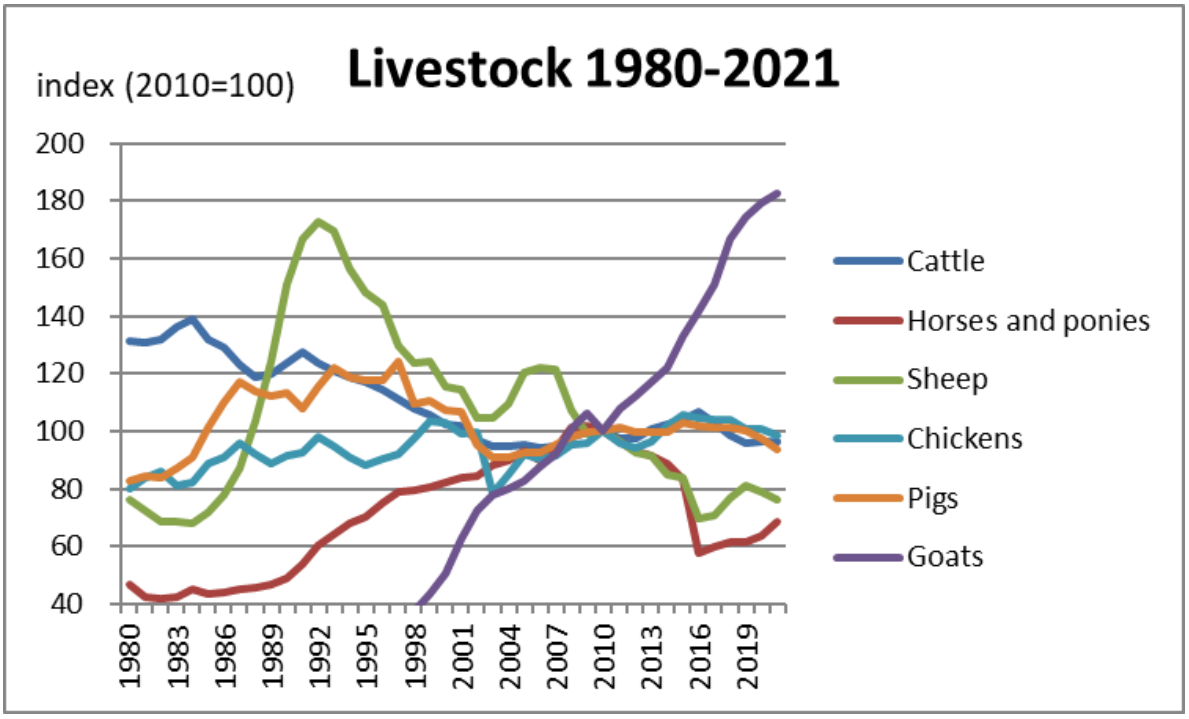


Figure 2.42 Livestock numbers in the Netherlands 1980–2021 (CLO, 2022e[43])

	Unit	1980	1990	2000	2010	2015	2020	2021
Cattle	x 1,000	5226	4927	4069	3976	4133	3838	3820
O/W Dairy Cattle	x 1,000	2356	1878	1504	1479	1622	1593	1571
O/W other cattle	x 1,000	2870	3049	2565	2497	2511	2245	2249
Horses and ponies	x 1,000	67	70	117	143	118	90	98
Sheep	x 1,000	858	1702	1305	1130	946	890	860
Goats	x 1,000	.	61	179	353	470	633	643
Chickens	x 1,000	76064	85492	94973	92652	96791	92395	90216
Swine	x 1,000	10138	13915	13118	12255	12603	11950	11457

Table 2.6 Livestock numbers in the Netherlands 1990-2021 (CLO, 2022e)

Dairy herd virtually unchanged

The number of cattle has decreased by more than a quarter since 1980: see Table 2.6 and Figure 2.42 (CLO, 2022e). The number fell from 5.2 million in 1980 to 3.7 million in

43 CLO, 2022e, Livestock development on farms, 1980-2021
https://www.clo.nl/indicatoren/nl2124-ontwikkeling-veestapel-op-landbouwbedrijven-?ond=20885

2006, before increasing again to 4.3 million in 2016. It then fell again to 3.8 million in 2021. The sharp drop in 1984 coincided with the introduction of milk quotas within the European Union, causing the number of dairy and calf cows to fall by 42 percent between 1984 and 2011 to 1.47 million. On 1 April 2015, these milk quotas were abolished, resulting in an expansion of the dairy herd. From 2011 to 2016, the number of dairy and calf cows increased by 19 percent to 1.75 million. In addition, since 2012 there has also been an increase in young stock for dairy farming. The number of young stock rose by 149 thousand to 1.34 million from 2012 to 2015, an increase of 13%.

Dutch livestock farming turned out to have produced more phosphate in 2015 than was allowed on the basis of European agreements. The largest increase came from dairy farming. In response to this, the phosphate reduction plan for Dutch dairy farming came into effect in 2017, requiring companies to sell dairy cattle in order to halt the growth of the dairy herd. The phosphate content in compound feed was also reduced in order to reduce the amount of phosphate in manure. As a result of the phosphate reduction plan, the number of dairy and calf cows decreased by 10% to 1.58 million from 2016 to 2019. From 2015 to 2019, the number of young stock fell by 413 thousand to 0.92 million, a decrease of 31%. In 2021, the size of the dairy herd remained virtually unchanged with 1.57 million dairy and calf cows. The number of young stock rose to 0.97 million.

Number of horses on the rise

The number of horses (and ponies) housed on farms increased from 67,000 to 145,000 between 1980 and 2009. Partly as a result of the financial crisis in 2008, the number of horses on farms decreased. Since 2017 the number of horses and ponies has increased again to 98 thousand in 2021. A great many horses are housed at locations other than farms, e.g. riding stables. It is not well known how many horses there are in the Netherlands, but according to estimates from the sector, there are between 400,000 and 450,000 horses in this country.

Fewer sheep

As a result of the introduction of the milk quota in 1984, the expansion of a farm with dairy cows was often no longer an option. Farmers therefore started to keep more sheep and the number of sheep has increased significantly. In 1980 there were 850,000 sheep in the Netherlands and in 1992 the peak number of 2.0 million sheep was reached. In that year, sheep were included under the manure legislation and there was a lower ewe premium, as a result of which the number of sheep started to fall. In 2006, the ewe premium, which was intended to provide income support to beef and dairy sheep farmers in adverse market conditions, was integrated into other government subsidy programs.

As a result, the number of sheep continued to decline after 2007, with a low of 780 thousand sheep being reached in 2016. In 2021 there were 860 thousand sheep, 3% fewer than in 2020.

Number of goats has increased

In 1980 there were only a few thousand goats in the Netherlands. In the period from 1980 to 2009 the number of goats increased significantly. Since 1992, goats have also been subject to manure legislation. After increasing to almost 375 thousand in 2009, the number of goats dropped to around 350 thousand in 2010 as a result of culling due to Q fever. Since then, the number of goats has increased at a rapid pace, growing to 643 thousand by 2021.

Number of chickens and pigs decreased

The number of chickens in the Netherlands has continued to fluctuate over the past few decades. In 1980 there were 81 million chickens and in 2021 there were almost 100 million. The sharp decrease in 2003 was a result of the bird flu epidemic. In the spring of 2003, nearly 30 million chickens were culled. The number of broiler chickens has fluctuated around 45 million since 2003. In 2021 there were 47 million broiler chickens in the Netherlands. After 2003, the numbers of laying hens increased, reaching a peak of almost 48 million in 2010. After 2010, this number fluctuated erratically. In 2021 there were 43 million laying hens in the Netherlands.

In 1980, there were 10 million pigs in the Netherlands. This number peaked in 1997 at 15 million. In February 1997, an outbreak of swine fever caused a sharp drop in the pig population. There was a downward trend in the years to follow up until 2004 as a result of factors such as market developments and environmental and animal welfare measures. At its lowest point in 2004, there were 11.2 million pigs. Over the past ten years, the number of pigs has remained steady at around 12.3 million on average. Due to recent legislation, the number of pigs decreased to 11.5 million in 2021.

2.12 Forests

The forested area in the Netherlands decreased slightly in 2021 compared to previous measurements to roughly 364,000 ha, which amounts to around 11% of the total land area used. The main causes of this are the felling of temporary forests established in the 1980s and 1990s, and the conversion of forest into other nature areas, such as heath corridors and sand drifts. Compared to previous periods, the establishment of new forested areas lagged behind in the 2013-2021 period.

Most of the forested area in the Netherlands was originally planted using regular spacing and just one or two species in even-aged stands, with wood production being the main purpose. The switch to 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 (see Figure 2.43; Schelhaas, et al., 2022[44]).

Dutch forests are becoming increasingly mixed, in many cases at the expense of unmixed coniferous stands. The share of broadleaved tree species exceeds the share of coniferous tree species for the first time since measurements began, in terms of surface area, volume and additional growth.

The stock of living wood has increased from 212 m^3/ha to 225 m^3/ha from 2013-2021. Standing dead wood has increased from 6.2 to 10.1 m3/ha and lying dead wood has increased from 6.6 to 9.3 m^3/ha. The felling volume remained more or less the same (1.15 million m^3 per year), while growth declined, likely due to drought and aging of forests.

Most forests are located in the provinces of Gelderland and North Brabant; the least-forested province is Zeeland (see Figure 2.44, CLO, 2020d[45]).

44 Schelhaas, et al., 2022, Seventh National Forest Inventory of the Netherlands
https://www.probos.nl/images/pdf/rapporten/1_rapport_nbi8.pdf
45 CLO, 2020d Land use in the Netherlands, 2015
https://www.clo.nl/en/indicators/en0061-land-use-in-the-netherlands

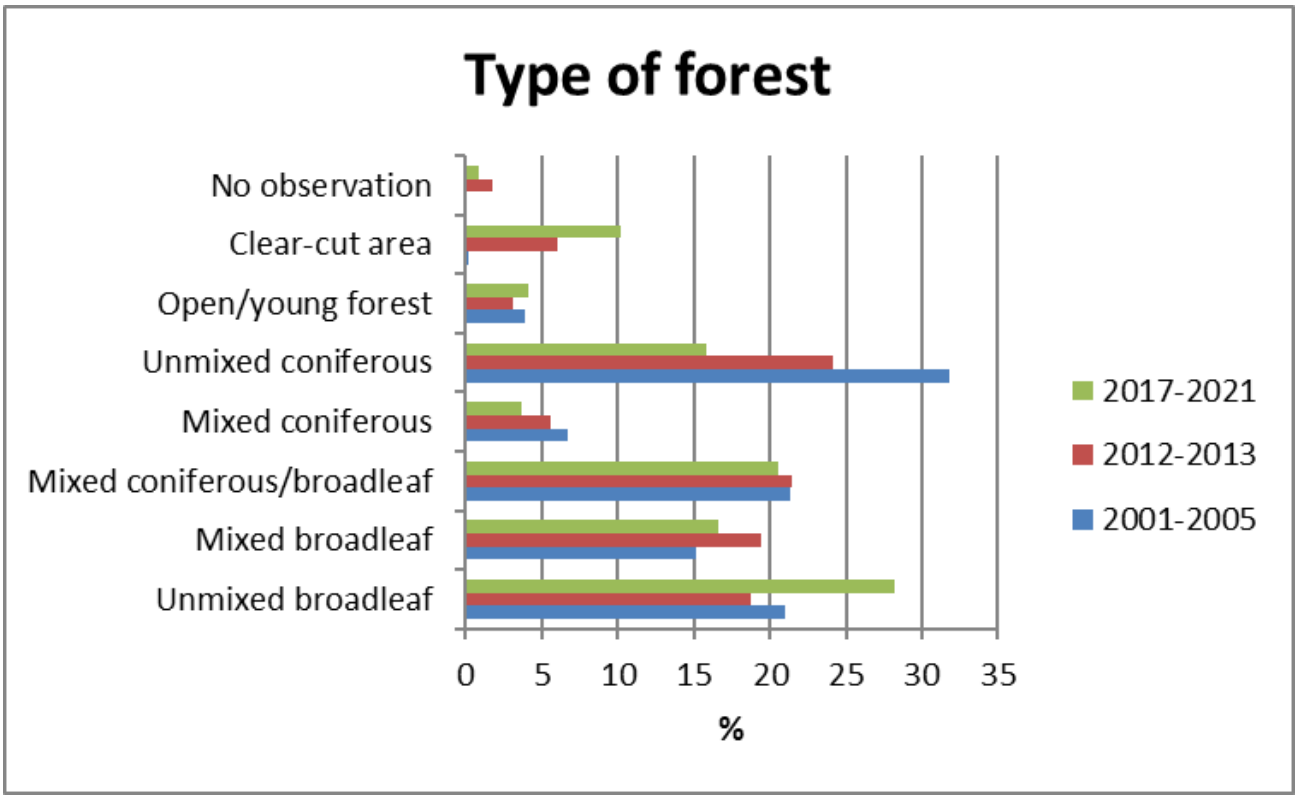


Figure 2.43 Types of forests in the Netherlands (Schelhaas et al., 2022)

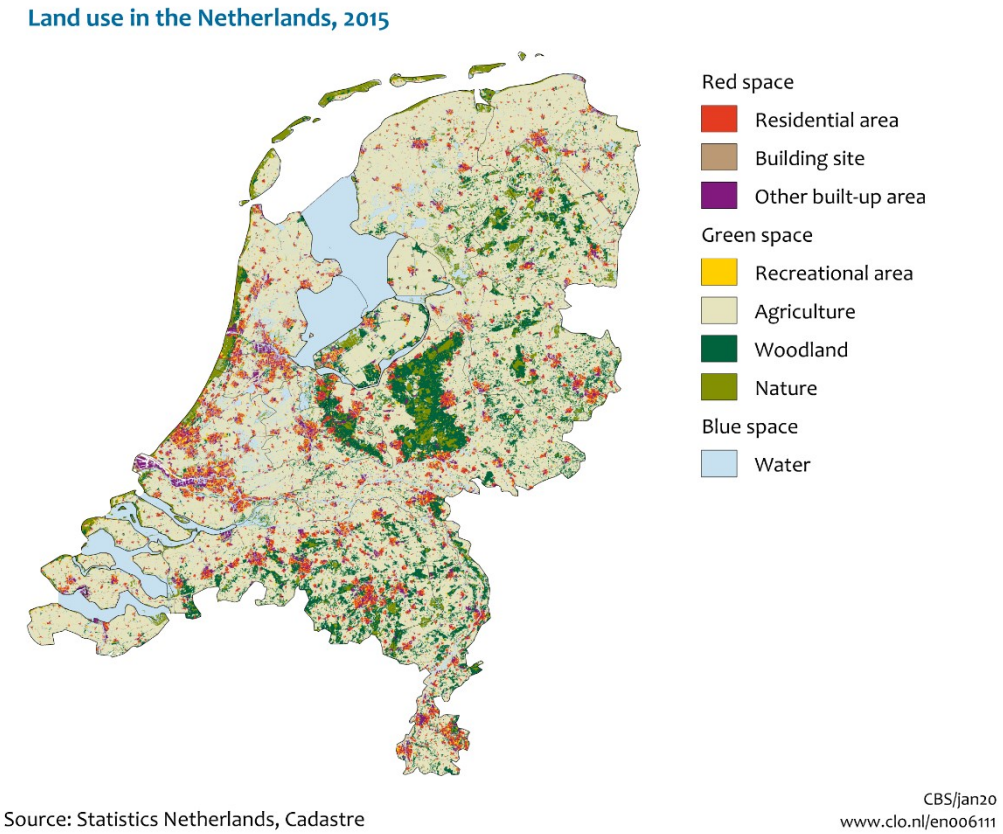


Figure 2.44 Land use in the Netherlands (CLO, 2020d)

3. GREENHOUSE GAS INVENTORY INFORMATION

3.1 (A) Summary tables

The Netherlands submitted its most recent greenhouse gas inventory (1990-2020 period) to the UNFCCC in April 2022. Summary tables, including trend tables for CO_2-equivalent (CO_2-eq) 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 1990-2020 period, as described in the National Inventory Report (NIR) 2022. More detailed explanations are provided in the NIR 2022.[46]

Trends in aggregated greenhouse gas emissions
In 2020, 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 164.32 Tg CO_2-eq. This figure is approximately 25.5% below the emissions in the base year of 1990 (220.5 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 1990–2020, emissions of carbon dioxide (CO_2) decreased by 15.0% (excluding LULUCF). Emissions of non-CO_2 GHGs, i.e. methane (CH_4), nitrous oxide (N_2O) and F-gases, decreased by 47%, 56% and 85%, respectively.

Emissions of LULUCF-related sources decreased by about 39% over the 1990-2020 period. The total amount of GHG emissions in the Netherlands in the year 2020 (including LULUCF) was 167.9 Tg CO_2-eq.

46 Ruysennaars et al., 2022.

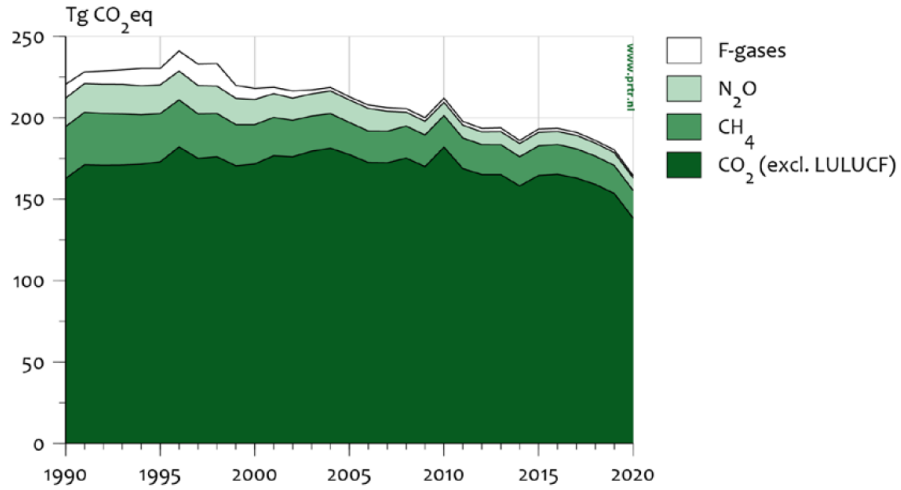


Figure 3.1: Greenhouse gas trends and emission levels, 1990–2020, in Tg CO_2-eq

Emission trends by gas

Carbon dioxide

Figure 3.2 shows the contribution made by the most important sectors to the trend in total national CO_2 emissions (excluding LULUCF). In the 1990-2020 period, national CO_2 emissions decreased by 15.0% (from 162.7 to 138.3 Tg). The energy sector was by far the largest contributor to CO_2 emissions in the Netherlands (96%), with the subcategories 1A1 Energy industries (34%), 1A4 Other sectors (22%), 1A Manufacturing industries and construction (20%) and Transport (19%) being the largest contributors in 2015.

In 2020, total CO_2 emissions decreased by about 9.9% compared to 2019. The main reasons for this were a reduction in coal combustion for electricity production (partly compensated by the use of gas, renewables and waste for electricity production), a reduction in total energy consumption of about 3.2%, and a reduction caused by reduced vehicle use as a result of measures imposed during the COVID-19 pandemic.

Indirect CO_2 emissions (calculated from the oxidation of NMVOC emissions from solvents) are only a minor source of these emissions in the Netherlands (0.4 Tg in 2020).

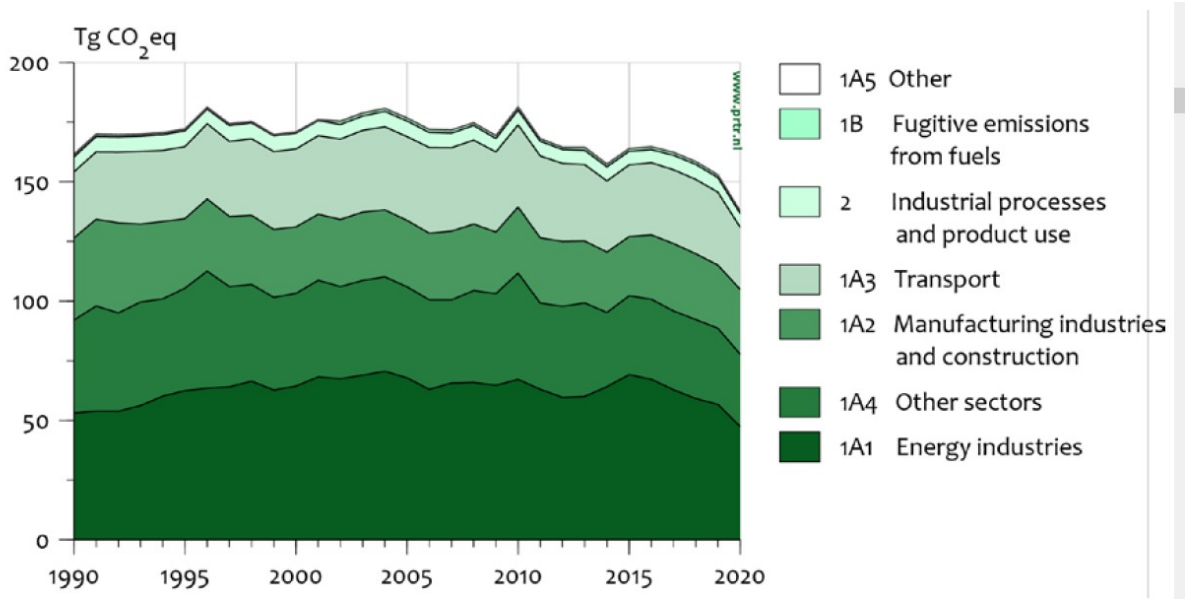


Figure 3.2: CO_2 emission trends and levels by sector (excl. LULUCF), 1990-2020, in Tg CO_2-eq

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 47%, from 31.8 Tg CO_2-eq in 1990 to 17.0 Tg CO_2-eq in 2020. The Agriculture and Waste sectors (70% and 15%, respectively) were the largest contributors in 2020. The waste sector made the biggest contribution to the total decrease, by 80,7%, mainly due to a reduction in CH_4 from landfill.

Compared with 2019, national CH_4 emissions decreased by about 1.5% in 2020 (0.3 Tg CO_2-eq). CH_4 emissions mainly decreased in terms of enteric fermentation in Agriculture and solid waste disposal on land.

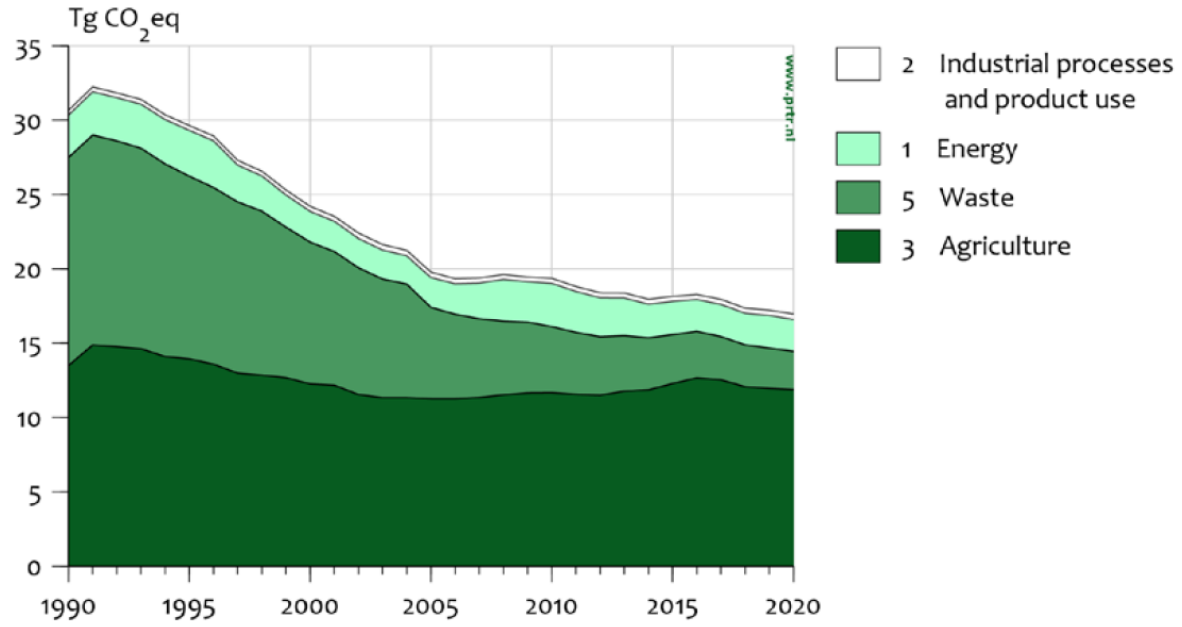


Figure 3.3: CH_4 emission trends and levels by sector, 1990-2020, in Tg CO_2-eq

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 56%, from 17.5 Tg CO_2-eq in 1990 to 7.8 Tg CO_2-eq in 2020. The Industrial processes sector made the biggest contribution to this decrease in N_2O emissions (emissions were 82% lower than in the base year, due to a change in the process of nitric acid production, leading to a substantial emissions reduction in this source category).

Compared with 2019, the total N_2O emissions decreased by 2.1% in 2020, mainly due to a decrease in emissions in the chemical industry.

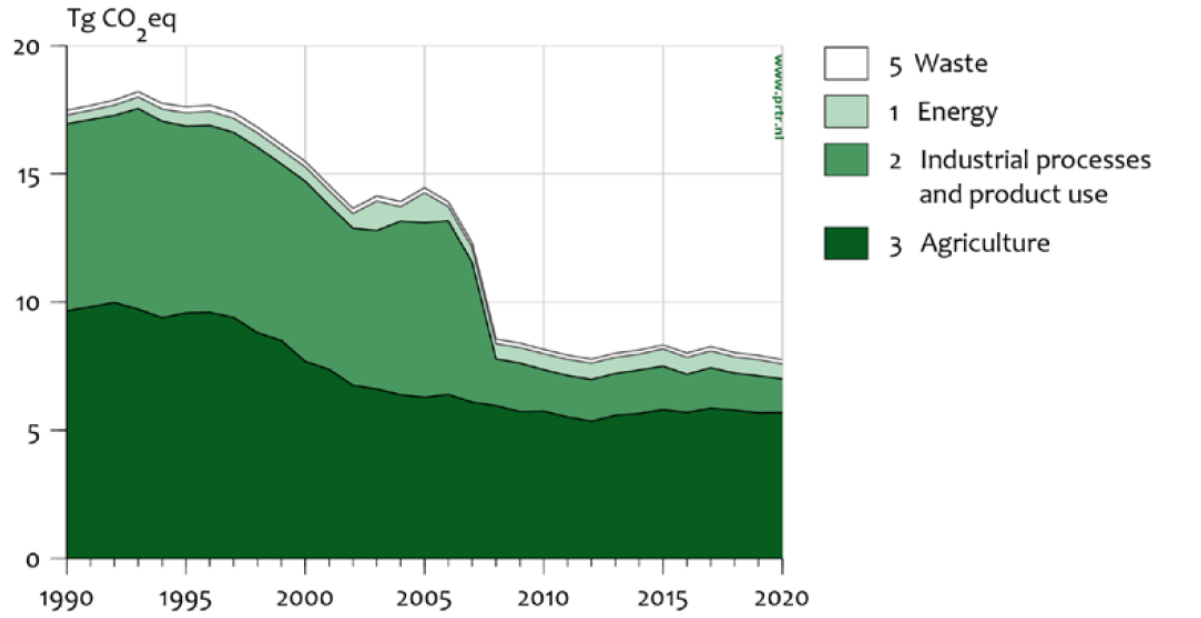


Figure 3.4: N_2O emission trends and levels by sector, 1990-2020 in Tg CO_2-eq

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 84% from 8.5 Tg CO_2-eq in 1990 to 1.3 Tg CO_2-eq in 2020. Emissions of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) decreased by approximately 79.5% and 97.5%, respectively during the same period, while sulphur hexafluoride (SF_6) emissions decreased by 39.7%. It should be noted that due to national circumstances, NF_3 emissions cannot be reported separately and are included in the PFC emissions.

Between 2019 and 2020, emissions of HFCs decreased by 19.7%, emissions of PFCs decreased by 42.9% and SF_6 emissions increased by 6.3%. Overall, the emissions of F-gases decreased by 19.5%.

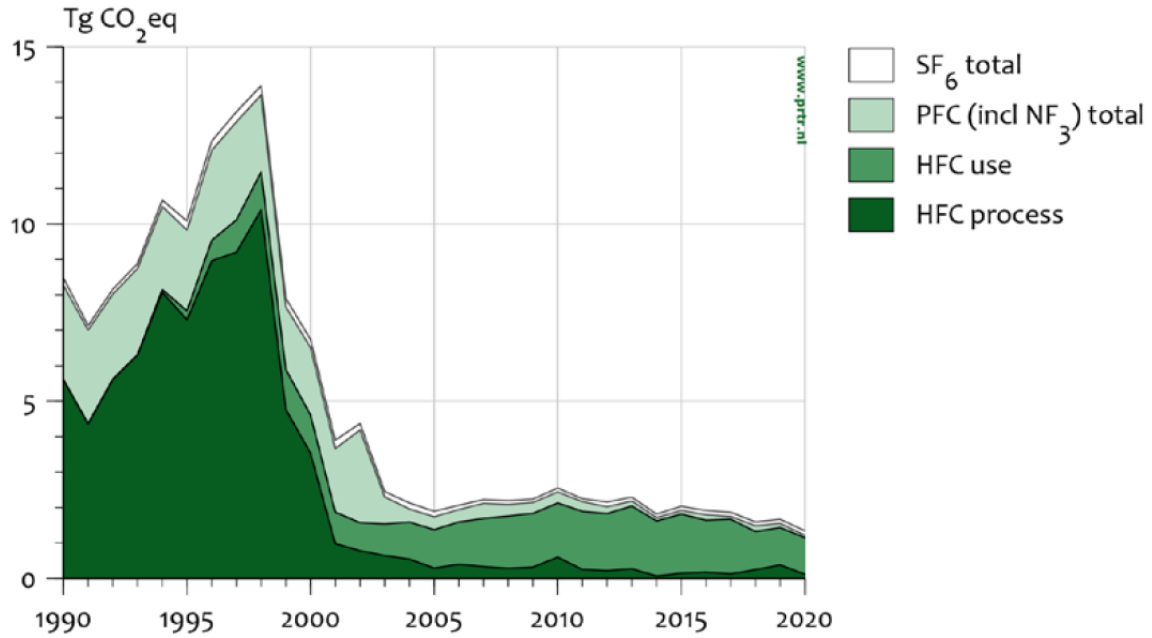


Figure 3.5: Individual fluorinated gases (F-gases) emission trends and levels, 1990-2020, in Tg CO_2-eq

Emission trends specified by source category

Figure 3.6 provides an overview of emission trends for each IPCC sector in Tg CO_2-eq.

The Energy sector is by far the biggest contributor to the total GHG emissions in the national inventory (accounting for 72% in the base year and 82% in 2020). Emission levels in the Energy sector decreased by approximately 15% in the 1990-2020 period. The total GHG emissions from the Waste, Industrial processes and Agriculture sectors in 2020 decreased by 81%, 61% and 28%, respectively compared with the base year. The LULUCF emissions decreased by 39% in the same period.

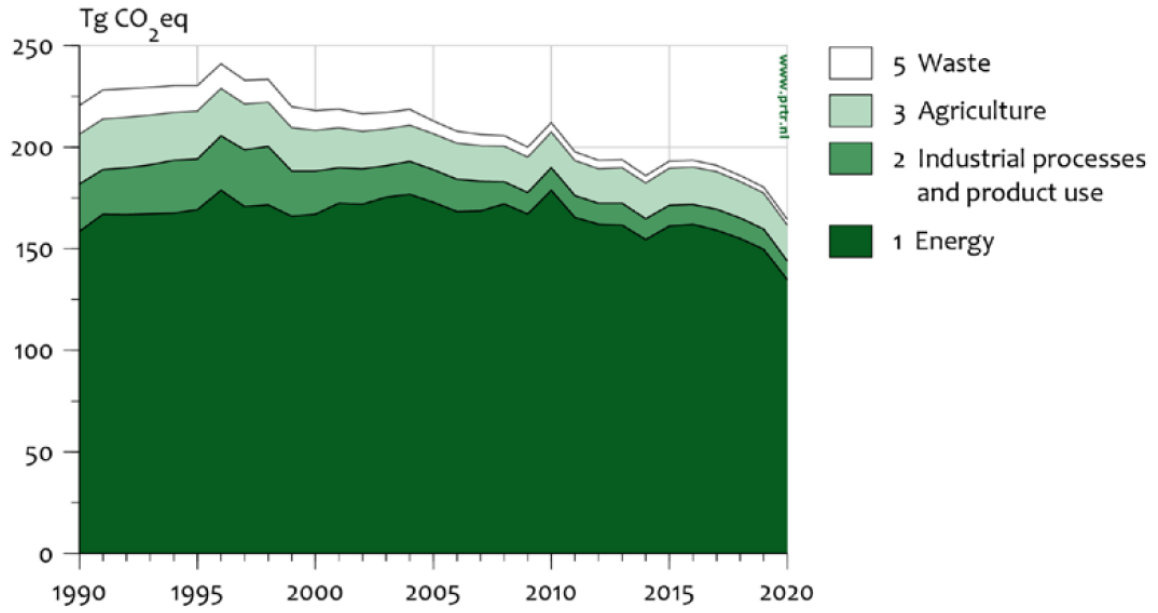


Figure 3.6: Aggregated greenhouse gas emission trends and levels by sector, 1990-2020, in Tg CO_2-eq

Indirect greenhouse gases and SO_2 emission trends

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 2020 had decreased by 60% and 55%, respectively. The reduction in SO_2 was 90% and the NOx emissions were 68% lower in 2020 than in 1990. With the exception of NMVOC, most of the emissions stem from fuel combustion.

Because of problems (incomplete reporting) 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 considered less reliable.

In contrast to direct GHGs, the 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 differs from the IPCC approach.

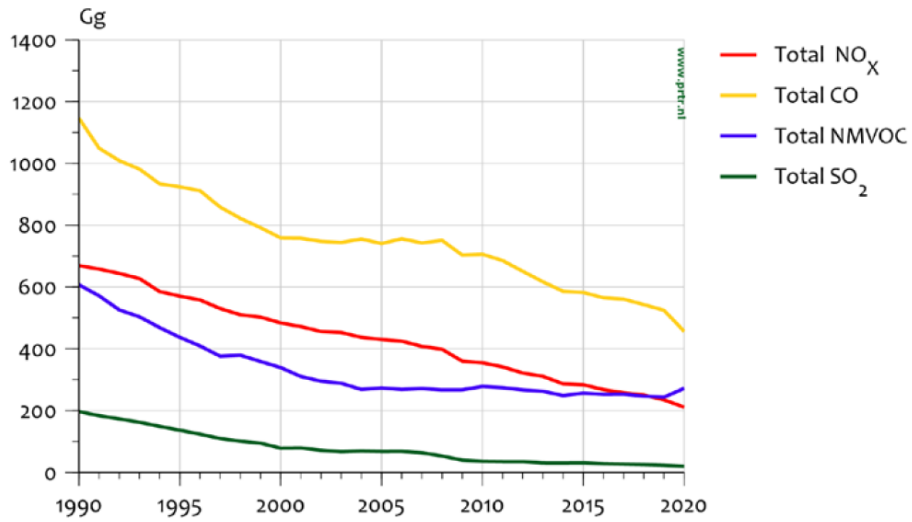


Figure 3.7: NO_x, CO, NMVOC and SO_2 emission trends and levels, 1990-2020, in Gg

Emission trends in relation to capita and GDP

The decrease in greenhouse gas emissions occurred despite a growing population and economy (see Section 2.2 Population profile and Section 2.5 Economic profile). Figure 3.8 and 3.9 show a trend of greenhouse gas emissions per capita, and the greenhouse gas emissions intensity versus GDP, respectively.

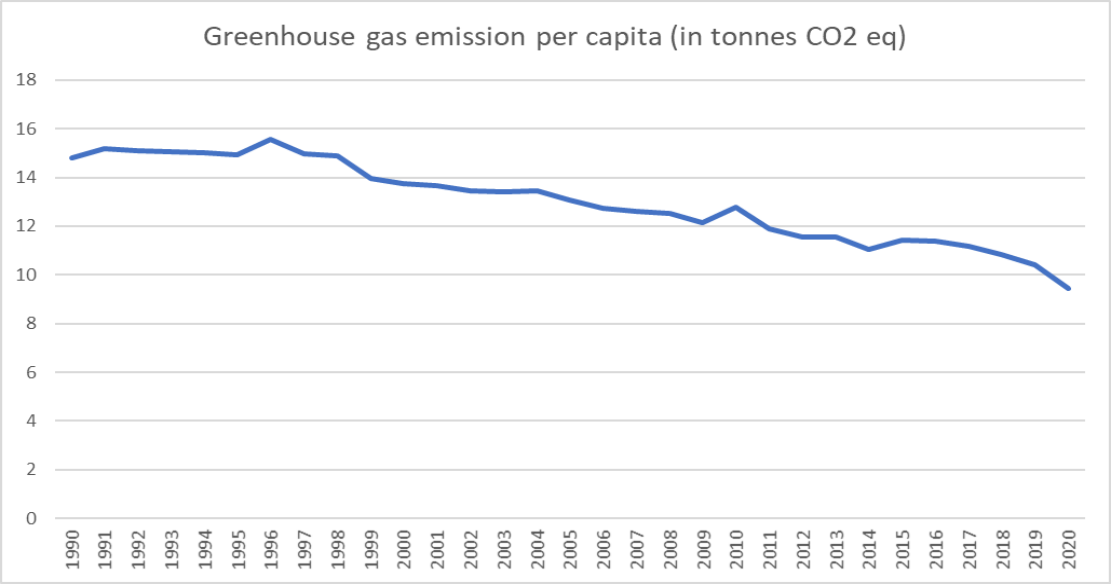


Figure 3.8 Trends of greenhouse gas emissions per capita (tonnes CO_2-eq per capita)

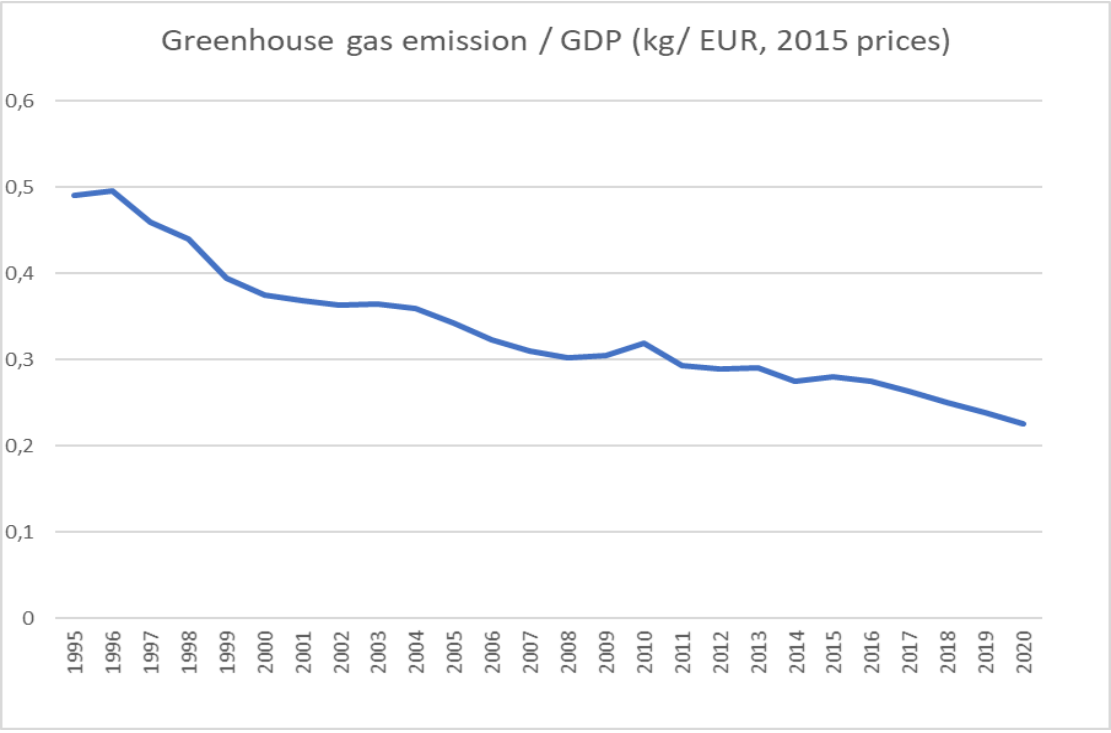


Figure 3.9 Greenhouse gas intensity versus GDP (kg CO_2-eq per euro (2015 prices)

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 a National System in place for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not regulated under 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 has therefore remained unchanged, with the following 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). Since 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 transferred 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. Since 2015, the NIRs have been based on these methodology reports. The main reason for this change is that it is easier to update five methodology reports than 40 protocols. In addition, the administrative procedure has been 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 on the National System website[47].
- 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 have retained their responsibility for integrating environmental policy targets and endorsing the environmental policies within their respective fields (e.g.

47 http://english.rvo.nl/nie

the Ministry of Infrastructure and Water Management is responsible for climate adaptation). In 2017, the ERT recommended providing more information on the methodologies used in the NIR. As a result of this recommendation, the Netherlands has included methodology reports in the annual submission since 2018 as an integral part of the NIR.

- Major decisions on the tasks and priorities of the PRTR are taken by the Steering Committee ER (SCER) by approving the Annual Work Plan. This committee consists of representatives of the commissioning ministries, regional governments, the RIVM, Statistics Netherlands (CBS) and the Netherlands Environmental Assessment Agency (PBL). Since September 2020, the SCER has been split into a Strategic Board consisting of representatives of the commissioning ministries (Ministry of Infrastructure and Water Management, Ministry of Economic Affairs and Climate Policy, Ministry of Agriculture, Nature and Food Security) and a Tactical Board consisting of representatives of the various external agencies and the RIVM (see Figure 3.11). The Strategic Board formally approves the Annual Work Plan. The PRTR project leader at the RIVM acts as Head of the PRTR and is responsible for the PRTR process; the outcomes of that process are the responsibility of the bodies involved. The collaboration of the various bodies is ensured by means of contracts, covenants and other agreements.

This report details the system as it operates on 31 December 2022, describing how the required functions are performed in the Netherlands using the outline from the reporting guidelines (see Box 1).

Objectives of the National System

Under the Kyoto Protocol, a National System[48] 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 regulated 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[49];
- to facilitate compliance with the commitments under Articles 3 and 7;
- to facilitate the review of the information submitted;

48 Definitions used in this report are those used in UNFCCC guidelines.
49 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).

- to ensure and improve the quality of the inventory.

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

Box 1: Reporting guidelines outline

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

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

(b) the roles and responsibilities of the various agencies and entities involved in 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, the 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

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

(a) The name and contact information of 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), PO Box 8242, 3503 RE Utrecht, the Netherlands.
Designated representative with overall responsibility for the inventory:
Jorieke Rienstra, jorieke.rienstra@rvo.nl, telephone: +31(0)6 46181287

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

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 granted authority by law to appoint a single national entity (also known as an NIE). The Minister has appointed RVO as the NIE with overall responsibility for the national inventory. RVO is responsible – among other things – for compiling and issuing 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.

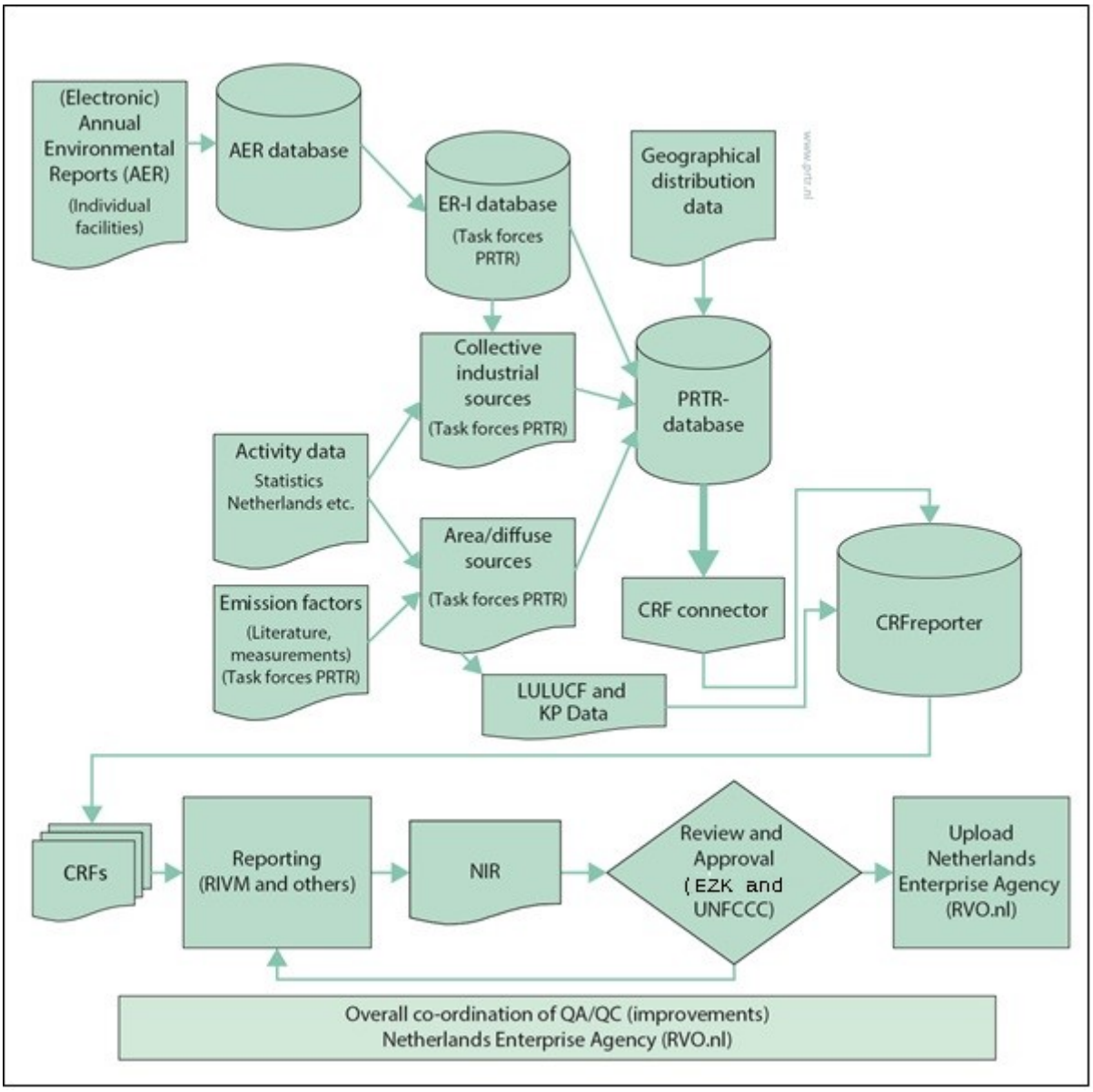


Figure 3.10: Schematic overview of main steps in the primary process; in practice, various feedback loops exist

The inventory and reporting process is illustrated in Figure 3.10 and briefly described below in three parts:

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

Arrangements for data collection

The emissions data are taken from the Pollutant Release and Transfer Register project (PRTR). A series of bodies and ministries in the Netherlands are involved in this collaborative project (which started around 1974). The objective of the project is to agree on one national data set for emissions inventories, covering some 350 pollutants in the air, water and soil. This data set is used for a variety of international and national applications. The RIVM, an agency under the Ministry of Health, Welfare and Sport (Ministry of VWS), is charged with its coordination.

The data sources, methods and processes used for elaborating the greenhouse gas emission estimates are described in the National System documentation, mostly 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 include national statistics from Statistics Netherlands (CBS) and a number of other sources of data on sinks, water and waste. The provision of the 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). With regard to greenhouse gases, the relevant agreements have been reached with Statistics Netherlands and Rijkswaterstaat Environment with respect to waste management. An agreement was established with the Ministry of Agriculture, Nature and Food Quality (LNV) and the related institutions in 2005.

Data from individual companies

Data from individual companies are provided in the form of electronic annual environmental reports (e-AERs). A great many companies have a legal obligation to submit an e-AER which includes, in addition to other environmental information, emissions data that has been 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 EU Emissions Trading System (EU ETS). These companies have to report their CO_2 emissions in specific annual ETS emission reports.

The data contained 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 in addition to 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 CO_2 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 CO_2 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, the RIVM concludes contracts and financial arrangements with various agricultural institutes and the Netherlands Organisation for Applied Scientific Research (TNO). In 2004, the Ministry of Agriculture, Nature and Food Quality (LNV) issued contracts to a number of agricultural institutes; in particular, these contracts related to the development of a monitoring system and provided 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 Task Forces (see Box 2) according to predetermined methods described in the methodology reports.

Arrangements for reporting, QA/QC coordination and review

Data processing and storage are coordinated by the RIVM. These processes mostly involve the elaboration of emissions estimates and data preparation in the PRTR database. The emissions data are stored in a central database thereby efficiently and effectively satisfying national and international criteria for emissions reporting. Using a custom-made program (CRF Connector), all relevant emissions and activity data are

extracted from the PRTR database and included in the CRF Reporter, thus ensuring the highest level of consistency. Data from the CRF Reporter are used in the compilation of the NIR.

The overall annual report for the UNFCCC is drafted under the responsibility of the RIVM and coordinated by RVO/NIE. To ensure the involvement of the relevant experts from the various bodies (CBS, TNO, PBL, RIVM, WUR, and so on) that supply 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. RVO/NIE is closely involved, but the coordination and fine-tuning of the contents of Part 1 of the NIR is delegated to the 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/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 WUR)).

RVO/NIE submits the annual report to the UNFCCC after approval has been obtained from the Ministry of Economic Affairs and Climate Policy (EZK). It is also charged with the 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 with regard to tasks and priorities are taken by the Steering Committee ER (SCER) by approving the Annual Work Plan. This committee consists of representatives of the commissioning ministries, regional governments, the RIVM, Statistics Netherlands (CBS) and the Netherlands Environmental Assessment Agency (PBL).

Since September 2020, the SCER has been split into a Strategic Board consisting of representatives of the commissioning ministries (Ministry of Infrastructure and Water Management, Ministry of Economic Affairs and Climate Policy, Ministry of Agriculture, Nature and Food Security) and a Tactical Board consisting of representatives of the various external agencies and the RIVM (see Figure 3.11). The Strategic Board formally approves the Annual Work Plan.

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

Task Forces

Various emissions 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 being thoroughly checked, the national emissions are accepted by the project leader of the PRTR project and the data set is saved in the Central Database.

The 650 emission sources are divided in a logical manner into 55 work packages. An emissions 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 assigned to the six task forces as described below.

Task Force on Energy, Industry and Waste Management (ENINA):

Charged with calculating the emissions released into the air by the Industry, Energy Production, Refineries and Waste Management sectors. Emissions experts from the RIVM, TNO, Statistics Netherlands (CBS) and Rijkswaterstaat Environment (Waste Management Department) are involved in ENINA.

Task Force on Transportation

Charged with calculating the emissions released into the soil and air by the Transportation sector (aviation, shipping, rail and road transport). The following organisations are represented: the Netherlands Environmental Assessment Agency (PBL), Statistics Netherlands (CBS), the RIVM, Directorate-General for Public Works and Water Management and TNO.

Task Force on Agriculture

Charged with calculating the emissions released into the soil and air from agriculture. Participating organisations include the RIVM, the Netherlands Environmental Assessment Agency (PBL), Wageningen Environmental Research (WenR), Wageningen University Research (WUR) and Statistics Netherlands (CBS).

Task Force on Water - MEWAT

Charged with calculating the emissions released into the water by all sectors. Experts from the Directorate-General for Public Works and Water Management, Deltares, the RIVM, Statistics Netherlands (CBS) and TNO are involved in MEWAT.

Task Force on Consumers and other sources of emissions - WESP

Charged with calculating the emissions produced by consumers, trade and services. The members are emissions experts from the RIVM and TNO.

Task Force on Land Use, Land Use Change and Forestry (LULUCF)

Charged with calculating sources and sinks of CO_2 from land use, land use change and forestry. Emissions experts from Wageningen University Research (WUR), PBL and the RIVM are involved in LULUCF.

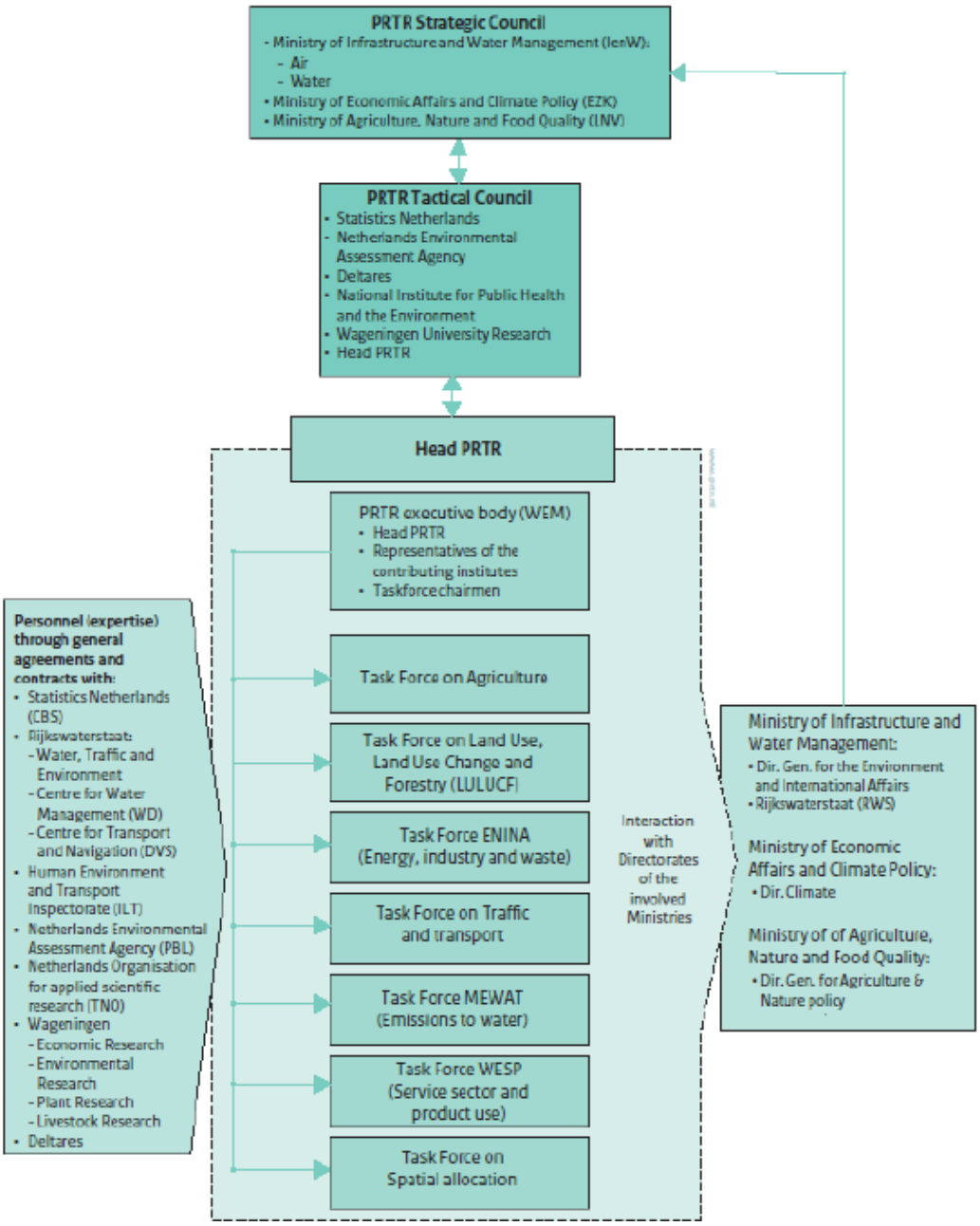


Figure 3.11: Organisational arrangements for the PRTR project

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 to serve 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 specific required functions are performed for each of these steps. Figure 3.12 illustrates the steps and the QA/QC tools used in each step.

(c) A description of the process for collecting activity data and 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 were 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 determine 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, during workshops and through special background studies, among other things.
Choices were made in line with the IPCC and UNFCCC guidelines 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 monitoring protocols (containing the methodological

descriptions as part of the National System) were replaced in the Netherlands 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. The results of internal and external QA/QC and review processes form an important basis for this procedure.

In recent years, the five-year extensive review activities were aimed at the changes to be made in connection with the introduction of the 2006 IPCC Guidelines (IPCC, 2006). For the longer term, RVO will consider how the improvement programme can be continued, albeit with a different scope. RVO is aiming for 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 in the section below in a description of the implementation in the National System of various functions as part of an annual management cycle in the Netherlands.

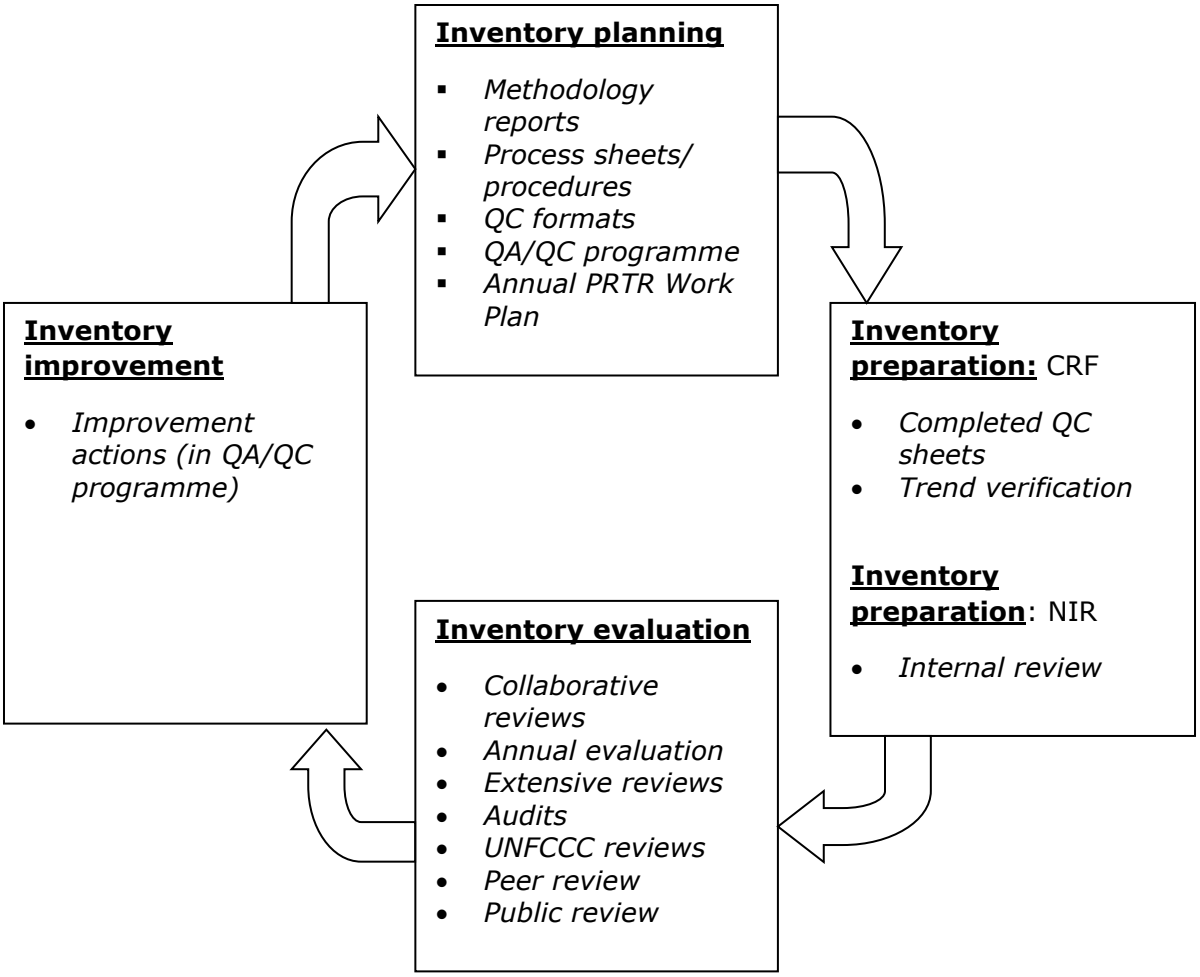


Figure 3.12: Annual cycle

Inventory planning

This step concerns the annual planning. QA/QC tools include the following set of planning documents, which are 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 available on the national system website[50] and listed in the Annual Work Plans (RIVM, 2022);
- *set of procedures,* describing other relevant key processes in the national system, including a list of applicable procedures (SenterNovem, 2005);

50 http://english.rvo.nl/nie

- *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 PRTR (RIVM, 2022), which provide more detail on the 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 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 NIE Advisory Board[51]. For LULUCF issues, the Ministry of Economic Affairs and Climate Policy (EZK) seeks to reach agreement with the Ministry of Agriculture, Nature and Food Quality (LNV).

The annual planning is further detailed in the Annual Work Plans, which provide information about staffing, the amount of time allocated 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[52] after consultation.

Inventory preparation

The inventory preparation includes 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 the 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);

51 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).
52 The Steering Committee ER grants its approval for the PRTR Work Plan.

- elaborating the CRF and NIR in accordance with the related procedures, including the trend verification workshop and internal review.
- annual "internal" review of the draft NIR before submission to the UNFCCC. This review is coordinated by RVO/NIE and involves internal quality checks.

(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 is 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, are taken into account by the RVO/NIE in the improvement actions and planning for the next cycle. The performance of 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. The methods can only be changed after formal approval of the revised methods has been obtained from 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 as to why a change in methods, data or factors is better and/or necessary. Such an assessment also involves considering 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 in addition to new scientific improvements and/or developments in data availability.

Inventory evaluation

The annual inventory evaluation consists of various elements:

- a basic peer review conducted by an external contractor with expertise in a specific sector that focuses only on a specific chapter/part of the NIR.
- a public review in which experts and organisations with a potential interest are invited to participate. From 2022, the public review will focus on a specific subject (e.g. biomass in 2022)

- implementation of an annual internal evaluation and improvement cycle, performed jointly by RVO/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 included. Improvements which influence methods or which may necessitate recalculations require formal approval in accordance with the relevant procedure. Proposals for methodological changes are submitted by the PRTR to RVO/NIE, which adds a recommendation on the proposals and sends them to the NIE Advisory Board for approval (see also the above text under point e). In addition, the QA/QC programme includes the 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 can be accessed centrally by RVO/NIE, with the exception of confidential information. Confidential information is not archived centrally but is available 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 available via 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/NIE.

3.3.4 Quality management aspects

Introduction

The National System itself is a key tool for 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 suggestions for

improvement 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 evaluations 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/NIE is responsible for the coordination and implementation of the programme. It is updated about once a year, as 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 RVO/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/NIE. The main activities include:

- an internal review of CFR/NIR before submission to the UNFCCC
- an annual peer review (conducted by an external party) of CRF/NIR after submission to the UNFCCC
- an annual public review after submission to the UNFCCC
- an extensive review process to coordinate improvements for the process in the longer term (see Section 3.3.3);
- an annual audit focusing on selected part(s) of the National System;
- the archiving of the internal audit reports by external agencies if 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. RVO/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 of 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 assessed in 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 reported that the National System continues to fulfil the requirements without providing any further recommendations;

- a follow-up to the annual recommendations of the UNFCCC reviews. In Annex 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 were implemented or why they were not (no data available, budget constraints, and so on). Of course, Saturday Paper issues were 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 the resubmission of the CRF data in February 2017;
- an annual review by the Technical Expert Review Team (TERT) under the Effort Sharing Decision (ESD) and Effort Sharing Regulation (ESR) 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 subsequent year's submission;
- annual QA activities carried out by RVO/NIE – internal reviews on the entire NIR, audits on part of the NIR and a peer review on part of the NIR, which is outsourced to an external expert. These activities have led to separate recommendations being issued on quality improvements to 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) grants approval for the NIR/CRF to be submitted by RVO/NIE to the UNFCCC after examining the results of the checks carried out by RVO/NIE and, if necessary, 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 might be considered a "regional programme" activity; the experts within the EU regularly convene to discuss experiences with their respective inventories in order to identify and, where relevant, implement actions for improvement. This procedure is achieved through expert workshops, working group meetings and joint EU research programmes.

In recent years, the Netherlands has also participated in special programmes where experiences with inventories were 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 enable Turkey to improve its reporting 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	Maaike Breukels
Address	Koningskade 4 – P.O. Box 91503
City	The Hague
Postcode	2509 EC
Country	The Netherlands
Telephone number	+31 70 456 8050
Fax number	+31 70 456 8247

Email	Maaike.breukels@emissieautoriteit.nl
Website	https://www.emissionsauthority.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[53].

(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)[54]

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),

53 https://unfccc.int/process/the-kyoto-protocol/registry-systems
54 See Decision 24/CP.8.

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 are 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.
When a 24-hour clean-up message is received from the ITL regarding a transaction, the web service rolls 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 EU service desk. Following this procedure, reconciliation will be performed to confirm that the data in the EU Registry and the ITL are aligned with each

other.

(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.

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

The Registry consists of a public area and a restricted area. While anyone can access the public area to find publicly available information as described in 13/CMP.1, Annex II.E, Paragraphs 44–48[55], only authorised users have access to the restricted area[56].

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

The user terms and conditions can also be accessed via the website of the Dutch Emissions Authority[57].

(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.

10 https://ets-registry.webgate.ec.europa.eu/euregistry/NL/public/reports/publicReports.xhtml
56 https://ets-registry.webgate.ec.europa.eu/euregistry/NL/index.xhtml
57 https://www.emissionsauthority.nl/documents/publications/2016/10/26/user-terms-and-conditions-pha-ta-ka

A description of the measures taken to safeguard, maintain and recover data can be found in the readiness documentation.

Physical security
The European Emissions Trading Registry is hosted and facilitated by the European Commission.
A description of the physical security measures can be found in the readiness documentation.

(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 implemented pursuant to the provisions of Decision 19/CP.7 relating to the technical standards for data exchange between Registry systems.

The 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.

Market Mechanisms
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 whereby the money has optimal GHG-reducing effects, and thus minimising the impact on the world economy. The Netherlands has made use of each of the flexible mechanisms. It has also signed MoUs regarding Clean Development Mechanism (CDM) projects with several countries worldwide. The Netherlands supports the World Bank's 'Partnership for Market Readiness' (PMR), which will help countries use the carbon trading system. The PMR will promote new market instruments and adjustments or expansion of the CDM.

To buy carbon credits under the CDM, the Dutch Ministry of Infrastructure spent €151 million between 2005 and 2008, and €132.6 million in the 2009-2012 period. The Ministry of Economic Affairs purchased carbon credits under joint implementation for €53.4 million between 2005 and 2008 and €109.1 million for the 2009-2012 period.
In total, the Netherlands has purchased 33.2 million tonnes of carbon credits from CDM projects, 17.1 million tonnes from JI projects, 3 million tonnes from Latvia (Green Investment Scheme), and 2.2 million tonnes from Participation in Carbon Funds (PCF).

The Dutch Emission Authority (NEa) has not taken any requests for Letters of Approval (LoA) for CDM or JI projects into consideration since 16 June 2020.

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 national, European and international commitments.

Section 4.2 describes the main policies and measures implemented and planned in the Netherlands. Section 4.3 describes the policies and measures that are no longer in place since the previous National Communication. Sections 4.2.15 and 4.2.16 report on other issues required under Art. 7.2 of the Protocol, i.e. 'domestic and regional programmes and/or legislative arrangements, and enforcement and administrative procedures' and 'policies and measures in accordance with Article 2'.

4.2 Policies and measures and their effects

4.2.1 Introduction

This section describes policies and measures currently implemented or planned that have (or are expected to have) a significant impact on GHG emissions in the Netherlands. The focus lies on national and EU policies and measures that contribute to GHG emission reduction targets up to 2030.

In order to ensure a clear link between the policies and measures included in the national GHG emission projections (discussed in Chapter 5), a distinction is made between policies and measures that have been implemented, planned or scheduled. Policies and measures that have been implemented up to May 2022 are included in both the 'with existing measures' (WEM) and 'with additional measures' (WAM) projection scenarios. Policies and measures that have been planned up to May 2022 are included in the WAM projection scenario only. Scheduled policies and measures are a new category in the national projections. These 'scheduled' policies and measures have been officially proposed by the government, but were not concrete enough to be included in the WAM projection scenario. Unless specified otherwise, this section describes the impacts of policies and measures according to the WAM projection scenario.

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 estimated impacts of policies and measures on the reduction of GHG emissions are summarised in Table 4.5. These impacts are derived from the National Climate and Energy Outlook 2022 (PBL, 2022[58]), which is described in more detail in Chapter 5. Not all policies and measures could be included in the 2022 projections, however. For those that were not included in Outlook 2022, this will be mentioned in the relevant descriptions.

The impacts are presented for groups of policies and measures affecting the various sectors rather than for individual policy measures. It is often neither possible nor meaningful to distinguish the impacts of individual instruments and programmes that focus on the same emission source or activity. Instead, the Netherlands applies a 'system approach', in which changes in parts of the energy system (such as heating of dwellings) are analysed. In practice, many changes are the result of multiple policies and measures, rather than of individual policy measures. This approach also considerably reduces double counting of impacts. 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. For a description of the European compliance architecture, including the responsibilities for ETS and non-ETS emissions, we refer to Annex IV, Chapter 3 of the BR5

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

4.2.2 General climate policy framework

To combat climate change, the Dutch government wants to achieve a 55% reduction of the Netherlands' GHG emissions by 2030, compared to 1990 levels, and reach climate neutrality by 2050. The Climate Act (Klimaatwet) adopted on 28 May 2019 calls for a 49% reduction in GHG emissions by 2030 and a 95% reduction by 2050, both compared to 1990 levels. The government is in the process of amending the Climate Act to reflect the government's ambitions and to align with the EU Climate Law[59].

[58] PBL, 2022, Klimaat en Energieverkenning 2022, https://www.pbl.nl/publicaties/klimaat-en-energieverkenning-2022
[59] See for more information on the EU Climate Law: https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_en

In order to achieve the current ambitions, the government published a draft climate policy programme in June 2022, proposing indicative sectoral emission reduction targets (see Table 4.1 below) and policies and measures to meet those targets. After scrutiny and adoption, the final programme should update the policies and measures in the Climate Plan 2021 -2030 (EZK, 2022[60]) and the National Energy and Climate Plan (NECP) (EZK, 2019[61]), both submitted to Parliament in 2019.

	KEV 2021 (Mt CO_2-eq)	**Effect of Climate Agreement (Mt CO_2-eq)**		**Indicative Reduction Climate Plan (Mt CO_2-eq)**		**Indicative residual emissions (Mt CO_2-eq)**	
	Medium	Low	High	Low	High	Low	High
Built environment	18.9	0.5	1.7	7.2	7.2	11.2	10.0
Agriculture	25.6	0.7	0.7	6	6	18.9	18.9
Land Use	3.5	0.8	1.7			2.7	1.8
Mobility	28.7	0.5	1.5	3.3	3.5	24.9	23.7
Industry	40.3	0	0	5	5.9	35.3	34.4
Electricity	21-8.1	0	0	0.5	2	20.5	6.1
Reduction bandwidth relative to 1990 (%)						49%-62%	

Table 4.1 – Indicative sectoral emission reduction targets

The Climate Plan and NECP from 2019 are based on the National Climate Agreement[62], concluded in June 2019. Drafted and signed by the participating sectors, this agreement concerns their actions to help achieve the climate goals. The participating sectors are electricity, industry, built environment, traffic and transport, and agriculture. The National Climate Agreement can be regarded as the successor to the Agreement on Energy for Sustainable Growth ('Energy Agreement'), which served as the general policy framework in the 2013-2020 period, as was described in BR3 and the Seventh National Communication (NC) from the Netherlands.

It must be noted that the national climate policy framework follows the sectoral definitions which differ from the sectoral definition according to the IPCC guidelines. Important differences exists with the (national policy) sectors Electricity and Industry.

[60] Ministry of Economic Affairs and Climate Policy (EZK), 2022, Klimaatplan 2021-2030, https://www.rijksoverheid.nl/documenten/beleidsnotas/2020/04/24/klimaatplan-2021-2030
[61] Ministry of Economic Affairs and Climate Policy (EZK), 2019, Integraal Nationaal Energie- en Klimaatplan 2021-2030, https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en
[62] https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands

Within the sector Electricity, emissions from energy companies producing electricity and/or heat are included. Emissions from heat and electricity produced by CHP installations owned by industrial (and horticultural) companies are allocated to the respective (end-use) sectors. Emissions from energy industries, such as from exploration and refinement, are allocated to the sector Industry. Other difference is the inclusion of emissions from mobile machinery in the sector Mobility. The projections reported in CTF tables accompanying this report however, follow the sectoral definitions IPCC guidelines.

4.2.3 Cross-sectoral policies

This section and the next describes the most relevant cross-cutting policies and measures, and sectoral policies and measures.

EU Emissions Trading System

As prescribed by Directive 2003/87/EC, the European Trading System for GHG 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. Installations can trade emission allowances with one another, which ensures that emission reductions take place where they are the least expensive. The EU ETS covers most manufacturing industries, as well as the power sector and intra-EU aviation (departing and landing within participating countries). Its geographical scope extends across the 27 Member States of the EU (EU-27) plus Norway, Iceland, Liechtenstein and the power sector in Northern Ireland. It covers around 39% of the EU's GHG emissions. In the Netherlands, around 343 companies are included in the ETS, which are responsible for around 43% of total GHG emissions in the country (NEA, 2022a[63]).

In 2021, the EU ETS entered its fourth phase, which runs until 2030. The legislative framework of the EU ETS for phase 4 was revised in 2018 to ensure emission reductions in support of the EU's 2030 emission reduction goal (40% relative to 1990 levels) and as part of the EU's contribution to the Paris Agreement. Key improvements were the increased annual cap reduction factor of 2.2% as of 2021 and the reinforced Market Stability Reserve (the mechanism established by the EU to reduce the surplus of emission allowances in the carbon market and to improve the EU ETS's resilience to future shocks). In addition, dedicated funding mechanisms (the Innovation Fund and

[63] NEA, 2022a, Factsheet ETS-uitstoot 2021, https://www.emissieautoriteit.nl/onderwerpen/rapportages-en-cijfers-eu-ets/documenten/publicatie/2022/04/14/factsheet-ets-uitstoot-2021

Modernisation Fund) were established in the industry and the power sector to meet the innovation and investment challenges of the low-carbon transition. The 2018 revision built on the reform of the ETS framework for phase 3 (2013 - 2020), which had changed the system considerably compared to the previous phases (2005 - 2007 and 2008 - 2012).

On 14 July 2021, the European Commission adopted a series of legislative proposals setting out how it intends to achieve climate neutrality in the EU by 2050, including the intermediate target of an at least 55% net reduction in GHG emissions by 2030. This included a proposal on the revision of phase 4 of the EU ETS. Key elements of this proposal are a more competitive rate for the reduction of allowances in the period after 2021, reinforcement of the Market Stability Reserve, full auctioning of allowances for aviation and adjusted rules on carbon leakage (in conjunction with the proposal on the Carbon Border Adjustment Mechanism)[64]. 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. With some exceptions[65], the Fit-for-55 proposals are not included in the WEM and WAM-variants of the projections. However, the assumed prices for EU ETS allowances in the projections do anticipate implicitly on the (partial) implementation of the Fit-for-55 package.

SDE++: Stimulation of Sustainable Energy Production and Climate Transition
The government has encouraged the production of renewable energy for many years, mostly using feed-in premium schemes which have evolved over time. The current scheme is the so-called SDE++ (Stimulation of Sustainable Energy Production and Climate Transition) incentive scheme. As of 2020, the SDE++ grant scheme was expanded to also stimulate other techniques that reduce GHG emissions. Its focus has shifted towards GHG reduction in general, instead of renewable energy only. Low-carbon heat (such as electric boilers and heat pumps) and low-carbon production technologies (such as CCS and hydrogen) have been added as eligible categories in the SDE++. In 2021, Carbon Capture and Utilization (CCU) and renewable transport fuels were added. Improvements are made on a yearly basis.

The SDE++ scheme is a floating feed-in premium system, (partly) financed by the Sustainable Energy Surcharge (ODE) on the energy tax paid by the end consumers of natural gas and electricity and the government budget. SDE++ takes an innovative

[64] See for more information: https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/revision-phase-4-2021-2030_en
[65] The proposal for new CO_2-performance standards for vehicles and vans have been included in the WAM-variant

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. The allocated budget for 2022 amounted €13 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. The ODE-tariffs and SDE++ budget will be decoupled in 2023.

The SDE++ scheme works as an operating grant. Producers receive financial compensation for the unprofitable component of the cost of the renewable energy produced or CO2-emissions mitigated. The production of renewable energy or CO_2-emission reductions are not always profitable because the costs 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). Since 2020, categories have been added which result in low-carbon heat production and low-carbon production processes that reduce CO_2-emissions. From 2023 onwards, a flexible reservation will be made for certain energy domains with a higher subsidy intensity ('fences'). In the 2022 round there is a cap of 33.5 TWh (production in 2030) for onshore renewable energy and a cap of 7.8 Mt (total CO_2-reduction in 2030) for CCS projects.

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. Under this method, the level of the SDE++ contribution is 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.

The impending decrease in combined heat and power (CHP) will not help energy efficiency. However, except for 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.

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 the Netherlands Enterprise Agency (RVO.nl).

Investment Subsidy Renewable Energy (ISDE)
While SDE++ focuses on supporting large-scale projects in renewable energy and CO_2-emission reductions, in 2016 the government also introduced a subsidy for small-scale investments. Under this scheme, consumers can apply for an investment subsidy to finance heat pumps, solar collectors, connection to heat grid and insulation measures. Businesses can apply for a one-time investment subsidy in heat pumps and solar collectors. In 2022, the available budget amounted to €228 million. A separate budget (€30 million in 2022) was available for small wind turbines and solar panels. Subsidy budgets are set annually by the government. In 2021, more than 43,000 applications received a subsidy for more than 94,000 eligible installations and/or measures. The claimed subsidies in 2021 amounted nearly €97 million.

Energy tax and sustainable energy-surcharge
The Regulatory Energy Tax (REB) was introduced in 1996, changing its name to Energy Tax in 2004. Taxing energy consumption makes energy saving more attractive (by changing behaviour or investing in energy-saving measures). The Energy Tax is levied on electricity and natural gas, and it's level 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 the various sectors and the government. Tariffs which are updated annually[66].

[66] See for the tariffs: https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/zakelijk/overige_belastingen/belastingen_op_milieugrondslag/tarieven_milieubelastingen/tabellen_tarieven_milieubelastingen?projectid=6750bae7%2D383b%2D4c97%2Dbc7a%2D802790bd1110

Industrial consumers pay much lower tariffs in order to secure a level playing field for these exposed companies. Various exemptions and lower tariffs apply, depending on the activities concerned. No energy tax is levied on fuels used for electricity production. Metallurgical and mineralogical activities are exempted. A lower gas tariff for the horticulture sector applies, which is linked to the specific sectoral emission system in that sector.

Several changes have been made to promote the production of renewable energy for private homeowners' cooperatives or associations. Since 2004, private homeowners have been allowed to settle the amount of electricity returned to the grid with their electricity consumption (since 2012 up to their annual consumption taken from the grid). Referred to as net metering, this stimulates the installation of PV-panels on homeowners' roofs. This scheme is intended to run until the end of 2024, then to be gradually phased out and terminated as of 2031. In 2014, a lower tariff was introduced for private homeowners' cooperatives and associations that produce their own renewable energy. With effect from 2015, the electricity produced by landlords and tenants using solar panels was exempted from energy taxation. In 2021, this exemption ended and was replaced with a new subsidy scheme: the Cooperative Energy Production Subsidy Scheme (SCE).

For small, residential consumers, the Energy Tax and sustainable energy surcharge combined accounted in 2022 on average around 43% of the market price of natural gas and 33% of the market price of electricity. In order to support renewable heat options such as heat pumps and waste heat utilisation, since 2016 the tariff for natural gas (up to a consumption volume of 170,000 cubic metres) has increased by 53%, while the tariff for electricity (up to a consumption value of 10,000 kWh) has increased by 10%.

In addition to the energy tax, a sustainable energy surcharge (ODE) is levied on electricity and natural gas consumed from the grid. The ODE was introduced in 2013 to cover subsidies granted to produce renewable energy and/or to reduce CO_2-emissions (the SDE++ subsidy instrument). The ODE tariffs differentiate between levels of energy consumption and between types of users (e.g. companies or residents). In 2020, the relative contribution to the ODE from residents was limited while the relative contribution from many companies increased.

The energy tax and ODE surcharge are also subject to Value added taxation (VAT) of 21%. Under certain conditions, solar panel owners can reclaim VAT on the investment in

solar panels and their installation. The government plans to introduce a zero VAT rate for the supply and installation of solar panels from 2023 onwards.

Excise duty is another form of (energy) taxation, which is levied on (amongst others) petrol, diesel and LPG[67].

Finally, 2021 saw the introduction of a taxation for out-going passengers from airports in the Netherlands. This air passenger tax was €7,947 per passenger per flight in 2022.

Energy Investment Tax Allowance

The Energy Investment Tax Allowance (EIA) is a tax relief programme that offers a direct financial advantage to companies in the Netherlands that invest in energy-saving equipment and sustainable energy. Entrepreneurs may deduct 45% of the investment costs for such equipment from their company's taxable profits over the calendar year in which the equipment was purchased. The list of eligible technologies is updated and published annually. Since 2013, the main focus of the EIA has been on energy-saving technologies instead of renewable energy options; for the latter, companies are referred to other schemes and measures (such as SDE++). The EIA budget in 2022 was €149 million. A similar programme (MIA Vamil) exists for other environmental measures.

Hydrogen

The government foresees a key role for hydrogen in replacing natural gas and as a way to 'store' surplus renewable electricity production. The ambition for 2025 is to have a capacity of 500 MW of electrolysers, which should increase to 4 GW by 2030. The government has launched a National Hydrogen Programme to facilitate this development[68]. A roadmap is foreseen in 2022. Various subsidy schemes support the production and/or application of hydrogen, including the SDE++ and a subsidy for hydrogen projects and several energy-innovation schemes. In addition, future projects may qualify for grants from the National Growth Fund (see above) and EU funds.

Regional Energy Strategies

The government has defined 30 'energy regions' in order to facilitate and integrate the increasing production of renewable energy on the local and regional level. All provinces, water boards and municipalities participate, together with regional stakeholders. Together, they identify locations for renewable electricity production using onshore wind and solar, amounting to a production of up to 35 TWh on land by 2030, of which 50% is

[67] See for more details: https://www.rijksoverheid.nl/onderwerpen/belasting-betalen/vraag-en-antwoord/accijns-betalen
[68] See for more information: https://nationaalwaterstofprogramma.nl/default.aspx

owned by local households and businesses. This replaces the previous Energy Agreement (2013) which provided for an onshore wind capacity of 6 GW by 2020. The inter-administrative programme NP RES (the National RES Programme) assists the 30 energy regions in drafting and implementing their strategies and coordinating with national policies.

The Regional Energy Strategies (RES) also include plans to use alternatives for natural gas used for heating buildings. Each region defines its own RES for the period up to 2030. Regions submitted their strategies by July 2021 and renew these every two years. The PBL analysed the strategies submitted in 2021, indicating that the plans add up to meet the renewable electricity production requirement, depending on timely capacity improvements of the power grid (PBL, 2021a[69]). The first progress report is expected in July 2023.

Infrastructure & energy system

Grid operators have stepped up their investments in increasing net capacity in order to overcome limitations in the national and regional electricity infrastructure. In the longer term, spatial planning and permit procedures for new and existing infrastructure (including the production installations themselves) are of key importance. This is being worked out in a national programme on the main energy infrastructure[70]. The draft version of this programme is expected to be published in 2023. The national Energy System programme, a vision on the energy system by 2050 is being developed, which is also expected in 2023[71].

Green Deals

The Dutch government set up the Green Deal programme in 2011 in order to stimulate sustainable economic growth. More than 300 Green Deals have since been signed, many in the areas of energy and climate[72.] This instrument supports civil society parties, companies and local authorities which embark on initiatives related to sustainable economic growth, but face obstacles for which they may require assistance from the national government. Exploiting opportunities for saving energy and generating local sustainable energy is not only a matter of access to finance. In practice, there are many other potential obstacles and difficulties to finding innovative solutions in society for scaling up green growth options; e.g. difficulties regarding regulations or permits,

[69] PBL, 2021a, Monitor RES 1.0, https://www.pbl.nl/publicaties/monitor-res-1.0
[70] See for more information: https://www.rvo.nl/onderwerpen/bureau-energieprojecten/lopende-projecten/peh
[71] See for more information: https://www.rvo.nl/onderwerpen/energiesysteem
[72] See for an overview of Green Deals: https://www.greendeals.nl/english

appropriate forms, cooperation networks, and so on. The government helps to solve such issues.

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 explains why no figures on CO_2 reduction are reported. In addition, this approach avoids double counting of CO_2 reductions achieved through other measures (such as energy taxes and feed-in premiums for renewable energy).

Climate and energy innovation policy

The government stimulates innovations in energy technologies, products and services through various policy instruments, both generic and energy-specific. The main generic innovation instrument is the Research and Development (Promotion) Act (WBSO, with a budget in 2022 of €1.3 billion), which provides fiscal benefits for research and development activities by companies. In addition, public or semi-public knowledge institutions (such as universities) have their research programmes financed by the government through the Dutch Research Council (NWO).

With regard to specific policy instruments related to climate and energy, the Integrated Knowledge & Innovation Agenda (IKIA) was developed in 2019 to support innovation approaches. With five projected yearly updates, the IKIA formulates five missions that contribute to substantial GH emission reductions by 2050, aimed at zero CO2 electricity generation, buildings and transport, climate neutral industry and agriculture/nature. For 2030, intermediate targets have been formulated for each mission. The innovation needs required to attain these targets have subsequently been formulated in 15 innovation programmes (MMIPs). These will serve as the basis for supporting subsidy instruments such as MOOI, TSE, DEI and HER+. Public spending on energy innovations is monitored by RVO[73].

Up until 2019, the Top Sector Energy (TSE)[74] was the main framework where governments, knowledge institutions and companies from all sectors cooperate. TSE has its own subsidy scheme, which is still in place.

[73] See for more information: https://www.rvo.nl/monitor-publiek-gefinancierd-energieonderzoek
[74] See for more information: https://topsectorenergie.nl/

The impact of energy innovation policy on CO_2 reduction is not calculated, as it is difficult to determine. Innovation subsidies support innovation projects that are still in development and 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.

Invest-NL

Invest-NL, an investment fund, provides attractive loans to other banks that finance innovative projects contributing to key societal transitions, such as a carbon neutral economy, which typically come with higher financial risks. Among other things, the fund invests in, energy projects, such as geothermal, energy storage and biomass projects. Invest-NL is operated by the Netherlands Investment Agency (NIA). Prior to 2019, the fund was known as the Energy Transition Financing Facility (ETFF) which was launched in 2017.

The National Growth Fund

Through the National Growth Fund, the Dutch government will earmark €20 billion over the 2021-2025 period for project investments in two fields with the highest potential for structural and durable economic growth. One of the themes is Energy and Sustainable Development. Funds have been earmarked for, amongst others, new nuclear power plants and hydrogen production.

Environmental Management Act: energy savings obligation

The Environmental Management Act covers all relevant environmental aspects, with specific provisions that stimulate energy savings by companies in all end-use sectors. The main requirement is for companies (and other organisations that fall within the legal scope of the Act) which consume more than 50,000 kWh of electricity or 25,000 m3 of gas on an annual basis to adopt energy savings measures with a payback time of five years or less. The competent authority – mostly the local municipality – can enforce compliance. In 2015 a set of Recognised Lists of Measures (EML: Erkende Maatregelenlijst) was added to help facilitate companies and local authorities implement this obligation. In 2019 a harmonised method was incorporated to determine the payback time of energy efficiency measures. To further support enforcement of energy-saving measures under the Environmental Protection Act, a mandatory notification system on implemented measures was introduced (Informatieplicht). Companies were obliged to announce their energy-saving measures via an RVO website application before 1 July 2019 and subsequently update their notifications every four years. The next round

for notifications closes December 2023. The energy savings obligation will be incorporated in the Environment and Planning Act in 2023.

The government decided to enhance the energy efficiency obligation and extend the 5 year payback obligation to renewable energy measures and an obligation to switch energy carrier. Companies with a large energy use, EU ETS installations and greenhouses partaking in the CO_2 sector system, will be included in this enhanced obligation from 2023 onwards. Large energy users cannot comply with a simple list of recognized measures, but are required to execute a thorough analyses of their efficiency possibilities. The national efficiency audit entails amongst others an insulation scan and an implementation plan. The government aims to merge the national audit as much as possible with the EU audit requirement that partially covers the same companies. Local authorities receive additional funds to enhance enforcement of the obligations.

National policy programme on the Circular Economy

Together with the business community, civil-society organisations, knowledge institutions and other public authorities, the national government is working on a sustainable, circular economy for the future. In this circular economy there is no waste and raw materials are reused over and over again. This will also contribute to lower CO_2-emissions as well as enhancing biodiversity, a cleaner environment and improving the security of supply of materials. Adopted in 2016, the government-wide Circular Economy programme sets out what is needed for a circular economy in the Netherlands by 2050 (I&W, 2016[75]). In 2019, transition agendas were formulated for five economic sectors: plastics, consumer goods, manufacturing industry, construction and biomass and food. The transition agendas set out how each sector can become circular by 2050 and what actions are needed for this. Actions identified were incorporated into the Implementation Plan Circular Economy 2019 – 2023 (I&W, 2019[76]). The Netherlands Environmental Assessment Agency (PBL) conducted a progress review in 2021 (PBL, 2021b[77]). In 2021, the government adopted the target to halve the consumption of primary raw materials (minerals, metals and fossil fuels) by 2030. The Implementation Plan was revised in 2021 (I&W, 2021a[78]). By the end of 2022, the Cabinet will present a new National

[75] Ministry of Infrastructure & Water Management (I&W), 2016, Rijksbreed programma Circulaire Economie, https://www.rijksoverheid.nl/onderwerpen/circulaire-economie/documenten/rapporten/2016/09/14/bijlage-1-nederland-circulair-in-2050

[76] I&W, 2019, Uitvoeringsprogramma Circulaire Economie 2019 – 2023, https://www.rijksoverheid.nl/onderwerpen/circulaire-economie/documenten/rapporten/2019/02/08/uitvoeringsprogramma-2019-2023

[77] PBL, 2021b, Netherlands Integral Circular Economy Report 2021, https://www.pbl.nl/sites/default/files/downloads/2021-pbl-icer2021_english_summary-4228_0.pdf

[78] I&W, 2021a, Uitvoeringsprogramma Circulaire Economie 2021-2023, https://open.overheid.nl/repository/ronl-669a180a-7f09-4336-890c-633cf2c3b852/1/pdf/uitvoeringsprogramma-circulaire-economie.pdf

Program for the Circular Economy (NPCE) which will integrate the current policies as described above with more concrete goals and measures for the period up to 2030. Part of this NPCE will be the adoption of an 'ambitious target for the circular economy', which will set out in more detail what contribution from the circular transition may be expected for both the national climate goal as well as in terms of chain emission reductions.

The Netherlands is a member of the Platform for Accelerating the Circular Economy (PACE)[79]. Including more than 40 countries, companies and international organizations, PACE is working to accelerate the circular economy.

4.2.4 Electricity

The indicative emission limit for the electricity sector amounts to 6.1-20.5 Mt CO_2-eq by 2030. There are several national policies and instruments important for the energy sector, such as regulations on coal fired power plants, regional energy strategies and SDE++ subsidies. Key European instruments are the EU ETS, the Renewable Energy Directive and the Energy Efficiency Directive (which includes smart metering). The key sectoral policy instruments currently in effect that have a major impact on the electricity sector are described below.

Closing down coal fired power plants

The previous government decided to phase out the use of coal for electricity production by 2030. Of the five existing plants in the Netherlands, one older plants have already closed down in order to reduce CO_2-emissions. A tender to close down a second, more modern powerplant was in a very advanced stage of completion, but at the end the powerplant involved decided it would not continue with the subsidy. Finally, in 2021 it was decided to limit the emissions of coal plants to 35% of their maximum capacity, for the period 2022-2024. However, this measure was abolished in June 2022 in order to allow for as much gas-to-coal switching as possible in order to reduce natural gas consumption by power plants. This was done in order to ensure sufficient natural gas supplies for the winter as natural gas deliveries had been disrupted by Russia.

Minimum CO_2 price electricity production

The 2019 Climate Agreement provides for the introduction of a gradually increasing minimum national CO_2 price for CO_2 emissions from electricity production, in support of the EU-ETS. This should contribute to investments that are less harmful to the

[79] See for more information: https://www.weforum.org/topics/circular-economy

environment. The legislation entered into force on 5 April 2022. At the request of the Senate, an evaluation of the price path, as defined in the legislation, will commence at the end of 2022.

Offshore Wind Energy

Increasing the production of offshore wind energy is pivotal in the transition to a climate-neutral energy system. More offshore wind capacity is needed to achieve the increased climate target of a 55% reduction in CO_2 emissions by 2030, compared to 1990 levels. On 11 February 2022, the Dutch Government raised the offshore wind energy target from 11.5 to approximately 21 GW around 2030. In September 2022, a 2030 – 2050 vision for offshore wind was published, outlining that the Government shall make preparations for the top of the bandwidth of the energy-scenario's. The Government is exploring ambitions of ca. 50 GW and ca. 70 GW in 2050, albeit there is uncertainty on how much offshore wind energy will be deemed necessary in the future (EZK, 2022a[80]).

The Regulation on Offshore Wind Energy 2015 and the Implementation Regulation on the Offshore Wind Energy Act, published on 3 July 2015, are meant to encourage the production of offshore wind energy. This legislative framework establishes statutory provisions for the allocation of suitable sites for offshore wind farms and the process of issuing permits and awarding subsidies for their construction and operation. In 2020, the amended Act was adopted to improve the procedures for subsidy free allocation of offshore wind sites, which include modalities with regard to biodiversity and natural habitat preservation.

A North Sea Programme 2022 - 2027 was adopted in 2022 (as part of the National Water Program 2022 - 2027), determining the space for additional offshore wind capacity, together with other (spatial) uses of the North Sea. Three new Offshore Wind Farm Zones were designated: Nederwiek, Lagelander and Doordewind. At the same time, the government removed the previously designated Hollandse Kust (southwest) and Hollandse Kust (northwest) zones. These two zones turned out to be less desirable with a view to ecology, shipping and fishing.

The 'Offshore Wind Energy Roadmap 2030', which is the basis for (decisions on) tendering processes for new off shore windfarms, has been updated to reflect the three new and the two expired wind energy areas. In June 2022, the Ministry of Economic Affairs and Climate Policy (EZK) published the new Offshore Wind Energy Roadmap 2030

[80] EZK, 2022a, Nieuwsbericht Nederland maakt ambitie wind op zee bekend: 70 gigawatt in 2050, https://www.rijksoverheid.nl/actueel/nieuws/2022/09/16/nederland-maakt-ambitie-wind-op-zee-bekend-70-gigawatt-in-2050

(EZK, 2022b[81]). The Netherlands Enterprise Agency organises tenders for the construction of wind farms. Bidders in these tenders can submit applications for a permit to build and exploit an offshore windfarm. Tenders have been organised since 2015.

Subsidy scheme (local) Cooperative Energy production

Introduced in 2021, the Subsidy scheme Cooperative Energy production (SCE) aims to stimulate projects of smaller-size (local) energy cooperatives for the local production of renewable electricity through wind, solar or water power. Installations and participants should be located in the same or adjacent postal code areas. Renewable electricity production is subsidized using a similar approach as the SDE++. The total available budget amounts to €150 million in 2022.

Smart metering (dissemination of smart meters)

In order to improve the possibilities for consumers to manage their energy consumption, most households in the Netherlands have been fitted with a smart meter. The aim was to have smart meters installed in at least 80% of households and small businesses by 2020, as mandated by the EU's Third Energy Package. By the end of 2020, 7.1 million smart meter had been installed, representing 84% of all small-scale connections to the grid (Netbeheer Nederland, 2021[82]).

4.2.5 Industry

The indicative emission limit for industry amounts to 34.4 Mt CO_2-eq by 2030. Both European and national policies are relevant. The EU ETS is the key European policy instrument which regulates CO_2 emissions (see section 4.3 Cross-sectoral policies). The EU ETS is complemented by a national CO_2-surchage. Other national policies aim to improve industrial energy efficiency and subsidise investments in CO_2-emission reductions. In addition, programmes are in place for regional clusters of industry and infrastructure. The Long-Term Agreements on energy-efficiency ended after 2020.

National CO_2-pricing system for industry

Since 2021, a CO_2-emission tax has been levied on industrial installations included in the EU ETS, and on waste incinerators and facilities emitting large amounts of nitrous oxide (N_2O) that are not covered under the EU ETS. Industrial installations incur a carbon tax, if their emissions exceed their baseline based on EU ETS benchmarks and a national reduction factor needed to reach the emission reduction target of 14.3 Mt CO_2-eq by

[81] EZK, 2022b, Offshore Wind Energy Roadmap, https://english.rvo.nl/sites/default/files/2022/06/WOZ-Routekaart-June-2022.pdf

[82] Netbeheer Nederland, 2021, Special Net.nl over afronden project slimme meter, https://www.netbeheernederland.nl/nieuws/special-net-nl-over-afronden-project-slimme-meter--1477

2030. Emissions below the EU ETS benchmark are exempted; for these emissions, dispensation rights are issued.

The tax started at €30,48/tCO_2-eq in 2021 and increases by €10,87/tCO_2-eq annually, for each year between 2021 – 2030, up to €128,71/tCO_2-eq in 2030. The national surcharge is complementary to the CO_2 -price in the EU ETS as the CO_2-price is deducted from the surcharge. The system is implemented and monitored by the Netherlands Emissions Authority (NEa).

In order to meet the more ambitious national climate target by 2030, the government has proposed to increase the reduction factor so as to achieve that by 2030 an additional 4 Mt CO_2 -eq emissions is reduced (NEA, 2022b[83]). This proposal is included in the projections (WAM-variant) (WAM).

Accelerated Climate-related Investments in Industry (VEKI)
The VEKI subsidy scheme offers subsidy possibilities for investment projects in emission reduction technologies in industry that have passed development and demonstration stages, but still have pay-back times in excess of five years. Eligible projects include investments related to energy efficiency, waste recycling, local infrastructure and other CO_2 -reduction technologies. The budget for 2022 was €47.5 million. The VEKI scheme is implemented by the Netherlands Enterprise Agency (RVO).

Sustainable Industry Infrastructure Programme (PIDI)
The PIDI programme focuses on accelerating decision-making on the energy infrastructure that is of national importance to ensure the timely sustainability of basic industry in the Netherlands (key focus on 2030, long-term outlook until 2050). The PIDI allows all relevant stakeholders to participate: ministries, basic industry, energy producers, local authorities and infrastructure companies. It includes a Multi-Year Energy and Climate Infrastructure Programme (MIEK), in which stakeholders make agreements about the main infrastructure for sustainable industry (in clusters), and discuss projects of national importance, including regional projects with consequences for the national energy system. This concerns the infrastructure for hydrogen, CO_2, electricity, heat, gas and the circular economy. The Cluster Energy Strategies (CES) and a safehouse are used to ensure the secure exchange of data for the programme.

[83] NEA, 2022b, Nieuwsbericht Aanpassing reductiefactor CO2-heffing aangekondigd, https://www.emissieautoriteit.nl/actueel/nieuws/2022/06/15/aanpassing-reductiefactor-co2-heffing-aangekondigd

Regional industrial cluster approach

The integrated approach involves five regional industrial clusters (and a sixth cluster with other participating industries), including the twelve largest emitting companies (the 'big-12') as front runners. Focusing on projects in GHG reduction and improved sustainable use of resources, the integrated approach will include aspects such as joint learning, coordination for infrastructural aspects (grids for electricity, hydrogen, heat, etc.), synergy by means of regional transition programmes, joint permit and/or subsidy scheme strategies etc. All five industrial clusters submitted their CES in 2021, which were reviewed by the Netherlands Environmental Assessment Agency (PBL, 2021c[84]). The CES are incorporated into the first Program on Energy and Climate Infrastructure ("MIEK") (EZK, 2021[85]) as part of the PIDI.

Policies for non-CO_2 greenhouse gases in the industry

The EU Industrial Emissions Directive (2010/75/EU), or IED, is the main EU instrument regulating pollutant emissions from industrial installations. Although the focus is on pollutants, application of the IED may also contribute to reducing GHG emissions. The IED covers around 50,000 installations in the EU, which are required to reduce harmful industrial emissions. In particular, the application of Best Available Techniques (BAT) must be applied to ensure operations in accordance with a permit (granted by the relevant Member State authorities). This permit should contain conditions set in accordance with the principles and provisions of the IED. For certain installations, such as large combustion plants, waste incineration and co-incineration plants, solvent using activities and titanium dioxide production plants, the IED also sets EU-wide emission limit values for SO_2, NOx and dust.

4.2.6 Transport and mobility

The indicative emission limit for transport and mobility amounts 23.7 Mt CO_2-eq by 2030. Both European and national policies are implemented. Important European policies include the CO_2 standards for vehicles and the mandatory use / blending of sustainable fuels. On the national level, policies are implemented promoting more efficient personal mobility, electrification of cars, efficient logistics and sustainable fuels.

[84] PBL, 2021c, Reflectie op Cluster Energiestrategieën (CES 1.0), https://www.pbl.nl/publicaties/reflectie-op-cluster-energiestrategieen-ces-1-0

[85] EZK, 2021, MIEK overzicht 2021 - Meerjaren Programma Infrastructuur Energie en Klimaat, https://open.overheid.nl/repository/ronl-e96fcc00-2650-4065-84e7-a4a5a2350bbf/1/pdf/meerjarenprogramma-infrastructuur-energie-en-klimaat.pdf

One of the adopted measures is a Green Deal on electric vehicles. Government and business organisations have agreed to promote electric vehicles by developing the consumer market and EV infrastructure and by initiating innovation projects. The ambition is that by 2025, 50% of all 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, in recent years, fiscal policies. Registration of new semi-electric or electric vehicles has been increasing sharply in recent years (RVO, 2022a[86]).

EU CO_2 emission performance standards

In 2009, the EU published legislation on CO_2 emissions from passenger cars in the form 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).

On 1 January 2020, Regulation (EU) 2019/631 entered into force, setting CO2 emission performance standards for new passenger cars and vans. It replaced and repealed former Regulations (EC) 443/2009 and (EU) 510/2011, concerning cars and vans respectively. The new Regulation sets EU fleet-wide CO_2 emission targets applying from 2020, 2025 and 2030 and includes a mechanism to incentivise the uptake of zero- and low-emission vehicles. As of 2021, emissions performance standards are specified at 95 g/km for cars and 147 g CO_2/km for vans. Starting in 2025 and 2030, Regulation (EU) 2019/631 sets stricter EU fleet-wide CO_2 emission targets, which are defined as a percentage reduction from the 2021 starting points:

- Cars: 15% reduction relative to 2025 and 37.5% reduction relative to 2030
- Vans: 15% reduction relative to 2025 and 31% reduction relative to 2030

If the average CO_2 emissions of a manufacturer's fleet exceed its specific emission target in a given year, the manufacturer has to pay – for each of its vehicles newly registered in that year – an excess emissions premium of €95 per g/km of target exceedance. Zero- and low-emission vehicles, cars and vans are assigned extra weight in the calculations.

In 2021, the European Commission proposed to revise the CO_2 emission performance standards for 2030 and 2035. By 2035, the CO_2 emissions of all newly sold cars and vans

[86] RVO, 2022a, Cijfers elektrisch vervoer, https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/elektrisch-rijden/stand-van-zaken/cijfers

should be zero. This proposal was accompanied by a proposed Alternative Fuels Infrastructure Regulation, which should ensure the timely availability of the recharging and refuelling infrastructure for zero-emission vehicles.

Fiscal incentives

For many years, the Netherlands has implemented fiscal policies to stimulate the uptake of low CO_2-emitting cars. The average of 130 gr/km for new cars was already achieved in 2011. In recent years, this has led to a swift uptake of (PH)EV's (RVO, 2022b[87]). 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 car's CO_2 emissions. No BPM is charged for electric cars and low-emission cars. CO_2 emission figures for each type of vehicle are listed in a register that is kept by vehicle registration authority RDW. In addition, beneficial fiscal rules apply to business drivers leasing low-emission cars.

Stimulation of zero-emission vehicles and efficient logistics

Following the 2019 National Climate Agreement, many new national policies have been introduced to further stimulate the uptake of zero-emission vehicles. These include subsidy scheme not only for passenger cars ('SEPP') , but also for vans ('SEBA'), public busses ('SpUk-Zebus'), trucks ('AanZET') and zero-emission mobile machinery (SSEB) in the construction sector. To facilitate the uptake of zero-emission vehicles, charging and refuelling infrastructure is developed under national programmes stimulating infrastructure for alternative fuels (AFid) and the National Agenda on Charging Infrastructure (NAL).

Furthermore, zero-emission zones for logistics activities in urbanized areas have been introduced. Efficient logistics are facilitated by enhancing the digital infrastructure. The planned implementation of a heavy goods vehicle charge by 2024 will stimulate a modal shift towards more efficient logistics.

An electric taxiing pilot project is currently taking place at Amsterdam Airport Schiphol. Electric taxiing means that aircraft need no kerosene to travel from the runways to the gates and vice versa. The results of the pilot will be used to evaluate whether electric taxiing can be implemented on a wider scale. If so, the government considers supporting this technology with a subsidy from 2024.

[87] RVO, 2022b, Dashboard Klimaatbeleid – Mobiliteit, https://dashboardklimaatbeleid.nl/viewer/jivereportcontents.ashx?report=mobiliteit_personenautos

Minimum share of renewable energy in transport

The EU Renewable Energy Directive 2018/2001/EU on renewable energy requires Member States to ensure that at least 14% of final energy consumption in transport comes from renewable sources by 2030. In 2021, this share was 17.5% (NEA, 2022c[88]) (based on energy content). Nearly 50% was sourced from waste and residuals (mostly frying fats). Almost 39% came from advanced biofuels. Conventional biofuels (from crops) contributed only 7%. Dutch policy is aimed at maximising the share of advanced biofuels that are not produced from food/feed crops. Since blending biofuels is obligatory, there are no additional tax incentives or subsidy programmes.

Eco-Driving (The New Driving) campaign

In 1999, the then Ministry of Transport and Water Management initiated a so-called Eco-Driving Programme in order to promote a fuel-efficient driving style among motorists. As part of this initiative, The New Driving programme (*HNR 1.0*) used information campaigns, financed demonstration projects and employed other promotional activities (including cooperation with businesses) to highlight 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. Since 2015, the programme has been 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 instructions on how to use eco-driving techniques specified for different car makes and types. Other means of communication include informing car owners through car dealers. The campaign is still ongoing.

In 2015 an information campaign was launched in cooperation with stakeholders to advise motorists on choosing the right energy-efficient tyres and applying the correct tyre pressure.

Green Deal 230: Sea transport, inland shipping and harbours

This deal aims to reduce GHG emissions and other harmful emissions (of NO_x, SO_x, particulate matter) into the air from the shipping sectors involved. The national government, provinces, port authorities, maritime sector organisations, shippers, transport companies, banks and research institutes are joining forces to promote

[88] NEA, 2022c, Rapportage Energie voor Vervoer 2021, https://www.emissieautoriteit.nl/documenten/publicatie/2022/07/01/totaalrapportage-energie-voor-vervoer-2021

sustainability in the shipping sectors. Inland shipping is a key topic under the new Climate Agreement. Agreements with sector parties on GHG emission reductions will form part of this Green Deal. Implementation is supported through subsidy scheme for promoting Sustainability of Inland Navigation Vessels (SRVB) and on Sustainable Shipbuilding (SDS).

4.2.7 Buildings

The indicative emission limit for buildings in the residential and services sector amounts 10 Mt CO_2-eq by 2030. A broad package of national policy instruments has been developed over many years for both new and existing buildings, 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.

National programs
In June 2022, the government announced a draft programme on Accelerating Sustainability Measures in Renovating the Built Environment (BZK, 2022[89]). This programme should act as the national framework for policies in the built environment, aiming to reduce GHG emissions and dependency on natural gas.

The programme works in conjunction with the National Insulation Programme (BZK, 2022[90]) and the forthcoming program on hybrid-heat pumps. The aim of the former is to insulate 2.5 million dwellings with poor energy performance scores by 2030. The latter programme aims to install 1 million hybrid-heat pumps in existing buildings by 2030, to be implemented by, amongst others, raising minimum efficiency standards for heating installations in existing buildings to such a level that hybrid-heat pumps will be the standard as of 2026.

A separate programme will be introduced for utility buildings a program. A fourth programme will be introduced which focusses on sustainable fuels and energy infrastructure. One of the aims of this program is to implement a mandatory blending of 1.6 bcm green gas by 2030, gradually starting in 2024-2025.

[89] Ministry of the Interior and Kingdom Relations (BZK), 2022, Beleidsprogramma versnelling verduurzaming gebouwde omgeving, https://www.rijksoverheid.nl/documenten/rapporten/2022/06/01/beleidsprogramma-versnelling-verduurzaming-gebouwde-omgeving
[90] BZK, 2022, Nationaal Isolatieprogramma, https://www.rijksoverheid.nl/documenten/publicaties/2022/04/02/nationaal-isolatieprogramma

The implementation of these national programmes strongly relates to the heat transition plans in the Regional Energy Strategies, in which regional and local governments are responsible for the planning and implementation of regional and local plans (see also section 4.2.4 Electricity).

Policy measures for new buildings
Energy performance standards of new buildings are implemented in national legislation according to the European Energy Performance of Buildings Directive (EPBD). The current energy performance standards require that all buildings should be nearly energy neutral as of 2021. This standard was already applied as of 2018 to buildings owned by the central government. Also, new buildings under permits granted after July 2018 are not connected to the national gas grid, as this was implemented in the Progress Energy Transition Act. This helps to decrease reliance on natural gas in the building sector. Only in specific circumstances is a natural gas grid connection allowed.

Policy measures for existing buildings
For existing buildings, a varied mix of policy instruments exists for private and social housing as well as for utility buildings.

In order to assist individual homeowners and help them to make their homes more sustainable, it is important to provide insight into the technical possibilities and financial support. An insulation standard per home type will provide owners with clear information about how they can improve the insulation of their home. This standard will be translated into targets for each insulation measure. Other measures include a digital platform where homeowners can find information about sustainability measures and the corresponding indicative energy. Homeowners can apply for financial support under schemes such as the Investment Grant for Sustainable Energy (ISDE), the National Heating Fund and Subsidy for Energy Savings at Home (SEEH).

Within the rental sector, housing associations play a central role in improving the sustainability of their housing stock. Other large landlords will also be making agreements about interim targets. Many housing associations often own large numbers of similar homes. This places them in an excellent position to initiate and drive effort to improve the sustainability of the built Environment, as the first step in scaling up the sustainability of housing stock. By connecting 100,000 homes to heat (district heating or heat pumps) in the short term, we can begin to reduce the costs of renovation and reduce CO_2 emissions. Housing associations are eligible for financial support in their efforts to make their housing stock more sustainable. As of 2030, new minimum energy

performance standards will be imposed, which will be in line with the EED and EPBD. Financial support is available through the Renovation Accelerator and a discount on the landlord levy for housing associations that wish to improve sustainability.

In non-residential buildings, the focus is on improving the sustainability of existing commercial and public buildings, such as offices, schools and care institutions. A coherent package of standardisation and support instruments will be implemented here, in cooperation with umbrella organisations. The most significant measure is the introduction of a statutory energy-performance standard for buildings from 2021. This includes a target for 2030 and a statutory final standard for 2050, by which time all non-residential construction must be low-carbon.

Policy measures for appliances

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. Currently, 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, and 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 which will again have an A–G scale (instead of A+++ to D), which has been shown to be more effective in motivating consumers to buy the most energy-efficient products. Further revisions are envisioned when the market has transformed in such way that a large number of products are in the A class. The new Framework Regulation has also introduced a product database (mandatory 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, 14 energy labelling regulations are in force, covering products such as household appliances, televisions, space and water heaters, and lamps[91]. Furthermore, a separate Regulation (EU/202/740) deals with tyres.

[91] See for more information: https://eprel.ec.europa.eu/screen/home

For products that have eco-design requirements as well as an energy label, both instruments are developed within the same policy process.

4.2.8 Agriculture

The indicative emission limit for the agricultural sector is 18.9 Mt CO_2-eq by 2030. For LULUCF, this limit is 1.8-2.7 Mt CO_2-eq. These emission limits contribute to the 'global methane pledge', which is to reduce global methane emissions with 30% by 2030 compared to 2020. These emission limits are met by reducing GHG emissions from agricultural activities, producing renewable energy (also for other sectors), switching to sustainable fuels for tractors and mobile equipment and sequestering carbon (CO_2) in soils and biomass.

For agriculture, a combined policy approach for rural areas is used to decrease both GHG emissions and air pollutants as well as to strengthen the quality of the natural environment and water. Provinces are required to publish their integrated plans to meet these targets within their territories by July 2023. In order to facilitate the implementation of these plans, the government has announced a €25 billion Transition Fund for Rural Areas and Nature.

Besides the combined rural approach, several policy instruments exists to stimulate emission reductions and/or to support farmers in implementing measures. Subsidy schemes are available, such as for sustainable stables and manure management (SBV) and for substituting artificial fertilisers with manure. In addition, there are several voluntary buy-out schemes for livestock-farmers as part of efforts to reduce phosphate and nitrogen emissions.

As for horticulture sector, the 2013 Energy Agreement included a CO_2 ceiling for the greenhouse horticulture sector. Participants who exceed the emission limit, which decreases every year, incur a penalty. This system will remain in place until 2030. The horticulture sector aims to be carbon-neutral by 2040. The transition will be actively supported by the Greenhouse as an Energy Source programme, which forms part of the multi-year agreement on the energy transition in greenhouse horticulture. This programme is a public-private partnership between the sector and the Ministry of Agriculture, Nature and Food Quality (LNV), and will see the implementation of a wide range of instruments: from knowledge and innovation development and knowledge transfer initiatives, to provision of subsidies via the Investments in Energy Efficient Greenhouse Horticulture (EG) and Greenhouse Horticulture Market Introduction for

Energy Innovations (MEI) subsidy schemes. Other subsidy instruments that are important for the horticulture sector are the SDE++ and the EIA.

4.2.9 LULUCF

In the Netherlands, CO_2 emissions and sequestration of carbon 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 construction, the oxidation of peatland due to water management, and the conversion of forest into grassland (including non-forest nature, such as heathland), infrastructure, settlements or other land use categories and vice versa. In the 2019 national Climate Agreement, it was agreed to introduce policies to reduce GHG emissions and sequester carbon in (agricultural) soils, forests and wetlands.

Forests and nature

Over the past decades, forest policy in the Netherlands has been integrated into nature policy, which reflects the change towards multi-purpose forests in which multiple functions are combined (e.g. nature and recreation). The development of a nature network is a central theme in 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 grow to a total size of 668,000 ha in 2027.

In 2020, the central government and the provinces announced a National Forest Strategy in order to preserve biodiversity and sequester carbon (LNV, 2020[92]). The strategy aims to increase the forest area by 10% between 2020 and 2030. This would result in a total forest area of 407,000 hectares, realised with both reforestation and afforestation within and outside the current nature network. Within that network, a careful balance must be struck between forestation and other values important for nature and society. It is estimated that about 15,000 hectares of new forest can be added up to 2030. An estimated 19,000 hectares could be added outside the current nature network. Potential suitable areas are agricultural land, river banks and valleys, urban areas and windfarm. Regional and local authorities are in the lead to identify suitable areas. A national project organisation should facilitate the implementation. Various instruments

[92] Ministry of Agriculture, Nature and Food Quality (LNV), 2020, Uitwerking ambities en doelen landelijke Bossenstrategie en beleidsagenda 2030, https://www.rijksoverheid.nl/documenten/kamerstukken/2020/11/18/uitwerking-ambities-en-doelen-landelijke-bossenstrategie-en-beleidsagenda-2030

including a forestation subsidy can be deployed to stimulated participation by landowners. Forestation will also be included in other national programmes, such as those for rural Areas and for adaptation. In their capacity as landowners, the central government and provinces themselves will include forestation in their management strategies. The measures and funding announced in the National Forest Strategy have not yet been implemented yet. Included in the projections as "scheduled measure".

Agricultural soils

The National Agricultural Soils Programme is meant to ensure the sustainable management of all agricultural soils in the Netherlands by 2030[93]. This should result in the capture of 0.5 Mt CO_2-eq per year in mineral agricultural soils. The programme started in 2019.

Provinces are developing strategies to reduce subsidence of peat lands, for example by setting limits to the maximum lowering of ground water levels or by increasing ground water levels. Higher groundwater levels will help to reduce degradation of organic matter in peat soils. Another measure is to convert agricultural peat soils to nature and/or wet agriculture. Provinces are to publish their plans by September 2022. The central government has reserved €200 million for the implementation of these plans.

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

4.2.10 Arrangements and procedures related to implementation of Articles 3.3 and 3.4 of the Kyoto Protocol

The approximately 375,000 hectares of forest in the Netherlands, which cover about 10% of the total surface of the country, have a number of functions, including recreation, nature, landscape, CO_2 sequestration and wood production. Dutch forests produce around 8% of the wood consumed. Because the production from the inland woods is

[93] LNV, 2020, Nationaal Programma Landbouwbodems, https://www.rijksoverheid.nl/documenten/kamerstukken/2020/09/04/nationaal-programma-landbouwbodems

large enough to increase the domestic wood production, the national administration is trying to encourage the harvesting of wood.

Most of the forest area in the Netherlands is managed according to the principles of sustainable forest management, which also apply to newly planted forests. The Forest Act and the Flora and Fauna Act ensure the sustainable management of forests. The Forest Act contains the obligation to report felling activities and to replant within three years of felling, while the Flora and Fauna Act ensures that the negative consequences of (management) activities on biodiversity are minimised. The sustainable forest management principles and the three aforementioned Acts ensure that the implementation of activities complying with article 3.3 and 3.4 (Forest Management) contribute to the conservation of biodiversity and sustainable use of natural resources.

4.2.11 Waste

According to the Environmental Management Act, the central government is required to adopt a waste management plan once every six years. The National Waste Management Plan for 2002–2012 was the first such plan. It was replaced in 2009 by a second plan for the 2009–2021 period, which remained in force until December 2017. The third plan[94], for the 2017–2029 period, is currently in place.

The current – third– 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. A target of waste policy is a 50% decrease of the amount of waste sent to incineration plants or landfills between 2014 and 2022. Other targets are, for example, increasing the rate of the separation of waste collected from households and businesses to 75%. Recycling rates of collected waste should go up to a minimum of 85% in 2023. This will reduce the amount of waste to be 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 third waste management plan also incorporates circular economy aspects, with a greater focus on waste as a reusable material for new products. This policy will also help to reduce energy consumption and GHG emissions.

[94] See for more information: https://lap3.nl/service/english/

A mix of policy instruments is used to implement the current plan, ranging from legislation, licensing, information campaigns, agreements with stakeholders, levies, taxes, deposit systems and policy programmes.

In 2021, the government announced that the third waste management plan will be followed up (after 2029) by a circular materials plan. The aim is to bring the new plan into force at the start of 2025 (I&W, 2022[95]). Consultations for this plan are currently ongoing.

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. Increasing the rate of separation of waste, having a landfilling prohibition for organic waste result in less landfilling of organic waste and thus also in decreasing the methane emissions.

4.2.12 Impact of policies and measures on GHG emission reduction

	2025				**2030**			
Name	Total	ETS	ESR	LULUCF	Total	ETS	ESR	LULUCF
Group of PAM's electricity sector	21.3	20.6	0.8	-	32.9	31.3	1.6	-
Group of PAM's industry	2.0	0.5	1.5	-	3.5	1.2	2.3	-
Group of PAM's buildings	4.5	2.1	2.4	-	5.7	1.8	3.9	-
Group of PAM's transport	2.6	-	2.6	-	2.9	-	2.9	-
Group of PAM's agriculture	1.2	0.0	1.2	-	1.7	0.0	1.7	-
Group of PAM's land use	0.3	-	-	0.3	0.6	-	-	0.6
National total	31.8	23.1	8.4	0.3	47.3	34.3	12.4	0.6

Table 4.2 - Impact of implemented and planned policies and measures (WAM-variant) on reduction of GHG emissions in 2025 and 2030 grouped by climate policy sector (Mt CO_2-eq)

[95] I&W, 2022, Kamerbrief over stand van zaken uitwerking Circulair Materialenplan, https://www.rijksoverheid.nl/documenten/kamerstukken/2022/06/24/stand-van-zaken-uitwerking-circulair-materialenplan

	2025				2030			
Name	Total	ETS	ESR	LULUCF	Total	ETS	ESR	LULUCF
Renewable energy*	25.3	22.5	2.7	0.0	28.1	24.1	3.9	0.0
Ban on coal for electricity production	0.0	0.0	0.0	0.0	8.6	8.6	0.0	0.0
Energy savings**	3.9	0.6	3.3	0.0	6.5	1.6	4.9	0.0
Non-CO_2 emissions	2.4	0.0	2.4	0.0	3.5	0.0	3.5	0.0
Land use	0.3	0.0	0.0	0.3	0.6	0.0	0.0	0.6
National total	31.8	23.1	8.4	0.3	47.3	34.3	12.4	0.6

Table 4.3 - Impact of implemented and planned policies and measures (WAM-variant) on reduction of GHG emissions in 2025 and 2030 grouped by mitigation category (Mt CO_2-eq)

The ex-ante impact of policies and measures on GHG emissions in Table 4.2 and Table 4.3 are based on the projections made by the PBL in the National Climate and Energy Outlook 2022. Data from the KEV has been processed and transposed by the Netherlands Enterprise Agency (RVO).

The KEV provides projections up to 2030 on, among other things, GHG emissions, (renewable) energy production and energy consumption, taking into account the impact of policies and measures. The projections cover both existing and additional (planned) policies and measures in two scenario's: with existing measures (WEM) and with additional measures (WAM). The KEV does not, however, give the quantitative impact of (individual) policies and measures.

For that reason, RVO has defined a baseline to enable comparison with the projections in the KEV. This was done for three categories of emissions reductions: energy savings, renewable energy production and the reduction of non-CO_2-emissions. The baseline assumes no further improvements in energy-efficiency, renewable energy production and non-CO_2 emission reductions after 2020. In this way, the calculated impact on CO_2-emissions can be attributed to policies and measures implemented or planned (those that show impact after 2020) in the national Climate Plan 2021-2030.

RVO has aggregated the impacts from these categories of emission reductions to the sector level as most projection results in the KEV are also given on a sectoral level. For this purpose, the sectoral definitions that were applied in the KEV were used.

RVO used CO_2 emission factors from the KEV2022 in order to calculate the impact of renewable energy production and energy savings on CO2-emissions. Depending on which

energy carrier is avoided in combination with the technology used, the reduced CO_2-emissions were allocated to a sector and to ETS or non-ETS. CO_2-emission reductions due to the avoidance of electricity consumption from the reference park, were always allocated to the energy sector and ETS. Emission reductions due to the avoidance of gasoline/diesel consumption are allocated to the transport sector and non-ETS (ESR). The allocation of CO_2-emission reductions due to the avoidance of natural gas consumption depends on the technology/measure. Of CO_2 emission reductions due to heating technologies applied by households and services, 1% is allocated to ETS and 99% to non-ETS. This allocation is based on the projected ETS and non-ETS CO_2-emissions in 2030 for the built environment in the KEV2022. Similarly, for the allocation of CO_2-emission reductions due to technologies generally applied in industry (i.e. biomass boilers), an allocation ratio of 75/25 for ETS/non-ETS was used.

4.2.13 Monitoring and evaluation of progress in climate change measures

The development of GHG emissions is monitored through the emission inventory system. Emissions under the EU ETS are monitored through annual reporting in accordance with the EU ETS. Non-ETS emissions are reported annually to the European Commission, as regulated in Governance Regulation (EU) 2018/1999. All EU Member States are required to report to the European Commission all information on national policies and measures related to greenhouse gas reductions by 15 March 2021 and every two years thereafter. Monitoring, reporting and verification of the ESR targets mainly takes place through the submission of the national GHG inventories by Member States. Submissions of emission inventories, policies and measures and projections are subject to thorough compliance and quality assurance reviews by the European Commission. (see also section 3.2.2).

The National Climate Act[96] adopted in 2019 provides the legal basis for reporting on policies and measures and the development of projections. the Climate Act lays down national GHG reduction targets: 49% by 2030 and 95% by 2050 compared to 1990 levels. In order for these targets to be reached, every five years the government is required to adopt a national climate policy plan for the next decade. The first climate plan covering the 2021-2030 period was published in 2020 (EZK, 2020a[97]). The Council of State, the highest legal advisor of the government, is consulted before adoption of the climate plan.

[96] See for details: https://wetten.overheid.nl/jci1.3:c:BWBR0042394&z=2020-01-01&g=2020-01-01
[97] EZK, 2020a, Klimaatplan 2021-2030, https://www.rijksoverheid.nl/documenten/beleidsnotas/2020/04/24/klimaatplan-2021-2030

The Climate Act also includes various provisions concerning the monitoring and evaluation of progress on the climate plan. The government reports annually to Parliament on the progress made. RVO prepares an annual Climate Policy Monitor to assist the government in reporting on progress in the implementation of policies and measures. The first monitor was published in 2020 (EZK, 2020b[98]). The Climate Act also requires the Netherlands Environmental Assessment Agency (PBL) to publish updated projections annually in which the impact of policies and measures is evaluated ex-ante. The government must address these projections in its report to Parliament. Every two years, the government evaluates the progress of the climate plan and proposes adjustments if deemed necessary, using the insights provided by the Climate Policy Monitor and the projections.

GHG projections are reported in the annual Climate and Energy Outlook (KEV). The KEV-report describes the policies and measures in place or planned and included in the projections with regard to energy savings, renewable energy and GHG emission reductions in the Netherlands as a whole, as well as for individual sectors. The KEV includes both the policy variants 'with existing measures' (WEM) and 'with additional measures' (WAM). The projections include quantitative estimates for a sequence of four future years ending with 0 or 5 immediately following the reporting year. The KEV published in 2022 covers a projection horizon up to 2040. Methods used in the KEV are consistent with those defined in the guidelines of the EU, UNFCCC and IPCC. The first KEV was published in 2019 as the successor to the National Energy Outlook (NEV), which had been published annually since 2014 (with the exception of 2018).

These projections are developed by the PBL, which is an independent governmental agency, in cooperation with Statistics Netherlands (CBS), TNO Energy Transition, the National Institute for Public Health and the Environment (RIVM) and the Netherlands Enterprise Agency (RVO). PBL has overall responsibility for the KEV and for projections and, specifically, for the evaluative aspects in the report in specific (including its final editing). This fits in with their role in the Netherlands as an independent planning agency and guarantees an independent evaluative view. CBS provides various statistics, for example on economic development and energy balances. RVO provides monitoring information on the implementation of many policies and measures. Where needed for specific data, other organisations supply additional input. For example, some non-CO_2 GHG data are supplied by the National Institute for Public Health and the Environment (RIVM). An advisory committee in which all partners and representatives from EZK, other

[98] EZK, 2020b, Monitor Klimaatbeleid, https://www.rijksoverheid.nl/documenten/publicaties/2020/10/30/monitor-klimaatbeleid-2020

ministries, the Council of State and the Progress Committee Climate Agreement are represented, provides suggestions on the set up of the KEV.

RVO is appointed by EZK to coordinate and submit the reports to the EU and UNFCCC. It uses the KEV-report as the basis for reporting to the EU and UNFCCC on projections. This includes the projections themselves, as well as information on policies and measures, the models used, the input parameters and sensitivity analyses. Since not all information required for reporting to the EU and UNFCCC is published in the KEV-report itself, PBL and/or their partners provide RVO with additional tables and details.

The reports on policies and measures to the EU and UNFCCC are based on various information sources. Progress on the implementation of policies and measures is described in the annual Climate Policy Monitor. To this end, RVO and other agencies work closely with the ministries involved in updating information on PAMs and other relevant actions and their progress. RVO uses the KEV as a basis for calculating the ex-ante impact of PAMs on GHG emissions. For the ex-post impacts and results, RVO uses mostly internal monitoring data on the implementation of policies and measures (such as subsidy schemes, tax deductions and reporting on the implementation of energy saving measures). Methods used by RVO are published on its website[99]. Relevant and up-to-date information is stored in RVO's internal PAM database, which holds the mandatory information on PAMs for reporting to the EU and UNFCCC and other national reports

4.2.14 Assessment of the economic and social consequences of response measures

Foreign policy agenda

The Netherlands' support for climate action in developing countries is an integral part of its international cooperation. Its 2022 policy note "Doing What the Netherlands is Good At" from the Ministry of Foreign Affairs sets out the development and trade agenda, the overall aim of which is to address the root causes of poverty, terror, irregular migration and climate change, and to achieve the United Nations Sustainable Development Goals (SDGs).

As Dutch support for climate action is part of its development cooperation policy, both our bilateral and our multilateral climate finance plans have a strong focus on poverty reduction. Most climate change typically affects the poorer people and communities, not

[99] https://www.rvo.nl/nie

only because these 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. The Netherlands is currently developing a Feminist Foreign Policy and Gender has been 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.

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. The table below provides a summary of public and mobilized private finance over the 2013-2020 period. Detailed information on public climate finance in NC8 reporting years 2019-2020 is provided in CTF Tables 7, 7a and 7b, with summary information available in Chapter 7.

For mobilized private finance, the details for 2019-2020 are presented in section 7.2.8. As data and methodological limitations are still a serious constraint, the reported amounts should be considered as best estimates.

Funding type and channel	Year of disbursement							
	2013	2014	2015	2016	2017	2018	2019	2020
Public Climate Finance through multilateral channels	89.90	134.50	243.44	256.14	152.18	139.04	217.28	224.31
Public Climate Finance through bilateral and regional channels	284.98	386.78	324.31	256.79	312.97	415.17	465.99	458.48
Total Public Climate Finance	374.88	521.28	567.75	512.93	465.15	554.21	683.27	682.79
Total Mobilised Private Finance	NA	NA	98.65	186.11	372.00	467.40	882.40	587.90
Grand Total	374.88	521.28	666.40	699.04	837.15	1,021.61	1,520.67	1,270.69

Table 4.4 Public and Mobilised Private Climate Finance provided by the Netherlands from 2013-2020 (in USD Millions)

Collaboration between authorities, businesses, knowledge institutions and civil society
Dutch public climate finance is first and foremost intended to assist the poorest communities and 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 institutions are partners in providing this support. Further details and a number of concrete examples are presented in Chapter 7.

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 GHG reduction. Their goal is to ensure that investments are made where the money contributes most to GHG emission reduction with a minimum impact on the world economy.

In the first commitment period of the Protocol, the Netherlands used 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)[100]. Credits were also acquired through national banks (e.g. Rabobank) and through a tender carried out by RVO. Acquisition activities started in the early 2000s.

The former Dutch Ministry of Infrastructure spent €151 million between 2005 and 2008 and €132,6 million over the 2009-2012 period to purchase carbon credits under the Clean Development Mechanism. The former Ministry of Economic Affairs purchased carbon credits under the JI mechanism for €53,4 million between 2005 and 2008 and €109,1 million for the 2009-2012 period. 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) to meet its obligations under the Kyoto Protocol in the first commitment period.

The Netherlands did not acquire any credits for the second commitment period under the Kyoto Protocol nor to meet domestic and/or European GHG emission reduction targets beyond 2012.

4.2.15 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 subject to EU climate policy, 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, the Effort Sharing Regulation (EU) 2018/842 and the LULUCF Regulation (EU) 2018/841. Also included is the Governance Regulation (EU) 2018/1999, which ensures that the EU progresses towards meeting its internal and international commitments. 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.

[100] See for more information the policy evaluation from 2014 on the clean development mechanism https://zoek.officielebekendmakingen.nl/blg-346237

Arrangements and procedures: national policy context

Environmental Management Act

Most 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[101]. It provides the legal basis for most environmental regulations that affect GHG emissions (for example, regarding waste prevention, energy savings obligation, landfill policy and CO_2 emissions trading)

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

- environmental plans, such as the national waste management plan that regulates municipal waste collection, disposal of discarded equipment (refrigerators, TVs etc.), and permits for hazardous waste shipment;
- environmental quality criteria for emissions and discharges of harmful substances, such as GHG and heavy metals, to air, water and soil;
- the 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 of Infrastructure and Water Management 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 (GHGs) 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.

Chapter 18 of the Environmental Management Act regulates the enforcement of legal measures. It denotes which authorities are responsible for enforcement and requires

[101] See for more information: https://www.government.nl/topics/environment/contents/roles-and-responsibilities-of-central-government/environmental-management-act

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 be brought into compliance at the expense of the violator, impose a financial 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 (up to six years).

The Act on general provisions for environmental law[102] (*Wet algemene bepalingen omgevingsrecht*, abbreviated as "Wabo" in Dutch) lays down the rules for granting a so-called All-in-one Permit for Physical Aspects. The Wabo act enables members of the public and companies to use one transparent procedure to apply to one competent authority for permits for activities that have an impact on the physical environment. Environmental permits: in addition to regulations for the emission of substances harmful to the 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[103].

Environment and Planning Act

The Environment and Planning Act (Omgevingswet in Dutch) will modernise and combine various related pieces of legislation in the fields of the environment, nature and spatial planning[104]. The Act will enable members of the public and companies to use one transparent procedure to apply to one competent authority for permits for activities that have an impact on the physical environment. The Act integrates regulations for, among other things, spatial planning, nature, water and the environment which will improve legal support for an integrated and area-oriented approach to the living environment. Regular updates of the regulations will be implemented, when appropriate. A planned update under one of the decrees (on buildings) concerns new regulations to enable a more sustainable use of roofs. This has recently been made available for public consultation.

The National Strategy on Spatial Planning and the Environment (NOVI) is also included as an instrument to this Act. This strategy provides a long-term vision on the future development of the living environment in the Netherlands. The NOVI presents a perspective for tackling major spatial challenges such as climate change, the energy transition, the circular economy, accessibility and housing.

[102] See for more information: https://www.infomil.nl/onderwerpen/integrale/wet-algemene/wabo-kort-1/
[103] See for more information: https://rwsenvironment.eu/subjects/general-provisions-0/all-one-permit/
[104] See for more information: https://iplo.nl/regelgeving/omgevingswet/english-environment-and-planning-act/

The new Environment and Planning Act and supporting decrees will contain much of the legislation from the present Act and decrees on these subjects, such as the Environmental Protection Act, the Wabo and its decrees. The new Act was adopted by Parliament in 2016; however its operationalisation and introduction is still ongoing. Implementation is scheduled for 2023.

Housing Act and Buildings Decree
Energy performance requirements for new buildings are laid down in the Buildings Decree (*Bouwbesluit*) pursuant to the Housing Act (*Woningwet*). 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 under Section 25 of the Municipalities Act and to criminal sanctions under Section 108 of the Housing Act. Energy performance requirements have been tightened several times over the last decade. The current energy performance requirements are in line with the revised European Energy Performance of Buildings Directive (EPBD).

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. On 22 December 2005, the Freedom of Information Act w extended to include 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 NC7, there have been no significant changes to the provisions for making arrangements and procedures publicly accessible.

4.2.16 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 they strive 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

The 17 Sustainable Development Goals (SDGs)[105] of the 2030 Agenda for Sustainable Development were adopted by world leaders at a UN Summit in September 2015. Countries have committed to ending all forms of poverty, fighting inequalities and tackling 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 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. A new Voluntary National Review was submitted in 2022 (BUZA, 2022[106]). In the Netherlands, SDG screening was added to the Regulatory Impact Assessment (RIA) in 2019. All new policy must now be screened against the various SDGs, for effects on gender equality, developing countries and the environment, among other things

The policies and agreements to promote a circular economy (see section 4.2.3) also contribute to mitigating the detrimental environmental and social impacts of the exploitation of virgin resources internationally.

Steps relating to GHG emissions from aviation and marine bunker fuels

In accordance with Article 2.2 of the Kyoto Protocol, the Netherlands is committed to achieving a limitation or reduction of GHG 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 Organization (IMO) respectively.

International aviation

The Netherlands is fully committed to and involved in addressing the challenges caused by climate change and is promoting resource-efficient, competitive and sustainable aviation. Due to its international character, the Netherlands prefers a global system for reducing CO_2 emissions from international aviation.

The ICAO Assembly adopted Resolution A40-18 on climate change at its 40th Session in 2019 (ICAO, 2019[107]). The resolution reiterated the two global aspirational goals for the

[105] See for more information: http://www.un.org/sustainabledevelopment/sustainable-development-goals/
[106] Ministry of Foreign Affairs (BUZA), 2022, Voluntary National Review on the Sustainable Development Goals, https://hlpf.un.org/sites/default/files/vnrs/2022/VNR%202022%20Netherlands%20Report.pdf
[107] ICAO, 2019, Resolution A40-18, https://www.icao.int/environmental-protection/Documents/Assembly/Resolution_A40-18_Climate_Change.pdf

international aviation sector: 2% annual fuel efficiency improvement through 2050 and carbon neutral growth from 2020 onwards, as established at the 37th Assembly in 2010. To achieve these goals and to promote the sustainable growth of international aviation, ICAO is implementing a basket of measures including aircraft technology improvements, operational improvements, the use of sustainable aviation fuels, and market-based measures (CORSIA).

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 of the four-pillar strategy for sustainable aviation are the development and use of innovative technology, air traffic management (ATM) measures, market-based measures and the use of sustainable (bio)fuels.

The Netherlands has been involved in the development and implementation of various measures, including the EU ETS and Single European Sky in ATM. To limit CO2-emissions from aviation, the government also introduced a tax on outgoing passengers from national airports (see section 4.2.3). The Netherlands also supports various innovative projects, such as electric taxiing and the production and use of sustainable (bio)fuels.

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 light of the developments within ICAO regarding a global reduction system, the EU decided in 2013 to grant a temporary derogation from the ETS Directive for aviation. Under this derogation 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. In 2017, the EU decided to continue the 'stop-the-clock' policy until 31 December 2023, i.e. 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 ICAO's 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 achieve a potential 10% reduction of CO_2 emissions by 2020. Examples of SES measures are the simplification and optimisation of the airspace and the 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.

Sustainable (bio)fuels

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 a supplier, an airport and a 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 system through the further development of a bio-kerosene market, making public/private arrangements to secure its commitment and future involvement.

Marine shipping

The Netherlands is committed to reducing the impact of maritime shipping on the environment. As with international aviation, the Netherlands prefers a global system to reduce CO_2 emissions from maritime shipping. To cut CO_2-emissions, IMO adopted the first set of international mandatory measures to improve ships' energy efficiency in 2011. In the past decade, IMO has taken further action, including further regulatory measures and the adoption of the Initial IMO GHG strategy. To support their implementation, IMO has been executing a comprehensive capacity building and technical assistance programme, including a range of global projects.

The 2018 Initial IMO Strategy on the reduction of GHG emissions from shipping sets key ambitions (IMO, 2018[108]). This is a policy framework, which aims to: cut annual GHG emissions from international shipping by at least 50% by 2050, compared to their level in 2008, and work towards phasing out GHG emissions from shipping entirely as soon as possible in this century. It also aims to reduce carbon intensity of international shipping (to reduce CO_2 emissions per transport work), as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008. The Initial GHG Strategy includes a series of candidate short-, mid- and long-term measures, building on already-adopted mandatory energy-efficiency requirements for ships. Since the adoption of the Strategy, IMO has approved a Programme of follow-up

[108] IMO, 2019, Initial IMO Strategy, https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx

actions of the Initial Strategy up to 2023 and made good progress with the consideration and implementation of some of the short-term GHG reduction measures.

Short term measures include amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, which will require ships to reduce their GHG emissions. These amendments combine technical and operational approaches to improve the energy efficiency of ships while also providing important building blocks for future GHG reduction measures. In addition, all ships are required to calculate their Energy Efficiency Existing Ship Index (EEXI) following technical means to improve their energy efficiency and to establish their annual operational carbon intensity indicator (CII) and CII rating. Carbon intensity links GHG emissions to the amount of cargo carried over the distance travelled.

In June 2021 the Marine Environment Protection Committee (MEPC) adopted a concrete work plan on the way forward towards proposed mid- and long-term measures, including measures to incentivize the move away from fossil fuels to low- and zero-carbon fuels to achieve decarbonisation of international shipping. The Initial Strategy will be revised by 2023.

In June 2013, the European Commission presented a strategy for the inclusion in its climate policy of measures to reduce maritime GHG emissions. The strategy comprises 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 emissions targets and developing of market-based measures. From 1 January 2018, large ships over 5 000 gross tonnage loading or unloading cargo or passengers at ports in the European Economic Area (EEA) are to monitor and report their related CO2 emissions and other relevant information. Monitoring, reporting and verification (MRV) of information shall be done in conformity with the EU Regulation on the MRV of CO_2 emissions from maritime transport (Regulation 2015/757, as amended by Delegated Regulation 2016/2071).

To ensure that the maritime transport sector contributes to the EU's increased climate ambition, in 2021 the Commission proposed, as part of the 'Fit-for-55'" package, to extend the scope of the EU's ETS to cover CO_2 emissions from large ships (above 5000 gross tonnage), regardless of the flag they sail under. The extension would include all emissions from ships calling at an EU port for voyages within the EU (intra-EU) as well as for 50% of the emissions from voyages starting or ending outside of the EU (extra-EU voyages), and would also include all emissions that occur when ships are at berth in EU ports. The proposal would cap maritime transport emissions as part of the overall ETS

cap. It would result in a price signal that should incentivise improvements in energy efficiency and low-carbon solutions and reduce the price difference between alternative fuels and traditional maritime fuels.

The Dutch government also made agreements with national sea ports and the maritime shipping sector. Signatories to the 'Sea Shipping, Inland Shipping and Ports Green Deal' have agreed to a 70% reduction of CO_2 emissions from shipping by 2050 compared to 2008. After that, shipping must become climate neutral as soon as possible. As early as 2030, an emission-free seagoing vessel that does not emit harmful substances must be put into service.

4.2.17 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 GHG emissions, parties that 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 when the increase of global warming is limited. This would limit the need for developing countries to adapt to climate change. The development of low-carbon energy systems by developed countries also improves the ability of developing countries to adopt renewable energy and improve energy efficiency as costs for such technologies drop globally. Furthermore, developing countries, especially the poorest and most vulnerable among them, are assisted in several ways to realise a low-carbon development path and to adapt to climate change.

Sustainable use of biomass

In 2021, biomass accounts for 5.4% of total gross final energy consumption in the Netherlands (CBS, 2022[109]). Biomass is used in the form of biofuels in the transport

[109] CBS, 2022, Aandeel hernieuwbare energie daalt ondanks stijging zon- en windenergie, https://www.cbs.nl/nl-nl/nieuws/2022/26/aandeel-hernieuwbare-energie-daalt-ondanks-stijging-zon-en-windenergie

sector, biogas produced from manure and waste management and solid biomass for heat- and electricity production. The biomass used must meet sustainability criteria according to the Renewable Energy Directive (2009/28/EC), which was revised in 2018 (Directive (EU) 2018/2001). One of the criteria is that greenhouse gas emissions must be at least 50% lower compared to fossil fuels taking into account indirect emissions which may occur during production and transportation.

For biofuels, compliance with these criteria must be demonstrated through one of the adopted certification systems[110]. These systems are checked in independent audits. All biofuels produced in the Netherlands fulfil these requirements. The share of renewable energy in the consumption of diesel and gasoline amounted to 17.5% of the energetic content in 2021 (NEA, 2022[111]). The raw materials for biofuels are mainly waste and residual materials such as used frying fat (which accounts for 43.6% of the energetic content of used biofuels, mostly originating from China. Most raw materials for all biofuels are mainly imported from Asia, Germany and the U.S.

Beside applying European sustainability criteria, the Netherlands has implemented additional sustainability requirements for the use of biomass resources in the Netherlands (I&W, 2021b[112]), specifically regarding the use of solid biomass for energy conversion. 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 was sourced is managed with a view to the long-term conservation or expansion of carbon stocks. Overall, these requirements can be considered to be quite stringent compared with those in other countries. These additional criteria have been adopted in national legislation[113] and are used for example as a requirement in the SDE++ subsidy scheme.

The Netherlands has initiated and promoted the Amsterdam Declarations in order to halt deforestation in highly relevant supply chains such as timber, soy and palm oil,[114]. The two Declarations—one on stopping deforestation and one on sustainable palm oil— were

[110] See for more information: http://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes
[111] NEA, 2022c, Rapportage Energie voor Vervoer 2021, https://www.emissieautoriteit.nl/documenten/publicatie/2022/07/01/totaalrapportage-energie-voor-vervoer-2021
[112] I&W, 2021b, Kamerbrief over duurzaamheidscriteria biogrondstoffen, https://www.rijksoverheid.nl/documenten/kamerstukken/2021/06/09/duurzaamheidscriteria-biogrondstoffen
[113] See Regeling conformiteitsbeoordeling vaste biomassa voor energietoepassingen, https://wetten.overheid.nl/BWBR0040431/2022-01-01
[114] See for more information: https://ad-partnership.org/

launched on December 7th 2015 with the intention of achieving fully sustainable and deforestation-free agro-commodity supply chains in Europe by 2020. Ambitions were renewed in 2021 to eliminate deforestation in relation to agricultural commodities by 2025. 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. To date, nine countries have signed: the Netherlands, Denmark, Germany, Norway, the United Kingdom, France, Belgium and Spain.

International trade

National policies and measures also have an impact on international trade, especially for the import of energy carriers. Policies to increase the efficiency of cars and the promotion of electric and hybrid vehicles, as well as fuel taxations should result in reduced use of fuels and import of oil. The policies to improve the insulation of buildings and a shift of heating by gas towards electric heating will result in a decrease of the import of natural gas. The introduction of sustainability criteria for biomass results in a decrease of the import of biomass originating from non-sustainably managed forests.

Climate action and development aid

The Netherlands integrates development and climate action budgets, policies and activities to maximise their impact and results, especially for the poorest and most vulnerable. Committed to supporting developing countries in their climate action and, as elaborated in the preceding section 4.2.12 and in Chapter 7, the Netherlands has been scaling up climate finance. Public climate finance amounted to €375 million in 2013, it fluctuated around €500 million in the years after, while in 2017 and 2028 it amounted to over €680 million. In addition, since 2015 the Netherlands mobilised an increasing amount of private finance from €98 million in 2015 to €588 million in 2018. More detailed financial figures are presented in Chapter 7. The Netherlands has 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 Programme of the Strategic Climate Fund, one of the Climate Investment Funds. Furthermore, the Netherlands has a focus on supporting access to renewable energy, halting deforestation, climate-smart agriculture, integrated water resource management and the provision of climate resilient water and sanitation (WASH) services. Chapter 7 of this report contains more detailed information.

Promoting clean energy internationally

The Netherlands is committed to the COP26 Glasgow declaration to end public support for international unabated fossil fuel energy sector, in line with the Paris Agreement and SDG agenda (FIN, 2021[115]). Conditions for financial export facilities (such as export credits) are therefore changed in line with this declaration by the end of 2022. In International Financial Institutions the Netherlands advocates for more investments in renewable energy and support investments in fossil fuels only in exceptional circumstances where no realistic alternatives are available.

The Netherlands also strives to accelerate the transition to renewable energy worldwide. The Netherlands is a 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 Programme (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.

Since April 2011, the Netherlands has also supported the World Bank's "Partnership for Market Readiness" (PMR) with a total pledge of $7.2 million[116]. 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.

To halt deforestation in highly relevant supply chains such as timber, soy and palm oil, the Netherlands has initiated and promoted two 'Amsterdam Declarations', one on stopping deforestation and one on sustainable palm oil, which were launched on 7 December 2015 with the intention of achieving fully sustainable and deforestation-free agro-commodity supply chains in Europe by 2020. To date, Denmark, Germany, Norway, the United Kingdom and France have also signed the Amsterdam Declarations. They 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 market demand for sustainable commodities in the signatory European countries, the Declarations aim to incentivise

[115] Ministry of Finance (FIN), 2021, Kamerbrief COP26 verklaring Aligning International Public Support for the Clean Energy Transition, https://open.overheid.nl/repository/ronl-bc5c72a1-b147-430b-9fd1-4b1f2760929a/1/pdf/kamerbrief-tekenen-cop26-verklaring-internationale-overheidssteun-voor-groene-energie-transitie.pdf

[116] See for more information: https://www.thepmr.org/pmrimplements/1

sustainable production in producer countries. On 2nd November 2021, during the COP, the Netherlands joined the "Glasgow leaders' declaration on forest and land use[117] and commit to working collectively to halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation.

Monitoring international 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. Examples are the evaluation of the Dutch contribution to renewable energy and development over the 2004-2014 period (BuZa, 2015[118]) and the ongoing evaluation of Dutch climate policy for developing countries. 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 annual reports 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)[119].

4.3 Policies and measures no longer in place

The following policies have been repealed or have expired since the Third Biennial Report and the Seventh National Communication:

- the 2013 Energy Agreement which served as the main framework for national energy policies, ended formally in 2020 and was superseded by the 2019 National Climate Agreement;
- the MJA/MEE energy savings covenants, which ended after 2020. These covenants have been replaced by the CO_2-surcharge for industrial companies and an increased scope of the energy savings requirements in the Environmental Management Act for

[117] See for more information: https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/
[118] BuZa, 2015, Policy review on the Dutch contribution to renewable energy and development (2004-2014), https://www.government.nl/documents/reports/2015/08/01/iob-%E2%80%93-renewable-energy-%E2%80%93-policy-review-on-the-dutch-contribution-to-renewable-energy-and-development-2004-2014
[119] See for more information: https://drc.ngo/our-work/resources/iati/

companies with relatively high energy consumption levels. However, a small part of the MEE-covenant, the 'Addendum-MEE', was extended up to 2022;

- the financial scheme of postal code area cooperative projects (RVT), which ended in 2021 and has been replaced by a new subsidy scheme for energy cooperatives (SCE);
- the Agroconvenant, which ended after 2020 and has been replaced by agreements in the National Climate Agreement for the agricultural sector;
- the local Climate Agenda, which ended after 2020 and has been replaced by agreements in the National Climate Agreement;
- the Emission Standards for Medium-Sized Combustion Plants Decree (BEMS), which ended after 2012. Emission standards of medium-sized combustion plants are now regulated in the Decree Environmental Activities;
- financial insurance for geothermal energy, which was extended up to July 2022;

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 7th National Communication described the projections published in the National Energy Outlook in 2017 (ECN and PBL, 2017[120]). The projections in the 8th National Communication, as well as those in the Fifth Biennial Report, are based on the National Climate and Energy Outlook 2022 (PBL, 2022[121]). Unfortunately, these projections do not include projections for air polluting emissions. These are expected to be available by the end of 2022.

Section 5.2 presents the main results for greenhouse gases for the years 2025 and 2030. Section 5.3 is dedicated to the aggregate results and the uncertainty and sensitivity analyses. The methodologies and assumptions underlying the projections are described in more detail in section 5.4.

5.2 (A) Projections

Scenario used and major changes relative to the previous National Communication
The projections described in this chapter are based on the National Climate and Energy Outlook 2022 ("KEV 2022) published by the Netherlands Environmental Assessment Agency ("PBL"), which describes the most plausible developments based on the best available information about prices, markets, technology and policies. Compared to the National Energy Outlook 2017, which was used in the previous National Communication, the present projections have taken into account, for example, the policies and measures agreed in the National Climate Agreement (2019) and the proposed National Programme on Climate (2022).

Assumptions on policies have also been taken into account up to May 2022. New insights gained after May 2022, such as recent policy developments and statistics, have been included in the report, where relevant, up to August 2022, but have not been incorporated in the modelling. Statistics on greenhouse gas emissions for the year 2021 are still provisional. The KEV 2022 incorporates new insights into economic and

[120] ECN and PBL, 2017, Nationale Energieverkenning 2017, https://www.pbl.nl/publicaties/nationale-energieverkenning-2017
[121] PBL, 2022, Klimaat en Energieverkenning 2022, https://www.pbl.nl/publicaties/klimaat-en-energieverkenning-2022

demographic developments, sectoral developments, fossil fuel prices, and CO_2 prices and policies. New insights into exogenous modelling assumptions were taken into account up to May 2022, using official national statistics, mostly 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 2020 or, where possible, 2021.

Data on greenhouse gas emissions are in line with 2006 guidelines of the United Nations Intergovernmental Panel on Climate Change (IPCC). The results are available on the basis of the Global Warming Potentials (GWPs) from both the Fourth and Fifth Assessments by the IPCC. Although 2006 IPCC guidelines do not prescribe using GWPs from the IPCC Fifth Assessment Report (AR5), these do align with the European and national greenhouse gas emission reduction targets for 2030. The emissions presented in this chapter therefore use GWP's from AR5. In order to facilitate international comparisons, the emission projections reported in the CTF tables accompanying this report use GWP's from AR4.

The National Climate and Energy Outlook also projects the emission levels of greenhouse gases until 2040. Emission levels of air pollutants are not included, but will be published early 2023.

The KEV 2022 includes an uncertainty analysis that takes into account uncertainties concerning economic development as well as energy and CO_2 prices and policies. Projection results for key indicators (such as the national emission of greenhouse gases) are presented with a 90% probability range, which is denoted by the lower and upper value of the range shown in square brackets: [x-y]. Uncertainties with regard to weather influences are not included. However, historical emissions which are used in the modelling are normalized for the average climate in the past 30-years. It must be noted that insights into (expected) developments on energy markets were taken into account up to May 2022. More recent developments are not included in the modelling. For (import) fuel prices, however, relatively high price spikes on the short term have been included in the 90% probability range.

Emissions from land use, land use change and forestry (LULUCF) are by default included in the projections on the national level (unless mentioned otherwise). In previous reports, LULUCF were mentioned separately. This change is due to the fact that the national climate target for 2030 now includes emissions from LULUCF, in line with the European climate targets.

Variant "With Existing Measures" (WEM)

This variant encompasses currently implemented and adopted policies and measures as from 1 May 2022. It includes measures that are sufficiently concrete and have been made binding, such as the European Emissions Trading System (ETS), subsidies for renewable energy and the concrete and binding measures of the 2019 Climate Agreement.

Variant "With Additional Measures" (WAM)

In addition to all measures in the WEM variant, this variant encompasses planned policies and measures which have been published but not yet officially implemented by May 2022. Nevertheless, they were specific enough to be included in the modelling; for example, the European CO_2 norms for cars and the EU ETS as proposed by the European Commission in 2021. The policies included in the WAM variant differ only slightly from those in the WEM variant. The main differences are the inclusion of lower energy tax rates for electricity relative to natural gas, the application of the energy savings (reporting) requirement being broadened to include large industrial companies, and stricter CO_2 norms for new cars and vans. The projection results for the WEM and WAM variant are therefore to a large extent the same.

Variant "with scheduled measures" (WSM)

Since 2021, the KEV includes the new policy variant "with scheduled measures". This variant also includes the planned policies and measures up to May 2022 which were *not* specific enough to be included in the modelling. This applies to many policies announced in the 2019 Climate Agreement and many parts of the so-called Fit-for-55 legislative proposals from the European Commission. To assess the impact of these "scheduled" policies, additional assumptions were made about their design[122]. Impacts were estimated using partial modelling and expert judgement, using the WAM-variant as a reference. Examples of "scheduled" policies that were included in this variant are the requirement of zero CO2-emission from gas fired electricity plants, new nuclear power plants and the mandatory blending up to 1,6 bcm of green gas by 2030. Also, the (possible) national implementation of many Fit-for-55 proposals were included. Detailed results of this variant are not available and are therefore not included in the tables of the KEV, nor in the common tabular format (CTF) tables in this report. The results are, however, discussed in the sections below.

[122] Only scheduled measures with a potential impact to reduce emissions with at least 0.5 Mt CO_2-eq were considered

A complete list of the policies and measures included in the projections, either as implemented, planned or as scheduled, is published separately from the KEV 2022 report itself.[123]

A variant "Without Measures" is not included in the projections, because climate and energy policies have been implemented in the Netherlands as early as the 1990s. 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 Climate Agreement agreed in 2020) or as a result of European policies (such as the ETS and Ecodesign) and their revisions. In addition to cross-sectoral policies, each sector has its specific policies. This has resulted in a complex framework of policies and measures, making the development of a variant "Without Measures" (e.g. no new policies after 2000) very difficult, as well as a highly theoretical exercise. However, in order to estimate the impact of (groups of) PAMs on the reduction of greenhouse gases, the year 2020 was used as a baseline (see section 4.10 for more details).

5.3 Projection results

5.3.1 General trends

National greenhouse gas emissions will continue to fall until 2030

Figure 5.1 presents the emission of greenhouse gases in the period 1990-2030. After a peak in 1996, annual emissions have largely been decreasing in the Netherlands. This has been mainly due to lower non-CO_2 emissions from industry and agriculture. CO_2 emissions have also decreased, mostly in the energy sector and the built environment sector. Based on existing policy (the "With Existing Measures" or WEM variant), greenhouse gas emissions are expected to fall to 122.5-127.9 [114-139] Mt CO_2-eq by 2030. This is an emission reduction of 39-50% from 1990 levels (see Figure 5.1). With a decrease to 122.2-127.6 Mt CO_2-eq, the WAM variant results in only slightly lower emissions. The uncertainty range and the reduction (as a percentage) compared to 1990 are similar to those in the WEM variant. The possible reduction of emissions from scheduled policies and measures is estimated to be around 5-6 Mt CO_2-eq in 2030. This would result in emissions by 2030 that would be 41-52% below 1990 levels. In all

[123] https://www.pbl.nl/publicaties/beleidsoverzicht-en-factsheets-beleidsinstrumenten-achtergronddocument-bij-de-klimaat-en-energieverkenning-2022

variants, the national target to reduce greenhouse gas emissions with 55% by 2030 compared to 1990 levels is not achieved.

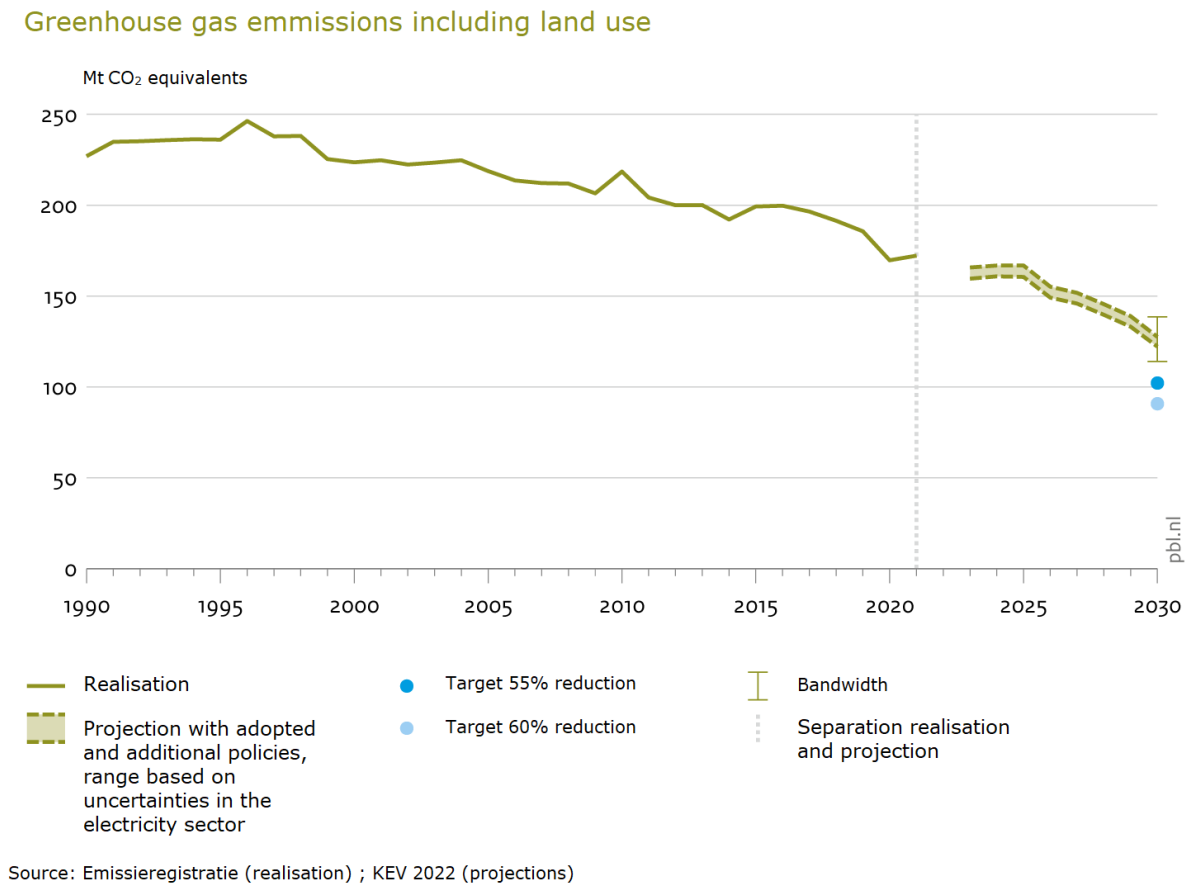


Figure 5.1: National emissions of greenhouse gases 1990-2030 (source: KEV2022)

Emissions of greenhouse gases are projected to decrease further after 2030

Based on the WAM variant, the emissions of greenhouse gases will further decrease after 2030 from 122.2-127.6 to 104.3-109.7 Mt CO_2-eq by 2040 (including LULUCF). This is 52-54% lower than 1990 levels. The projected rate of emission reduction, however, is lower than in the previous decade, as few existing and currently foreseen additional policies have set higher reduction ambitions after 2030. The main drivers for the decreasing emissions after 2030 are therefore related to (assumed) developments of energy and CO_2 prices and technology developments. The uncertainties associated with such exogenous and/or autonomous developments up to 2040 are, however, substantial.

Emissions covered by the European CO_2 emission trading system

Greenhouse gas emissions from companies in the Netherlands covered by the European Emission Trading System (EU ETS) have been declining since 2015, mostly due to increased use of renewable energy and lower electricity production from coal-fired power

plants. In the projections with existing measures, emissions are expected to decrease further to 39.3-44.7 [33-55] Mt CO_2-eq by 2030. This decrease is largely due to the ban on the use of coal for electricity production from 2030 onwards. Emissions in the WAM variant by 2030 are 39.9-45.3 [33-55] Mt CO_2-eq, which is slightly higher compared to the WEM variant. This is due to a slightly higher electricity demand by end users. See also section 4.2 for additional information.

Emissions covered by the European Effort Sharing Regulation
Greenhouse gas emissions from the Netherlands covered by the European Effort Sharing Directive (ESD) have been decreasing since 2010. As mentioned in section 4.2, cumulative emissions in the period 2013-2020 amount to 787 Mt CO_2-eq[124], which is well below the emission allowances allocated to the Netherlands (totalling 921 Mt CO_2-eq). The decrease over this period was mostly due to lower emissions from buildings and mobility/transport.

In the 2021-2030 period, emissions covered by the Effort Sharing Regulation (ESR) are expected to decrease further across all sectors. In the projections with existing measures, emissions are expected to decrease to 79.5 [75-84] Mt CO_2-eq by 2030. Emissions in the WAM variant by 2030 are 78.6 [74-83] Mt CO_2-eq. Projected cumulative emissions in the WAM variant amount to 865 Mt CO_2-eq, whereas the allocated emission allowances amounts to 903 Mt CO_2-eq. According to the proposed revision of the ESR, the amount of allocated emission allowances would drop to 839 Mt CO_2-eq. This would imply additional policies are required to reduce emissions further.

[124] On the basis of the AR4 GWPs, these were also used to determine the allowances.

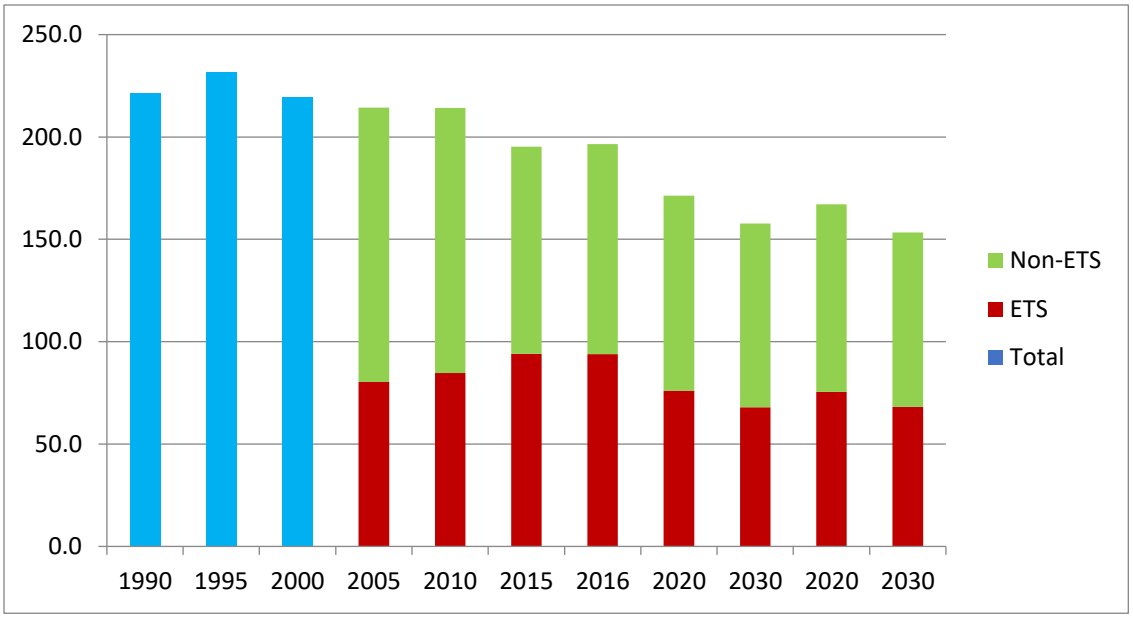


Figure 5.2: Historical emissions and projections (ETS/non-ETS split), 1990-2030, in Mt CO_2-eq

Projections of sectoral emissions

The following sections elaborate on the sectoral projections of sectoral greenhouse gas emissions. In Table 5.1, the projected sectoral emissions of greenhouse gases are compared to the indicative targets for remaining emission levels set by the current government. Based on the WAM variant, projected emissions in 2030 are above the targeted levels for most sectors, except for the electricity and (to some extent) the industrial sector.

Sector	1990	Projection 2030 with existing and additional policies	Bandwidth Projection 2030	Bandwidth projection 2030 including scheduled policies	Indicative residual emissions
Electricity	39.6	8-13	7-21	10-25	6.1-20.5
Industry	86.4	41	32-47	28-43	34.4-35.3
Built environment	30	18	15-21	13-19	10-11.2
Mobility	32.2	28	26-31	25-30	23.7-24.9
Agriculture	33.1	23	21-24	21-24	18.9
Land use	5.7	3.7	3.2-4.2	1.8-3.1	1.8-2.7
Total (Mt)	227	122-128	114-139	108-133	94.9-113.5
Reduction from 1990 (%)		44%-46%	39%-50%	41%-52%	50%-58%

Table 5.1 Projections of sectoral greenhouse gas emissions with existing and additional policies compared to the indicative targets set for remaining emission levels (KEV2022)

Please note that the sectoral definitions used in this chapter are according to the Dutch national policy framework. These differ from the sectoral definitions according to the IPCC guidelines. This gives rise to important differences when it comes to the electricity sector and the industrial sector. Under the Dutch national policy, emissions from energy companies producing electricity and/or heat are included within the electricity sector. Emissions from heat and electricity produced by combined heat and power (CHP) systems owned by industrial (and horticultural) companies are allocated to the respective (end-use) sectors. Emissions from energy industries, such as from fossil fuel extraction and refining, are allocated to the industrial sector. Another difference is the inclusion of emissions from mobile machinery in the mobility sector. The projections reported in CTF tables in this report, however, follow the sectoral definitions according to the IPCC guidelines.

5.3.2 Electricity

Emissions from the electricity sector encompass emissions from electricity and heat production and distribution by energy companies. By contrast, emissions from the combustion of fuels for use in buildings and horticulture are excluded and described in the sections below. In addition, emissions from energy industries (fossil fuel extraction and refining) are included in the industrial sector. CO_2 accounts for nearly all greenhouse gas emissions in the electricity sector. Less than 1% of emissions comes from methane and nitrous oxide, which is associated with processing and combusting fossil fuels.

Emissions from the electricity sector are entirely covered by the European Emission Trading System. Important measures for these sectors are the Stimulation of Sustainable Energy Production and Climate Transition (SDE++) subsidy scheme, the roll-out of offshore wind farms, the ban on the use of coal for electricity production, and the closure of coal-fired power plants).

Projections of emissions from electricity production are relatively uncertain due to the integration within the North West European electricity market. Price differentials between countries within this market result in changes in the export and import of electricity, influencing emissions in those countries. Therefore, the (central) projection is presented as a range of emissions accounting for uncertainties related to production and consumption patterns within the entire North West European market. Other uncertainties within the Netherlands (e.g. uncertainties concerning fuel prices and economic development) are included in the 90% probability range.

Between 2000 and 2015, annual emissions ranged around 50 Mt CO_2-eq, depending on import and export patterns and relative price differences between coal and natural gas. In 2020, emissions dropped to 32.7 Mt CO_2-eq due to the (temporary) closure of coal-fired power plants, increasing renewable energy production and due to measures in response to the COVID pandemic. Emissions are expected to decline gradually until 2030 despite an (modest) increase in electricity consumption due increasing electrification and the uptake of increasing renewable energy production (see Figure 5.3 below), but the projections are considered highly uncertain due to recent market developments. Based on the existing policies, projected emissions are expected to drop sharply to 7.5-12.9 [6-21] Mt CO_2-eq in 2030 due to the ban on the use of coal for electricity production. Due to a slightly higher electricity demand, emissions in the WAM variant are with 8.1-13.5 [7-21] Mt CO_2-eq slightly higher. With scheduled policies, emissions are expected to increase with 3-5 Mt CO_2-eq from the electricity sector, due to increasing demand for electricity by other sectors. Scheduled policies for the electricity sector itself, such as a subsidy for zero-emission gas power plants, are expected to have an impact after 2030.

Annual emissions are expected to decrease further after 2030 to 6.2-11.6 Mt CO_2-eq and 7.9-13.4 in 2040 for the WEM and WAM variant, respectively. Electricity demand is growing due to further electrification. To meet this increasing demand, electricity production is increasingly, mainly from wind and solar, but also from natural gas.

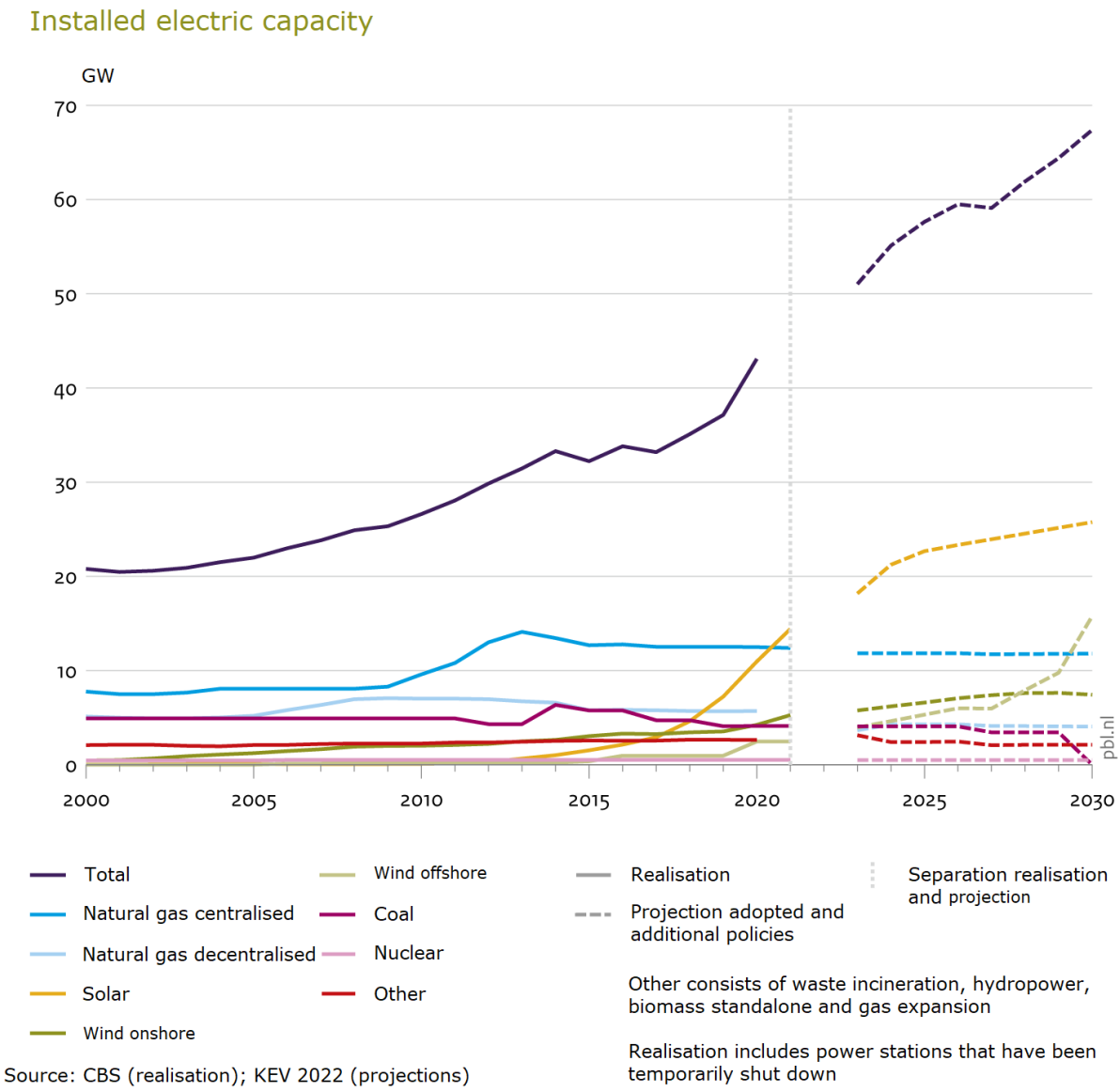


Figure 5.3: Historical and projected installed electric capacity by energy source (KEV 2022) with existing and additional policies and measures, 2000-2030

5.3.3 Industry

Emissions from the industrial sector comprise emissions from manufacturing and the food & beverages industry, construction companies, refineries, cokes industry, extraction and distribution of fossil fuels, waste management and (drinking) water companies. Key policy measures in this sector are the EU ETS, the national CO_2 surcharge, SDE++ subsidies and energy savings obligations.

Between 2000 and 2021, total emissions from the industrial sector decreased from 74 to 53 Mt CO_2-eq, mainly due to sharply decreasing emissions of methane, nitrous oxide and fluorinated gases (see Figure 5.4). This was mainly the result of a gradual decline of methane emissions from landfills and of mitigation measures in the production of nitric acid. Emissions of CO_2 decreased slightly in the same period from 49.6 to 47.1 Mt due to lower production and thus energy consumption.

Emissions are projected to decrease further to 41 [32-47] Mt CO_2-eq by 2030 with existing measures. Emissions of CO_2 are projected to decrease substantially to 37 [28-43] Mt CO_2, while non-CO_2 emissions decrease modestly to 4.3 [4.0-4.7] Mt CO_2-eq. CO_2 emissions are largely reduced in the chemical industry, refineries and waste incineration plants using Carbon Capture and Storage (CCS), amounting to around 9 [5-11] Mt CO_2 captured and stored in 2030, based on projects to be subsidised through the SDE++. Other important contributions to this decrease come from electrification and energy efficiency improvements, which will also drive emission reductions after 2030. Methane emissions from landfills and natural gas extraction continue to decrease gradually after 2021. Emissions from the production of caprolactam are expected to remain stable up to 2030, although at a lower level due to high natural gas prices, resulting in slightly lower emissions (-0.5 Mt CO_2-eq) compared to 2021. As few additional policies are taken into account, the projections including additional measures are similar to the WEM variant. Scheduled policies, such as the use of green hydrogen, could reduce emissions further with 2-6 Mt CO_2-eq by 2030.

Similar to the electricity sector, the projections for the industrial sector are considered highly uncertain due to recent developments on energy markets, especially for the coming years. Energy intensive industries have responded to increasing energy prices by lowering their production levels. The central projection assumes a return to previous production levels in the coming years. The lower values of the 90% probability range, however, assume a continuation of lower productions levels.

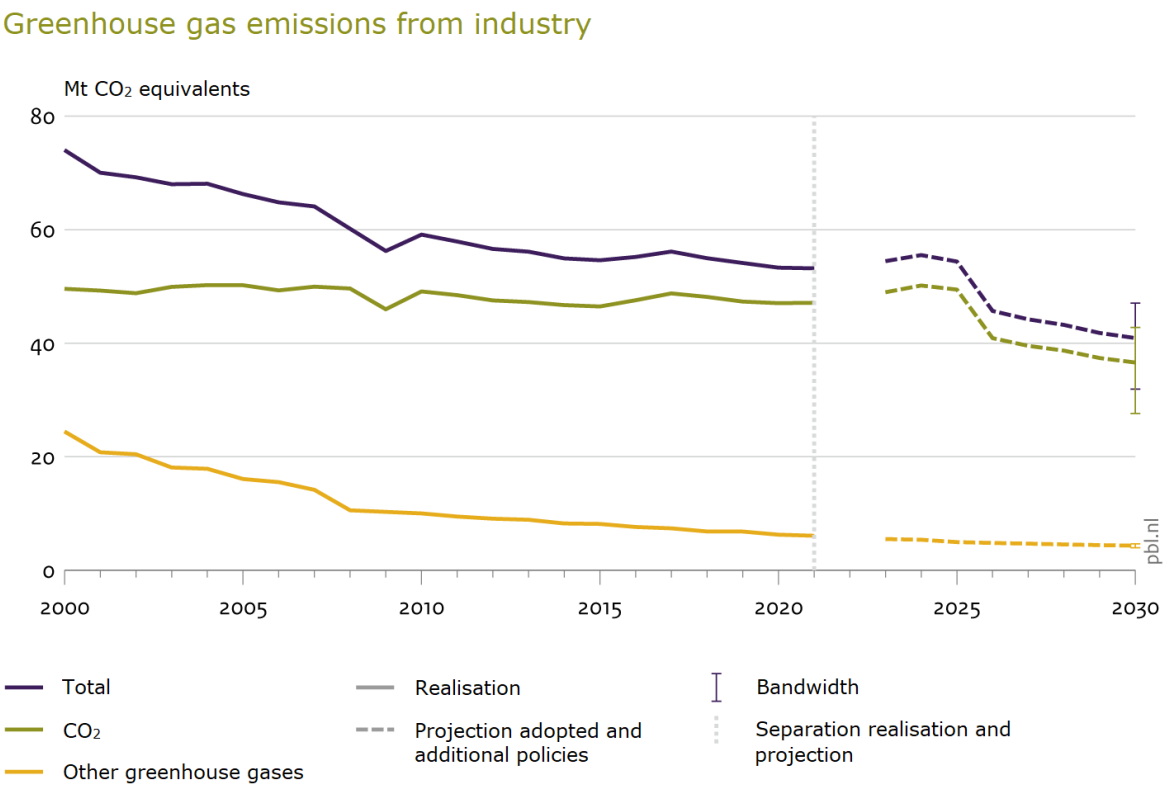


Figure 5.4: Historical emissions and projections (WAM variant) from the industrial sector (KEV2022)

5.3.4 Built environment

The emissions from the built environment encompass the emissions from dwellings and non-residential buildings in the services sector (such as offices, schools and hospitals), but exclude emissions from buildings in the industrial and agricultural sectors (which are allocated to those sectors). CO_2 emissions arise from the use of natural gas for spatial heating, cooking and tap water. Yearly fluctuations largely follow changes in the mean temperatures during winter. Projections are modelled using historical emissions which are normalised for an average winter. The projected demand for heating and cooling also takes into account increasing mean temperatures, in line with (national) climate scenarios. Non-CO_2 emissions occur but are small compared to CO_2 emissions (2% of sectoral emissions in 2021). They include methane slip from gas boilers and nitrous oxide from product use (i.e. dissolvents and spray cans).

The emissions in the built environment decreased from 29.7 Mt CO_2 in 2000 to 24.5 Mt CO_2-eq in 2021,[125] despite a 20% increase in the number of households and a 24% increase in the floor area of non-residential 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, mainly due to the installation of (hybrid) heatpumps, further insulation and expansion of district heating. With existing measures, emissions are projected to amount to around 18 [15-21] Mt CO_2-eq in 2030 (see Figure 5.5). The projections including additional measures are similar to the WEM variant. The developments for dwellings and non-residential buildings are described below. Scheduled policies, such as mandatory (end-of-life) replacement of gas boilers with hybrid heat pumps, could result in 1-3 Mt CO_2-eq lower emissions in 2030.

Households

The normalised natural gas consumption by households dropped from 381 to 296 PJ between 2000 and 2021, despite the fact that the number of households grew from 6.3 to 7.6 million during this period. It is expected that this trend will continue up to 2030 and 2040, respectively. Both in the WEM variant, the projected natural gas consumption by households is around 236 PJ by 2030 and 204 by 2040. Consumption in the WAM variant is only 1-2 PJ lower. Projected emissions are 18.2 [15-21] Mt CO_2 in 2030. This decrease in demand for natural gas is due to renovation measures, increasing use of heat pumps, increasing connections to district heating, and the construction of new dwellings (which are gas-free dwellings). Increasingly warmer winters are also expected to contribute to lower gas consumption.

Solar PV electricity production has increased sharply over a period of 10 years from nearly zero to 16PJ in 2021. This is expected to grow to 32 PJ and 50 PJ by 2030 and 2040, respectively, which will largely offset the increase in demand from electric appliances and electrification of heating systems.

[125] Normalised emissions amounted to 31.6 and 23.8 Mt CO_2 equivalents in 2000 and 2021, respectively.

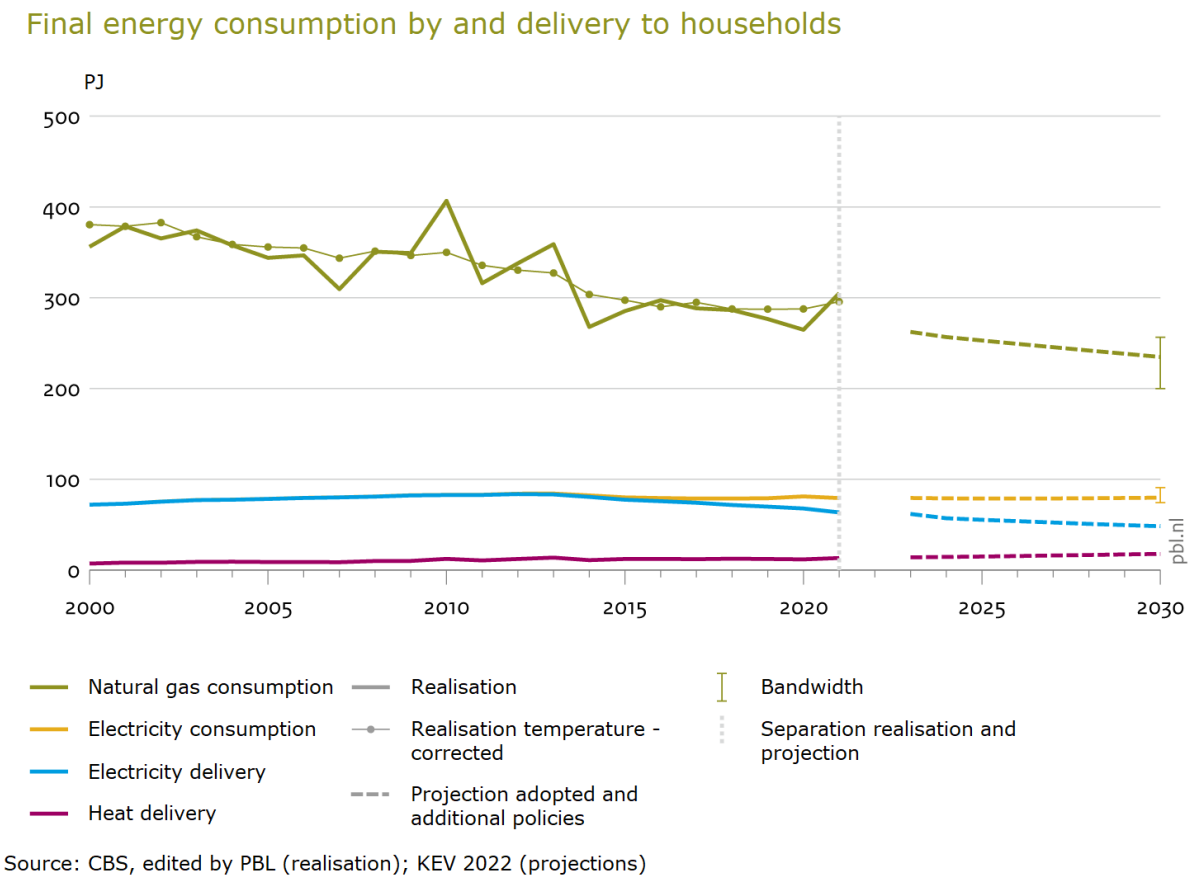


Figure 5.5: Historical and projected (WAM variant) final energy consumption by households (KEV2022)

Services

While the building stock in the services sector almost doubled between 1980 and 2010, there was a marked decrease in new building after 2010 as a result of the economic recession, creating a surplus of office and retail premises. This was a temporary slowdown, however, as the total floor area is increasing again, albeit at a slower 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 ("the new world of work") and senior citizens staying in their own homes for longer are also contribute to the decreasing need for space. Vacancy levels were around 3% on average in 2020 and are assumed to remain stable in the projections.

Natural gas consumption decreased from 138 to 113 PJ between 2000 and 2021,[126] largely due to efficiency measures taken and increasing energy performance

[126] Normalised natural gas consumption amounted to 149 and 109 PJ in 2000 and 2021, respectively.

requirements for new buildings. In addition, the use of renewable energy for heating (mostly heat pumps) increased during this period. Projected natural gas consumption decreases further in the WAM variant to 71 [65-77] PJ in 2030, mainly due to the energy savings obligation, including a stricter enforcement of the minimum energy label C for existing buildings.[127]

Electricity consumption, on the other hand, increased from 97 PJ in 2000 to 126 PJ in 2011. Thereafter, consumption fell to 120 PJ in 2020 due the use of more efficient lightening and appliances under the EU's Ecodesign framework. Although consumption increased slightly to 122 PJ in 2021, consumption is expected to decrease again in the WAM variant to 116 [111-128] PJ in 2030 as the result of (stricter enforcement of) the energy savings obligation.[128] From 2027 onwards, however, electricity consumption will start to grow again as energy efficiency improvements are outpaced by the growth of the building stock and electrification of heating systems. On the other hand, PV solar electricity production is expected to grow even faster, which will reduce the amount of electricity supplied to end users by energy companies.

[127] The projected consumption in the WEM variant is 1 PJ higher.
[128] The projected consumption in the WEM variant is 2 PJ higher.

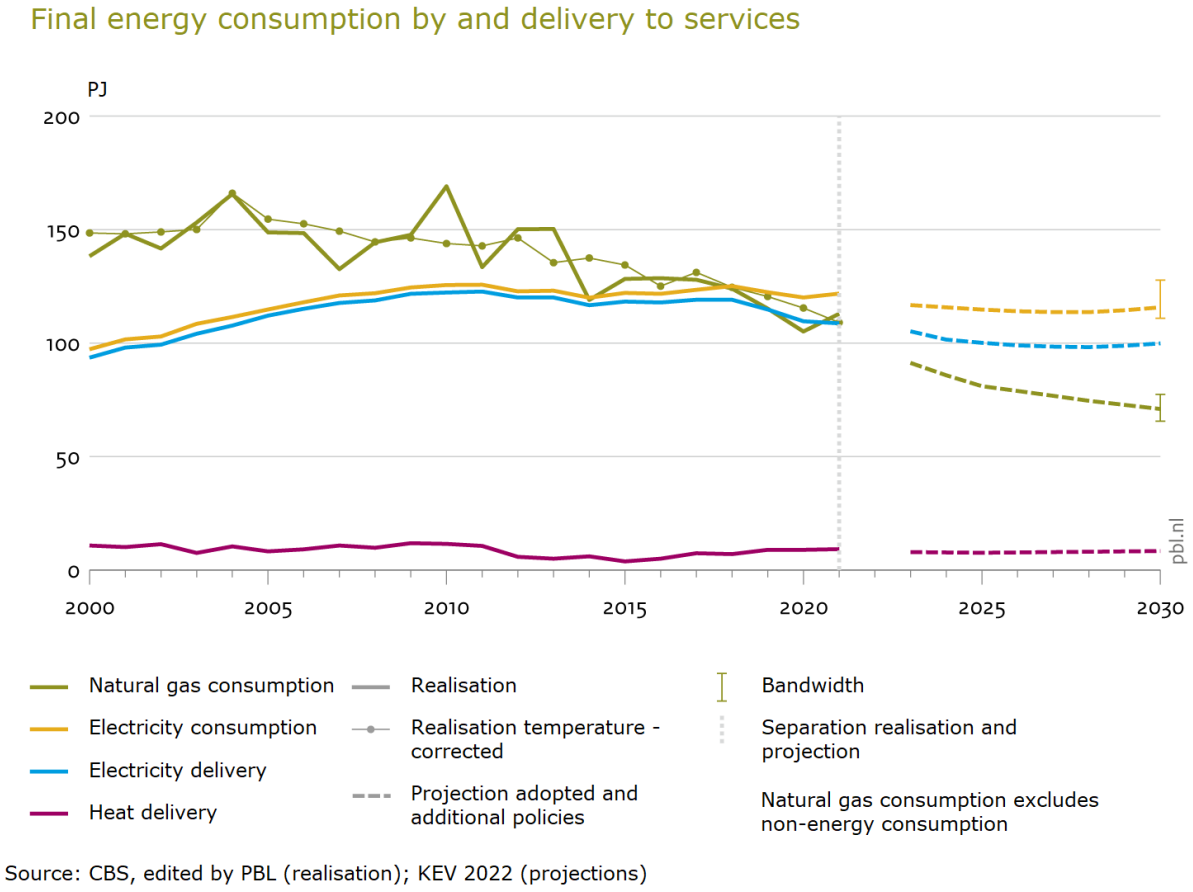


Figure 5.6: Historical and projected (WAM variant) final energy consumption by the services sector (KEV2022)

5.3.5 Mobility

The mobility sector encompasses emissions from mobility and transport in the Netherlands. This includes emissions from mobile machinery from other economic sectors. Road traffic and transport is responsible for around 85% of the emissions. With a share of 98%, CO_2 emissions make up the lion's share of total emissions. Emissions related to international aviation and maritime shipping is excluded and discussed separately in section 5.3.9.

After 2010, emissions from mobility and transport in the Netherlands decreased from 39 Mt to 30.5 Mt CO_2-eq by 2021. This decrease was mainly due to the weaker growth in road traffic, a more economical vehicle fleet under the influence of the European standards for CO_2, mandatory blending of petroleum and diesel with biofuels and tax incentives to boost uptake of fuel efficient vehicles. Emissions in 2020 fell below 1990 levels due to the impact of the COVID pandemic, although traffic volumes are expected

to rebound to pre-COVID levels in 2022. In addition, the maximum speed limit on motorways during day times was lowered from March 2020 from 130 km/h to 100 km/h in order to reduce nitrogen oxide emissions, which also contributed to a more economic fuel consumption.

It is expected that the demand for transport (of both goods and passengers) will continue to increase as a result of further economic growth. In the WEM variant, although energy consumption in the sector will remain relatively stable until 2030, emissions are projected to fall further to 28.9 [27-32] Mt CO_2-eq in 2030 due to a swift increase of the share of electric vehicles and a growing share of biofuels. By 2040, the emissions are projected to decrease further to 24.4 Mt CO_2-eq as a result of increasing electrification.

In the WAM variant, emissions are projected to fall to 28.2 [26-31] Mt CO_2-eq Mt by 2030 and decrease further to 19.8 Mt CO_2-eq by 2040. Compared to the WEM variant, busses and mobile machinery are electrified faster in the WAM variant. In addition, more efficient vehicles are sold in this variant due to the increased European CO_2 performance standards. Emissions could be around 1 Mt CO_2-eq lower with scheduled policies.

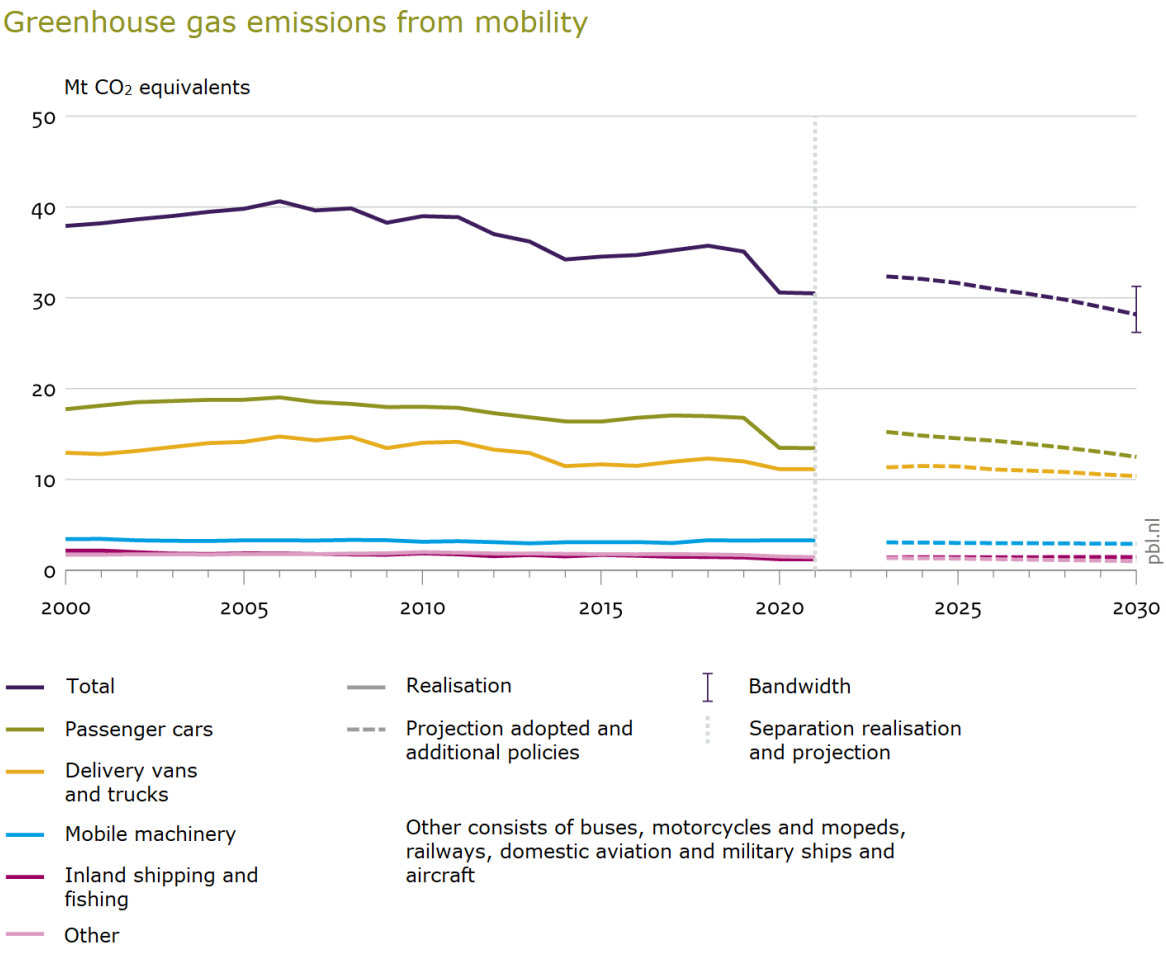


Figure 5.7: Historical data and projections (WAM variant) of greenhouse gas emissions from mobility (KEV2022)

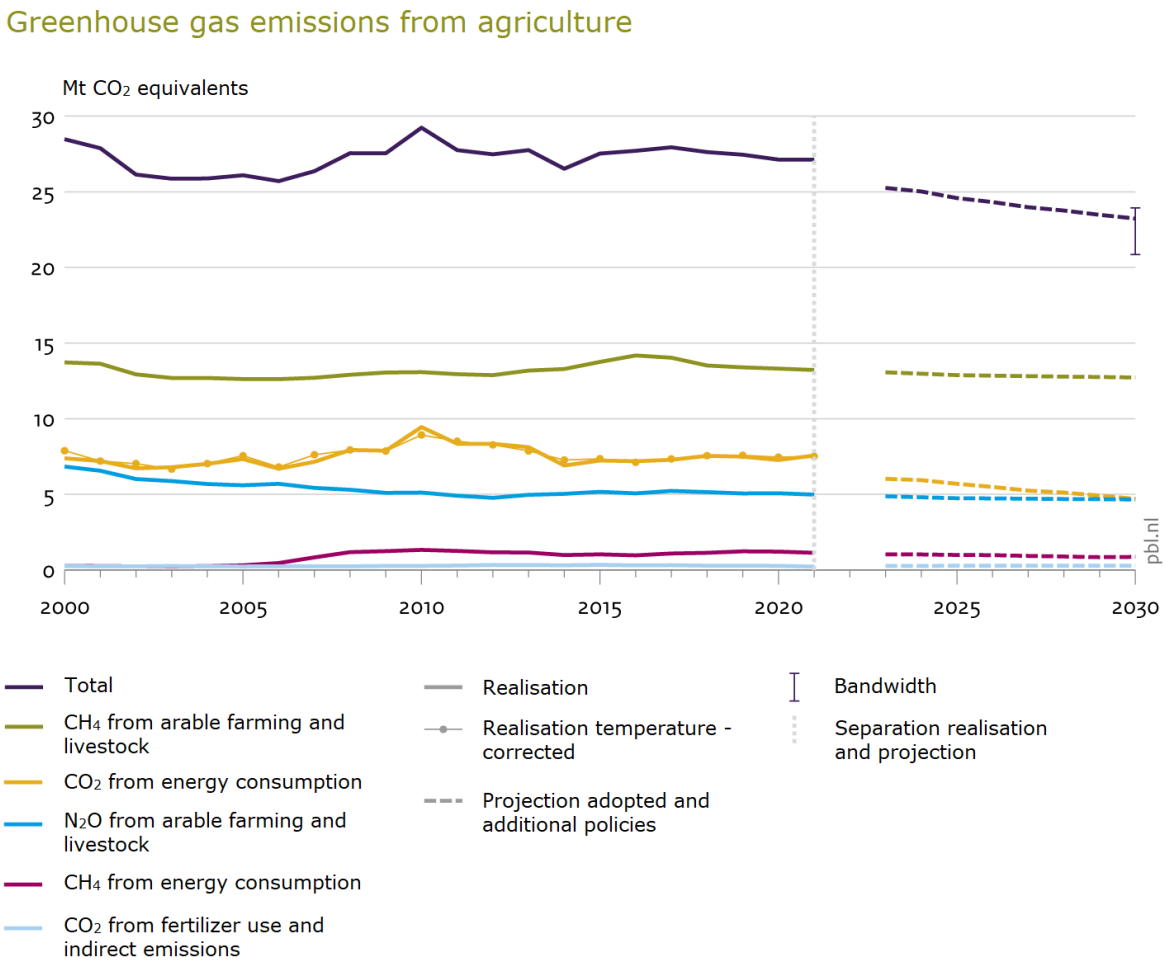
5.3.6 Agriculture

Emissions from agriculture encompasses energy-related CO_2 and methane emissions from (mainly) the horticulture and process emissions of methane and nitrous oxide from cattle, manure management and the use of fertilisers. Methane makes up 53% of total sectoral emissions in 2021, and largely takes the form of process emissions. CO_2 makes up 29% and nitrous oxide 18%. Total emissions in 2021 amounted to 27.1 Mt CO_2-eq, of which 8.7 Mt CO_2-eq was energy-related and 18.5 Mt CO_2-eq was process-related. It is projected that emissions will decline to 23.3 [21-40] Mt CO_2-eq by 2030.

This projected decline is largely due to declining energy-related emissions to 5.7 and 5.6 Mt CO_2-eq in 2030 in the WEM and WAM variants respectively. High energy prices and a shift toward less energy-intensive crops result in lower natural gas consumption by the

horticulture. This also results in less methane slip from CHP systems, which are widely used within this sector. The modestly increasing use of renewable energy also contributes to the decrease in emissions. The area "under glass" and total CHP capacity installed are assumed to remain stable up to 2030 and 2040, but market developments are currently highly uncertain.

The process-related emissions of methane and nitrous oxide have been decreasing steadily from 20.6 Mt CO_2-eq in 2020 to 18.4 Mt CO_2-eq in 2021. This decrease is due to the reduced use of artificial fertiliser under the influence of the manure policy and high natural gas prices and because fewer dairy cattle were grazing outdoors. This has also led to lower nitrous oxide emissions. In the projections, these trends are expected to continue, resulting in process-related emissions of 17.7 [16.1-17.6] Mt CO_2-eq (in both the WEM and WAM variants). Changes in the cattle size also contribute to the decrease in process-related emissions. The numbers of cows and pigs are expected to decrease with 5% and 9% respectively between 2020 and 2030 due to national policy measures. These numbers may even decrease somewhat more, as the derogation the Netherlands has been granted from the (higher) European limits for the amount of nitrogen from manure that can be applied annually, is expected to end in the coming years. Poultry numbers are expected to remain relatively stable. With scheduled policies aiming to reduce nitrogen emissions, greenhouse gas emissions could be 0.1-0.4 Mt CO_2-eq lower by 2030.



Source: Emissieregistratie, edited by PBL (realisation); KEV 2022 (projections)

Figure 5.8: Historical and projected emissions (WAM variant) from agriculture (KEV2022)

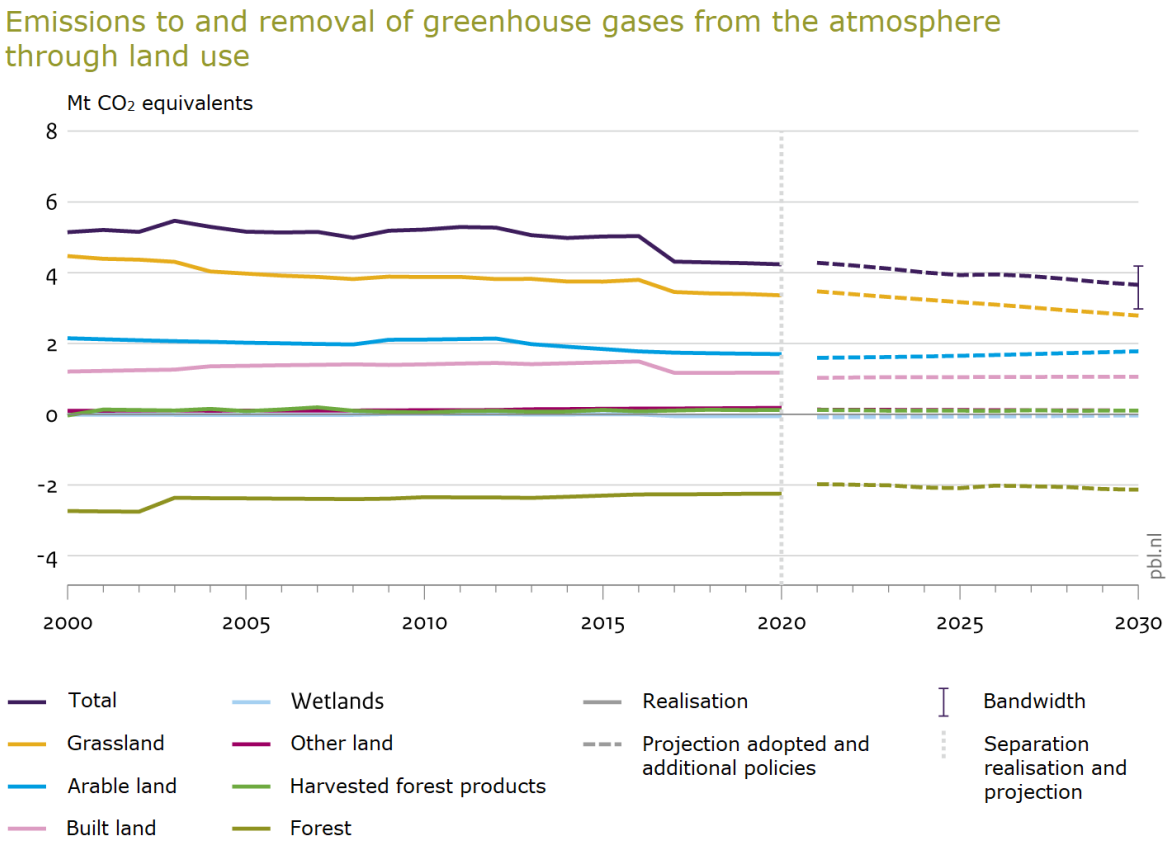
5.3.7 LULUCF

Emissions and removals from land use, land use change and forestry do not include emissions from the use of manure and fertilisers in the agricultural sector. Emissions and removals from agricultural soils are included in the LULUCF sector. With a share of 98% in 2021, CO_2 emissions are dominant. Although removals of CO_2 occur in forests and wetlands, the LULUCF sector in the Netherlands is a net emitter of CO_2.

Net emissions from LULUCF declined from 5.1 Mt CO_2-eq in 2000 to 4.3 Mt CO_2-eq in 2021. The main emission sources are grasslands (on peatland), croplands and soils in the built environment. Since 2000, emissions declined primarily due to changed use of grassland and forest management. Forests are the main net sink of CO_2, which has,

however, been declining gradually since 2000. Forests are becoming relatively older (meaning less CO_2 is removed per hectare) and net deforestation has increased. Emissions from grassland are declining as a result of its conversion to cropland as well as the construction of new infrastructure and buildings, which both result in a net release of CO_2 from the soil. Since 2000, more CO_2 is captured by forests due to the growth of existing forests and the creation of new forests.

Projected net CO_2 emissions from LULUCF will decrease to nearly 3.7 [3.0-4.2] Mt CO_2-eq in 2030 in both the WEM and WAM variants. This the result of various developments. It is expected that emissions from grassland will decrease as the area shrinks due to conversion to build land and the implementation of policies aiming to reduce CO_2 emissions from peat soils. Emissions from built land will slowly decrease as new buildings are increasingly built within the existing built environment. Forests, however, are expected to take up slightly more CO_2 as the result of policies on reforestation and nature development.



Source: Emissieregistratie (realisation); KEV 2022 (projections)

Figure 5.9: Historical and projected emissions from LULUCF (KEV2022)

5.3.8 International shipping and aviation

In accordance with international climate agreements, CO_2 emissions from international shipping and aviation are not allocated to the Netherlands. This also applies to emissions from inland shipping with a destination or departure outside of the Netherlands. Energy consumption for international aviation is, however, included in the energy savings targets of the EU EED. Similarly, energy consumption attributable to international shipping counts towards the target for the total gross end consumption of renewable energy under the Renewable Energy Directive (RED). Substantial amounts of bunker fuel are sold in the Netherlands for international shipping and aviation in Europe. In 2021, around ¾ of the bunker fuel sold was used for international maritime shipping, 17% for international aviation and 6% for international inland shipping. CO_2 accounts for 99% of the total greenhouse gas emissions from this sector. Nitrous oxide and methane emissions make up a relatively small part of total missions.

Emissions from sold bunkers fuels to international shipping and aviation amounted to 43.8 Mt CO_2-eq in 2021. This is 10% lower than emission levels in 2019 due to the impact of the COVID pandemic. Emissions of international shipping were 33.7 Mt CO_2-eq 2021, which are projected to remain relatively stable up to 2030 with 34 [27-40] Mt CO_2-eq in the WAM variant. A growth of shipping volumes is compensated with increasing fuel efficiency of vessels and declining share of Dutch ports in bunker fuel market.

Emissions from international aviation in 2021 was 7.3 Mt CO_2-eq, almost 40% lower compared to 2019 levels. Emissions are expected to recover to pre-COVID pandemic levels, but at a slower pace as the increasing emissions in the period up to 2019 due to high oil prices and higher national taxation on outgoing flights and (stricter) European policies on emission trading and the mandatory use of sustainable aviation fuels. Projected emissions for international aviation for 2030 are 10.9 [9.6-12.1] Mt CO_2-eq in the WAM variant. Emissions could be reduced with more than 1 Mt CO_2-eq as the result of scheduled polices such as the (national) mandatory blending of biofuels and excise duty on kerosine.

Emissions from international inland shipping in the WAM variant is projected to increase slightly from 2.7 Mt CO_2-eq in 2021 up to 2.8 [2.2-3.5] Mt CO_2eq in 2030 due to growing shipping volumes while at the same time fuel efficiency and the use of biofuels increases.

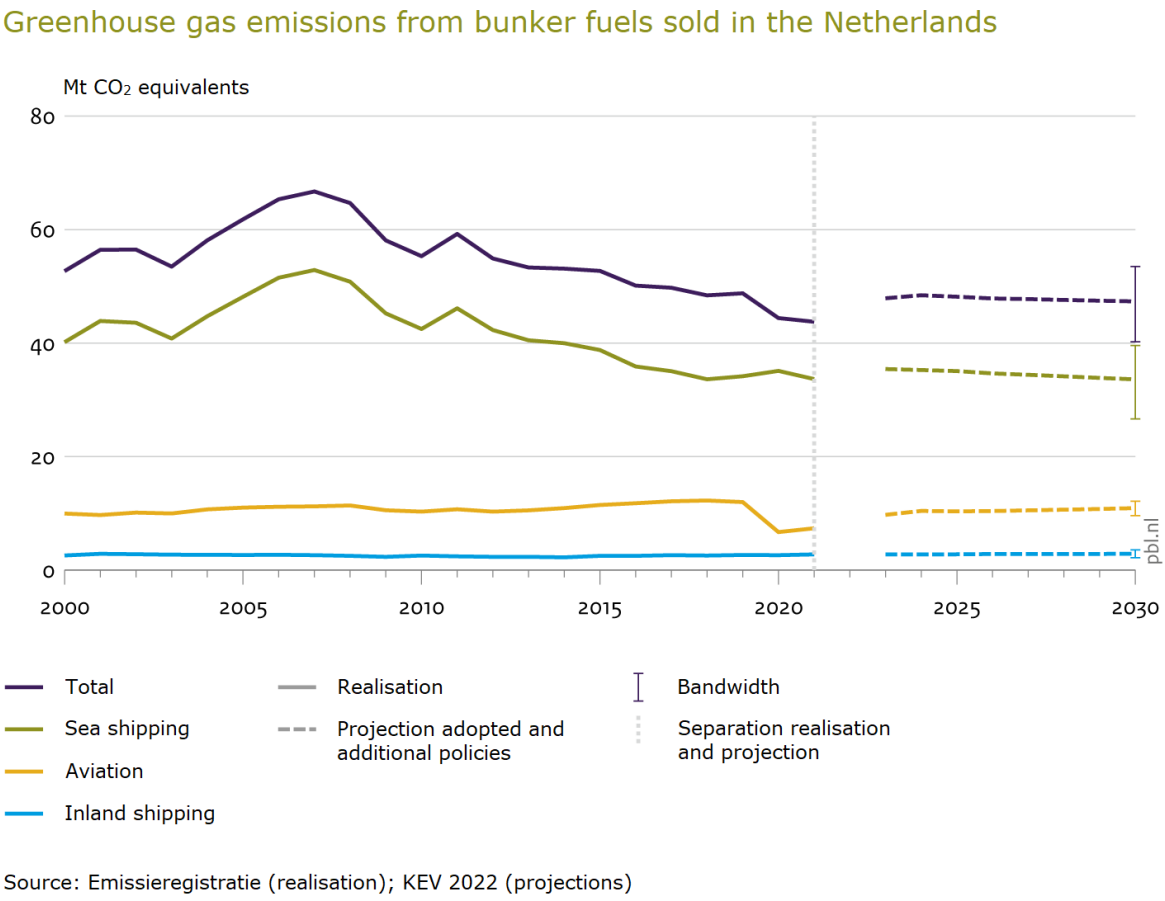


Figure 5.10: Historical emissions and projections from international aviation and shipping, including existing and additional measures (KEV2022).

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

5.4.1 Effects on emissions of greenhouse gases

The national emissions of greenhouse gases with existing and additional measures (WAM variant) are projected at 122-128 [114-139] Mt CO_2-eq, which is 44-46% [39-50%] below 1990 levels (see Table 5.2 below). This is insufficient however to meet the national emission reduction target of 55%. When the possible impact of scheduled policies are taken into account, the reduction is 41-52% below 1990 levels.

Emissions included in the EU ETS fall 44-51% between 2005 and 2030 in the WEM variant. In the WAM variant is nearly the same. Emissions covered by the EU ESD fall with 40% in the WEM variant, almost similar to the WAM variant.

The impact of additional measures can be determined by the difference between the WEM and WAM variants, which amounts to 0.3 Mt CO_2-eq by 2030. As there are few differences in the measures that have been taken into account, the impact of additional measures is limited. The impact of scheduled measures relative to the WAM variant has been estimated using expert judgement methods. According to the KEV2022, the total impact of scheduled measures, for which quantification of impacts was possible, is 5-6 Mt CO_2 eq. The expected impact of policies and measures on emissions in 2030 is also described in section 4.2.12.

Total greenhouse gas emissions in Mt CO_2 equivalents on the basis of GWPs in AR5 (including LULUCF)										
									WEM	WAM
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021***	**2030**	**2030**
Total emissions	227,0	236,0	223,6	218,8	218,5	199,3	169,7	172,2	122,5 - 127,9	122,2 - 127,6
breakdown by gas										
carbon dioxide	168,4	178,4	176,7	182,4	187,1	169,5	142,4	145,3	98,7 - 104,1	98,4 - 103,8
methane	35,7	33,2	27,1	22,1	21,7	20,3	19,0	18,7	16,8	16,8
nitrous oxide	15,6	15,8	13,9	12,4	7,3	7,5	7,0	6,7	6,0	5,9
fluorinated	7,3	8,7	6,0	1,8	2,4	1,9	1,3	1,5	1,0	1,0
breakdown by ETS and non-ETS										
ETS				80,4	84,7	94,1	74,1	74,1	39,3 - 44,7	39,9 - 45,3
non-ETS				133,2	128,6	100,2	91,4	93,8	79,5	78,6
*** provisional data**										

Table 5.2: Greenhouse gas emissions 1990-2030, central range of projections including existing and planned policies and measures, split by gas and ETS/non-ETS (Source: KEV2022)

5.4.2 Uncertainty analysis

The projections makes use of the best information available up to May 2022. However, many developments are largely exogenous to the modelling – such as the economy, demography, import fuel prices, technology and human behaviour – for which assumptions are used about their future development. As future developments are

inherently uncertain, these factors have a significant influence on the modelled trends. The effects of policy measures can also be uncertain, because the behaviour of targeted groups is usually difficult to predict. Therefore, an uncertainty analysis is included in the KEV2022 that takes into account key uncertainties concerning economic development, as well as energy and CO_2 prices and the impact of policies. The 'central' resulting values reflect the development which can be expected on average. Projection results for key indicators (such as the national emission of greenhouse gases) are also presented with an upper and lower value of a 90% probability range. This range is denoted between the brackets [and]. Uncertainties with regard to weather influences are not included. The KEV2022 does not include a sensitivity analysis on the impact of specific key uncertainties. It must be noted that insights in (expected) developments on energy markets were taken into account up to May 2022. More recent developments are not included in the modelling. For (import) fuel prices, however, relatively high price sparks on the short term have been included in the 90% probability range.

In addition, projections of electricity production in the Netherlands are relatively uncertain due to the integration within the North West European electricity market. Price differentials between countries usually result in swift changes in export and import of electricity, thus influencing emissions within those countries. Therefore, the projection results for the electricity sector are presented as a range of emissions instead of a single 'central'. As no single 'central' value is assigned to the electricity sector, the 'central' projection results of national totals are also assigned as a range. This range takes into account uncertainties related to production and consumption patterns within the entire NW European market. Other uncertainties (such as fuel import prices and economic development in the Netherlands) are included in the 90% probability range.

The KEV2022 also includes projection results for 2035 and 2040. Where the projection up to 2030 can be considered as an ex-ante impact assessment of climate and energy policies, the projection results after 2030 must be considered as an outlook. The results are even more uncertain compared to the projections up to 2030 as exogenous factors and market behaviour are difficult to predict for such long periods. Equally important are the uncertainties related to European and national policies after 2030. With some exceptions (such as the continuation after 2030 of the EU ETS, EU performance standards on energy and CO_2 and the SDE++), there are yet policies to be defined for the period after 2030. Policies therefore play a limited role in the outlook. Emissions developments after 2030 are mostly driven by assumed developments of exogenous factors, such as energy and CO_2 prices and autonomous factors such as technological

development. Therefore, only ranges for emission developments after 2030 are given in the KEV2022.

The varying degrees of uncertainty surrounding the exogenous and other factors are shown by means of uncertainty ranges with a 90% probability range, which means that an outcome outside the given ranges is very improbable but still conceivable. This range is calculated using a Monte Carlo analysis taking into account the key uncertainties for the various sectors, reflected as upper and lower values. The uncertainty calculations produce ranges in the total emissions of 16% for 2030 (see Table 5.3).

	2030	
	WEM	WAM
Central range	123 - 128	122 - 128
Uncertainty range	114 - 139	114 - 139
Deviation from central range	-7% / +9%	-7% / +9%

Table 5.3: Projected national emissions with uncertainty ranges, 2020-2030, in Mt CO_2-eq, including LULUCF, using GWP values from AR5

5.5 (C) Description of methodology

5.5.1 Models and methods used

The KEV2022 used a combination of models to construct an energy balance sheet of energy consumption and production in the Netherlands that reflects on the past and projects the future. The quantitative developments in the underlying activities form the basis of the projections and include the production of electricity and goods, the use of devices, the heating of buildings, the number of kilometres travelled, cattle size, etc. 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. These statistics are used to calibrate the models. For the projections, the expected changes to these activities are calculated on the basis of assumptions about developments in the economy, demographics and the energy market. The projections also include 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

CO_2 mitigating measures (such as renewable energy and CCS technologies). Finally, the energy consumption and production is converted into CO_2 emissions.

The projections of non-energy-related emissions are determined using specific models (like for agriculture and LULUCF) and/or spreadsheet tools (like for IPPU and waste). 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 5.4 below.

Key underlying assumptions	Unit	2000	2005	2010	2015	2020	**Projected** 2030
GDP	EUR 2015 x million	580,703	620,748	664,765	690,008	727,885	885,503
GDP growth rate	index (2000=100)	100	107	114	119	125	152
Sectorial gross value added	EUR 2015 x million	514,117	550,014	593,884	620,835	652,598	840,808
Population	millions	16	16	17	17	17	18
Population growth	index (2000=100)	100	103	104	107	110	116
Number of households	millions	6.8	7.1	7.4	7.7	8.0	8.7
Household size	inhabitants/household	2.3	2.3	2.2	2.2	2.1	2.1
Exchange rate to EUR and to US dollar	USD/EUR	0.92	1.24	1.33	1.11	1.14	1.27
International oil price	EUR 2021 / barrel	46.18	58.22	71.14	52.59	39.08	92.02
International coal price	EUR 2021 / tonne	48.49	70.97	81.70	64.75	58.49	80.70
International gas price	EUR 2021 / m^3			0.22	0.23	0.13	0.43
Electricity (commodity baseload price)	ct2021/kWh	6.3	5.6	5.8	4.4	3.3	7.3
Carbon price ETS sectors	Eur2021/tonne CO_2			17.0	8.4	25.6	109.8
Electricity prices by residential	ct2021/kWh	25.0	22.6	22.1	21.3	16.0	23.0
National retail natural gas prices -households	ct2021/m^3	58.4	69.3	74.3	79.3	83.5	142.0
Cooling degree days	day	60	95	95	95	146	
Number of passenger-kilometres	million pkm	175,500	183,000	181,300	182,182	149,235	205,863
Freight transport tonnes-kilometres	million tkm	101,288	109,756	108,860	114,006	115,784	137,936
dairy cattle	millions	2.8	2.6	2.7	3.0	2.5	2.4
non-dairy cattle	millions	1.2	1.2	1.2	1.2	1.2	1.2

Key underlying assumptions	Unit	2000	2005	2010	2015	2020	Projected 2030
pigs	millions	8.0	6.7	7.1	7.0	6.4	5.8
poultry	millions	102.6	91.7	99.9	104.8	96.4	94.1
Nitrogen input from application of synthetic fertilizers	mln. kg N	339	280	222	268	244	186
Nitrogen input from application of manure	mln. kg N	329	288	293	307	314	296
Municipal solid waste (MWS) generation	tonnes				7,565,000	7,572,000	6,249,000
Municipal solid waste (MWS) going to landfills					0	0	0

Tabel 5.4 Key variables used in the KEV2022 projections

5.6 (D) Supplementary 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 Mt in carbon credits from CDM projects, 17.1 Mt from JI projects and 2.2 Mt 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

There are no plans to use credits to meet national climate targets. For the use of allowances and credits in the ETS and ESR, see section 4.2

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 potential 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, give rise to climate change impacts that require risk assessments and decisions on timely and smart interventions.

The Sixth National Communication[129] described the National Programme for Spatial Adaptation to Climate Change (ARK)[130], which started in 2006 and ran until 2011, as the central programme for adaptation in the Netherlands. As described in the Seventh National Communication[131], the Dutch Delta Programme, which started in 2010, has since been the main vehicle for climate change adaptation planning in the Netherlands (see Box 6.1). The report by the Netherlands Court of Audit (2012)[132] recommended broadening the scope beyond the water domain. This challenge was taken up, resulting in the National Climate Adaptation Strategy 'Adapting with ambition' (2016)[133]. 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 fifteen years (2006–2022).

Year	Action
2006	The Royal Netherlands Meteorological Institute (KNMI) publishes climate scenarios for the Netherlands for 2050 and 2100

[129] Available here: Sixth National Communication (2013)
[130] National Programme for Spatial Adaptation to Climate Change, Ministry of Housing, Spatial Planning and the Environment; Ministry of Transport, Public Works and Water Management: Ministry of Agriculture, Nature and Food Quality; Ministry of Economic Affairs, VROM 7222 / April 2007.
[131] Available here: Seventh National Communication (2018)
[132] Adaptation to climate change: National strategy and policy, Algemene Rekenkamer, 2012
[133] Adapting with ambition, National Climate Adaptation Strategy 2016 (NAS), Ministry of Infrastructure and the Environment, December 2016

Year	Action
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
2010 onwards	An updated Delta Programme is presented each year, as part of the annual government budget planning (available in English)
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

Year	Action
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
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	Publication of the 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
2018	Publication of the Implementation Programme 2018–2019 of the National Climate Adaptation Strategy (NAS) of the Netherlands called 'Implementing with ambition'
2020	Publication of the NAS reporting 2017–2019, 'National perspective on Climate Adaptation; a growing challenge in a changing environment' (Nationaal perspectief klimaatadaptatie; Groeiende opgave in een snel veranderende omgeving)
2021	The Netherlands Environmental Assessment Agency (PBL) published a study 'Navigating towards a climate resilient country' (Navigeren naar een klimaatbestendig Nederland), describing options for short and long-term monitoring and evaluation of climate adaptation policies
2021	Climate Signal 2021, the Royal Netherlands Meteorological Institute (KNMI) published the latest insights in climate change in the Netherlands, based on the 2021 IPCC report and KNMI research
2022	Final report on the evaluation of the NAS

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

Box 6.1 The Delta Programme and Adaptive Delta Management

The Delta Programme's[134] aim is to ensure that our flood risk management, freshwater supply, and spatial planning will be climate proof and water resilient by 2050, so that our country will continue to be able to cope with the increasing weather extremes. 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 organisations, the business community, and knowledge institutes (Delta Commissioner 2013, www.deltacommissaris.nl). The Minister of Infrastructure and Water Management 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 Water Management 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. Three sub-programmes apply to the whole of the Netherlands:

-Flood risk management (coastal and fluvial floods)
-Fresh water supply
-Spatial adaptation

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-

[134] More information on the Delta Programme can be found here: https://english.deltaprogramma.nl/

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 flood risk management, 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 were proposed to Parliament in September 2014. The implementation of the proposed policy and strategies has since commenced and will span 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)[135] 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 2012[136]; 2015[137]). 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[138]; 2015). The sectoral assessments[139] 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 carried out by the same organisations.

Figure 6.1 visualises the broader picture of climate effects and some of its sectoral implications in the Netherlands.

[135] Climate Adaptation in the Dutch Delta, Strategic options for a climate-proof development of the Netherlands, PBL, 2011
[136] The effects of Climate Change in the Netherlands: 2012, PBL, 2012
[137] Adaptation to climate change in the Netherlands – Studying related risks and opportunities, PBL, 2015
[138] Aanpassen met beleid. Bouwstenen voor een integrale visie op klimaatadaptatie, PBL, 2013
[139] More information on the sectoral assessments can be found here: https://klimaatadaptatienederland.nl/@188130/onderzoeksprogramma-kennis-voor-klimaat/

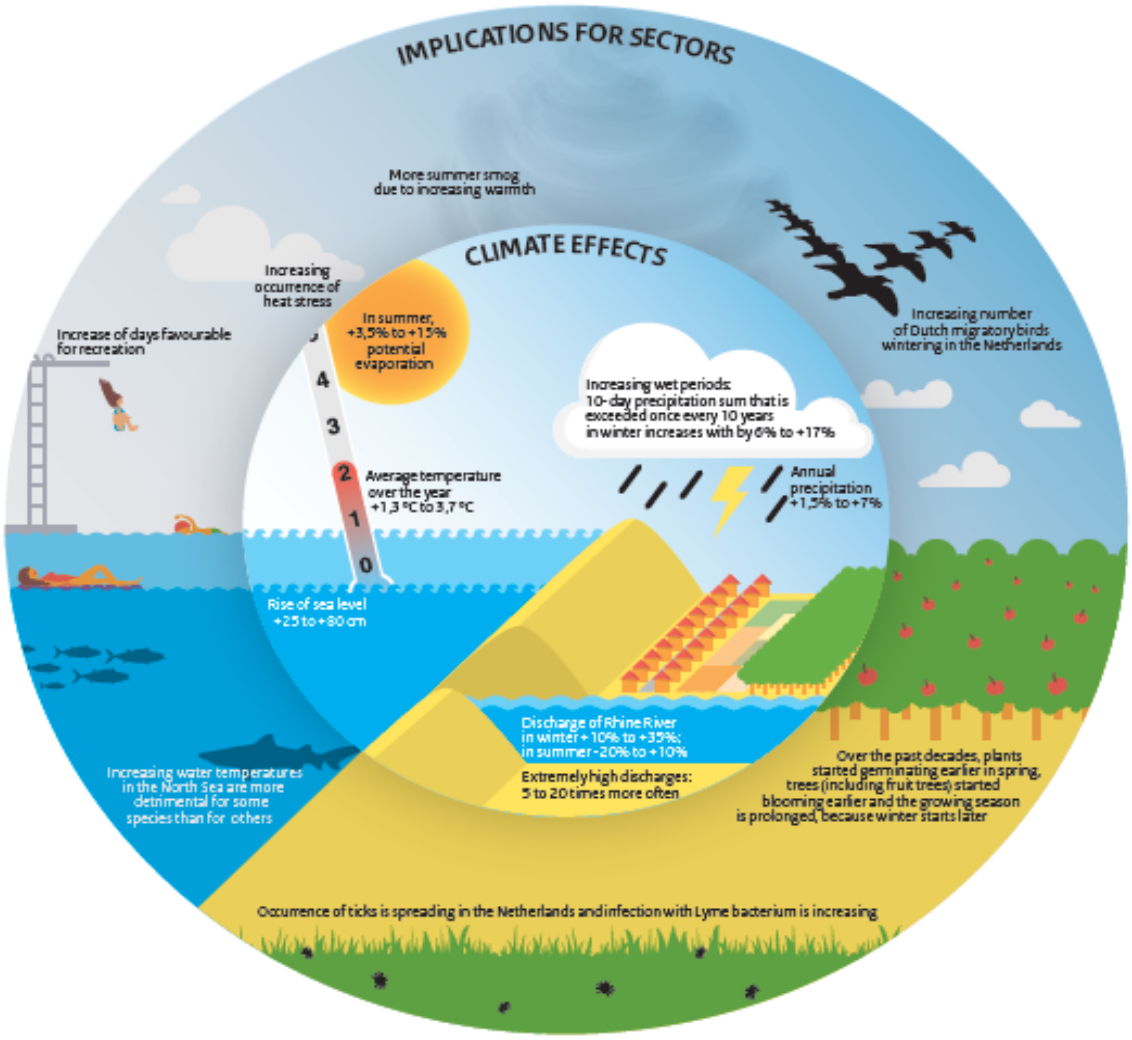


Figure 6.1 Overview of some climate effects and implications for sectors (source: Deltares 2015[140]; KNMI 2015[141]).

6.1.1 Effects of climate change

The Netherlands has become warmer. Average temperatures in De Bilt increased by 2.3 °C between 1901 and 2020[142]. 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

[140] Implications of the KNMI'14 climate scenarios for the discharge of the Rhine and Meuse, comparison with earlier scenario studies, Deltares, 2015
[141] KNMI'14 climate scenarios for the Netherlands, brochure - revised version, KNMI, 2015
[142] KNMI 2021: KNMI Klimaatsignaal'21: hoe het klimaat in Nederland snel verandert, KNMI, De Bilt.

intensities of extreme precipitation[143]. 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)[144]. 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[145]. 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. The 2014 scenarios have since been supplemented by the 2021 climate signal which combines the insights of the sixth review cycle of the IPCC and the KNMI's own research on the effects of climate change on the Netherlands. New climate scenarios – which will replace the 2014 scenarios – are forecast to be published by 2023.

[143] See the KNMI'14 scenarios for more information regarding the increased frequency of extreme precipitation and analysis of other types of extreme climatic events (e.g. temperature extremes, hail and thunderstorms) compared to past observations.
[144] For more information on these scenarios, see: www.climatescenarios.nl
[145] See the KNMI'14 scenarios (pp. 4–6) for the detailed tables comparing the trends in future climate with trends observed in the past (compared to the difference between the averages for 1951–1980 and the reference period of 1981–2010).

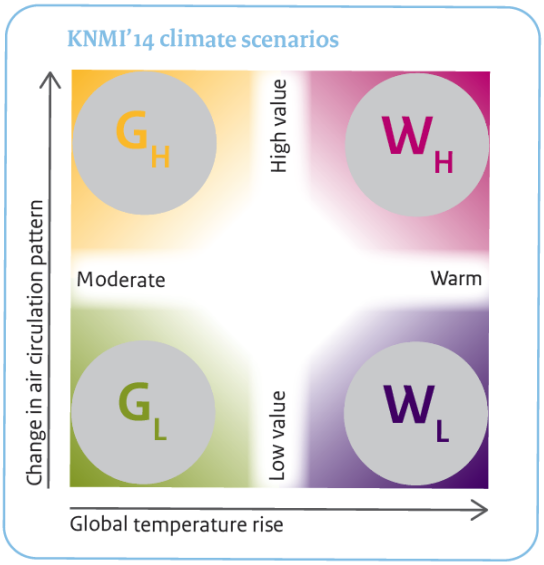


Figure 6.2 The four KNMI'14 scenarios (KNMI 2015)

	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%
Absolute sea level 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%

	Climate reference (1981–2010)	Climate around 2050			
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%
Absolute sea level 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, projected values for 2050 and 2085 (KNMI 2015)

The overall trends in the KNMI'06 and KNMI'14 climate scenarios do not differ substantially, since the underlying scientific evidence on which these scenarios are based, the fourth and fifth assessment IPCC reports respectively, are quite similar for the individual emission scenarios, while the choices made for the KNMI climate scenarios were also almost identical. 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[146]. 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, with an update following in 2018.[147] Its hydrological conditions were based on the KNMI'06 scenarios, while its socioeconomic trends derived from WLO 2006.[148] 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 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. In 2017–2018, these new insights into socio-economic trends and the Paris climate agreements were incorporated into an interim update of the Delta Scenarios. 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. Table 6.3 summarises the most important risks and opportunities for various sectors as derived from the KNMI'14 scenarios.

[146] For more information on the Delta Scenarios, see: https://english.deltaprogramma.nl/delta-programme/knowledge-development/delta-scenarios
[147] Deltascenario's voor de 21e eeuw, actualisering 2017. H.A Wolters, G.J. van den Born, E. Dammers, S. Reinhard, Deltares, 2018
[148] Welvaart en Leefomgeving, een scenariostudie voor Nederland in 2040. L.H.J.M. Janssen, V.R. Okker, J. Schuur; Centraal Planbureau, Milieu- en Natuurplanbureau en Ruimtelijk Planbureau, 2006

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 the expected acceleration of the sea level rise in the near future
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 as fossil fuel-powered energy production will gradually phase out
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'14 scenarios and elaborates on the four climate trends ('Hotter', 'Wetter', 'Drier' and 'Rising Sea Level') to characterise the implications of climate change for 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.

6.1.2 Implications for water and spatial adaptation

The main impacts of climate change on water management, if insufficient countermeasures are taken, include the following:

- a raised likelihood of coastal erosion and flooding;
- an increase in peak discharges from the rivers in winter, raising the likelihood of flooding;
- 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 it is projected to increase further (Table 6.2). This rising sea level leads to coastal erosion, reduces safety along the coast, and leads to a need for increased pumping capacity for discharging excessive fresh water supply during peak periods into the sea. 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. 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)[149], 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, a study of the salt tolerance of agricultural crops generated more insight into salinisation and its impact.[150]

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 exacerbates 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;

[149] The National Flood Risk Analysis for the Netherlands, Rijkswaterstaat VNK Project Office, 2015
[150] Inventarisatie en analyse zouttolerantie van landbouwgewassen op basis van bestaande gegevens, L C P M Stuyt, M Blom-Zandstra en R A L Kselik, Wageningen Environmental Research (Alterra), Wageningen Plant Research, oktober 2016

- 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;
- more frequent dry periods in summer causing groundwater depletion, salinisation, and habitat loss of species that live in and near water;
- more frequent floods causing damage.

The annual average temperature in the Netherlands has increased by 2.3 °C between 1901 and 2020, with the summer warming the most.[151] This is twice the magnitude of global warming. Nature cannot keep up with the speed of temperature change: research shows that nature is adapting ten times too slowly.[152] This problem is only expected to get worse in the coming decades. Climate change has multiple impacts on nature and biodiversity in the Netherlands.

Firstly, climate change will allow some plant and animal species from warmer, more southerly regions to become established in the Netherlands. With the arrival of new heat-loving species to the Netherlands, the competitive relationships between species are changing. Little is known about the exact effects of this. 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. At the same time, more cold-loving species, such as wheatears, black-tailed godwits, Linnaea borealis, arnica and burbots, are disappearing. This process has been observed already (Figure 6.3) and constitutes a natural process. It is often the weather extremes that cause rapid changes in nature. An extremely high maximum temperature, intense or prolonged drought, wildfires or a severe storm can cause major deaths among species or promote the establishment of new species. The extreme drought in 2018 and 2019, for example, had a very large effect on many nature reserves. This process of changing species abundance could be amplified by low spatial cohesion between the nature areas in the Netherlands

[151] Temperatuur in Nederland en mondiaal, 1907 - 2019 | Compendium voor de Leefomgeving (clo.nl)
[152] Van Swaay, C. A. M., van Turnhout, C. A. M., Sparrius, L. B., van Grunsven, R. H. A., van Deijk, J. R., van Strien, A. J., & Doornbos, S. (2018). Hoe onze flora en fauna veranderen door klimaatverandering. *De Levende Natuur*, *119*(6), 256-259.

and those of our neighbouring countries (species cannot follow shifting climate zones due to habitat fragmentation).

Secondly, climate change also has an effect on the growing and flowering periods of plants[153] as well as on the breeding season of birds[154] (phenology). The increased temperatures are the main explanation for this shift. Climate change also affects the times when birds migrate, insects emerge, and mammals and amphibians hibernate. 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 other species. 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[155]).

[153] See: https://www.naturetoday.com/intl/nl/observations/natuurkalender/sightings/annual-reports/jaaroverzicht-2001-2015
[154] See: https://www.clo.nl/indicatoren/nl1405-verloop-van-de-eilegdatum-van-zangvogels
[155] Adaptation strategy for climate proofing biodiversity, PBL, September 2010

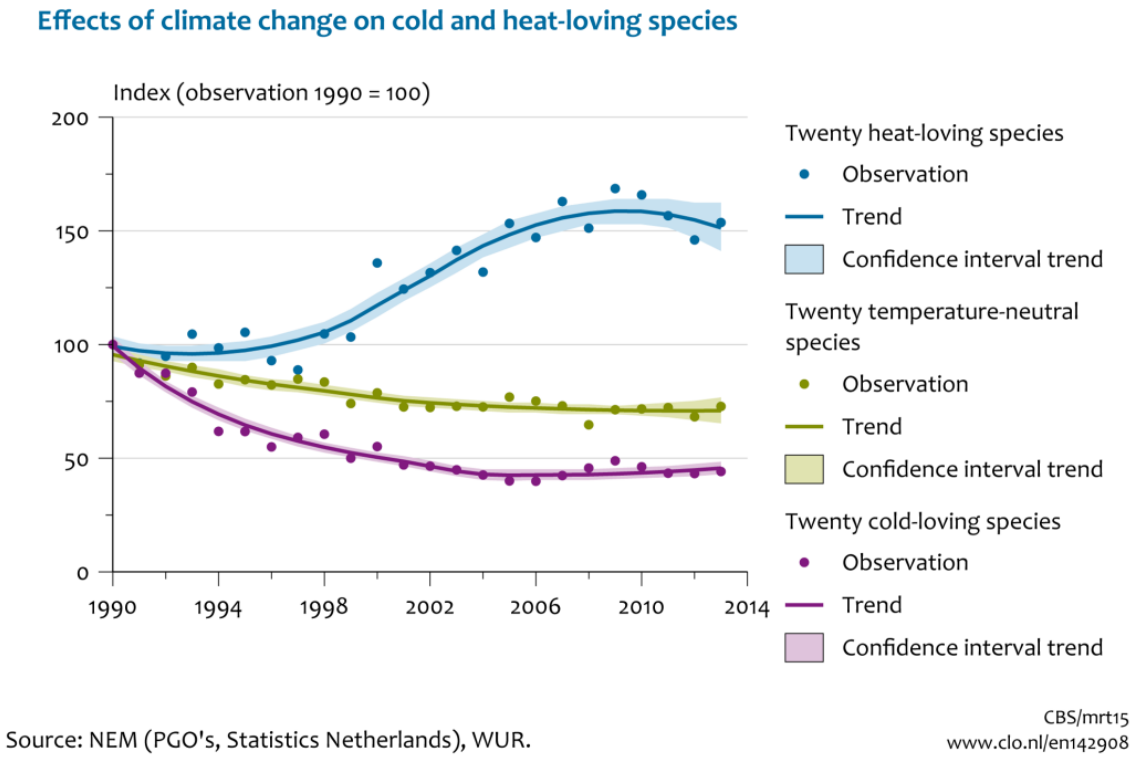


Figure 6.3: Climate change impacts on species in the Netherlands (Environmental Data Compendium 2015[156])

6.1.4 Implications for agriculture, horticulture and fisheries

The main effects of climate change on agriculture are:

- an increase in crop productivity and extension of the growing season due to the warmer climate;
- changes in the distribution, frequency, intensity and occurrence of pests and diseases affecting crops and livestock due to the warmer and wetter climate;
- a decrease in crop production and crop damage due to waterlogging caused by the increased intensity and/or duration of precipitation;
- crop damage from soil water deficits and/or brackish groundwater seepage;
- an increase in damage to buildings (e.g. greenhouses) and crops, and an increase in erosion in hilly areas due to the increased frequency and intensity of weather extremes (such as storms, heavy rain, hailstorms, heat, and night frost);
- an increase in crop damage and crop production constraints due to the extended dry periods and increased frequency of droughts throughout the growing season and during harvest;

[156] Available from: Environmental Data Compendium 2015

- an increase in crop damage and crop production constraints due to salinisation as a result of the rising sea level, in combination with droughts and land subsidence;
- an increase in livestock heat stress, affecting their well-being and production, due to extended dry periods and increased frequency of droughts.

Changes in the climate will generally improve the average climatic conditions for farming in the Netherlands, especially in comparison to southern European countries. Higher temperatures mean longer growing seasons and 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 results from scarcity throughout Europe. Potatoes and dairy production are examples of agricultural commodities where the competitiveness of the Netherlands is high[157].

On the other hand, the agricultural sector regards climate change-related extreme weather events as one of the greatest challenges posed by climate change. Too much water (flooding and waterlogging) as well as too little water (drought) can result in yield loss and economic damage. Flooding of agricultural land in river areas and waterlogging due to increased rainfall damage agricultural soils and crops and decrease crop production, as was seen in the Limburg flood in 2021. Also, weather extremes such as storms, heavy rainfall and hail, which are expected to occur more frequently with climate change, damage crops. 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, such as the higher sandy soils in the east and south of the Netherlands. Periods of drought can severely damage crops and decrease crop production. In combination with droughts and land subsidence, sea level rise will also increase the salinisation in the coastal areas and the province of Flevoland in the Netherlands. Salinisation negatively impacts agriculture and horticulture, especially salt-sensitive cultivation such as tree cultivation and flower bulbs.

In addition, the distribution, frequency, intensity and occurrence of pests and diseases may increasingly affect crops and livestock. Fungal diseases, insect pests and weed growth, especially for crops such as potatoes and onions, are expected to increase. Additionally, the warmer weather and increased droughts increase the chance of heat stress of livestock, which negatively impacts health and production, or decreases grazing time.

[157] Exploring the future of European crop production in a liberalised market, with specific consideration of climate change and the regional competitiveness, C.M.L. Hermans, I.R. Geijzendorffer, F. Ewert, M.J. Metzger, P.H. Vereijken, G.B. Woltjer f, A. Verhagen, Ecological Modelling Volume 221, Issue 18, 10 September 2010, Pages 2177-2187

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 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[158]. 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[159]. Other calcifying organisms like mussels and oysters can also be affected by ocean acidification. Mussels are an important food source and can have impaired growth and reduced structural integrity at higher concentrations of dissolved CO_2[160].

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[161];
- an increase in mental stress caused by increased pluvial flooding and flood threats[162].

[158] 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.
[159] 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.
[160] Fitzer, S., Phoenix, V., Cusack, M. et al. Ocean acidification impacts mussel control on biomineralisation. *Sci Rep* 4, 6218 (2014). https://doi.org/10.1038/srep06218
[161] 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.
[162] Idem.

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%, largely due to the aggravation of pre-existing conditions.[163] 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.[164] 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

[163] Effecten van klimaat op gezondheid : Actualisatie voor de Nationale Adaptatiestrategie [The effects of climate on health : Update for the National Adaptation Strategy], Wuijts S, Vros AC, Schets FM, Braks MAH, 2016, RIVM rapport 2014-0044

[164] For a substantiation of this fact, see also: Climate change and public health policy: translating the science, Braks M, van Ginkel R, Wint W, Sedda L, Sprong H, Int J Environ Res Public Health. 2013 Dec 19;11(1):13-29.

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.
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:

- increased flooding and obstruction of facilities and roads caused by excessive rain, in case of insufficient drainage capacity;
- more erosion of road infrastructure and embankments by heavy rain and flooding, which results in more maintenance;

- more traffic congestion and less safety due to more extreme rainfall;
- changing groundwater levels. In periods of drought this may lead to increased soil subsidence. The rise of groundwater levels in wet circumstances increases the risk of uplift of tunnels;
- an increase in corrosion due to higher precipitation and higher temperatures;
- an increase of rutting on melting road surfaces (in case of dense asphalt, as porous asphalt is less vulnerable to heat), deformation of rail tracks, as well as failure of technical installations;
- due to higher temperatures waterway infrastructure / engineering structures, such as moveable bridges and lock gates, might jam or not close fully;
- more obstruction of traffic by roadside fires and safety hazards due to drought and heat, and subsequent threats to adjacent nature;
- drought impacts vegetation which increases the risk of erosion of embankments in case of rain after a dry period;
- reduced navigability of rivers in periods when water levels are too high or too low. Low water levels lead to reduced transport capacity for inland shipping, which increases pressure on rail and road transport capacity, increased transport costs, and consequently shortages of e.g. fuel and building materials. Shortage of water leads to problems with the availability of locks. In general extreme water levels reduce the capacity for transfer of goods in harbours;
- problems with low water are further increased by ongoing erosion in parts of the river bed. Low water in combination with erosion lead to a restriction of the space available for navigation;
- an increase in damage to oil rigs, high-voltage transmission lines, roads, bridges and vehicles from extreme storms (thunderstorms or tornado-like storms with extreme windspeeds; in general average wind is not expected to change significantly in the Netherlands due to climate change);
- fewer problems due to extreme winter conditions; e.g. fewer occasions when roads need to be salted, reduction in damage to rail tracks and roads by frost and salt, fewer constraints on water transport from ice cover and fewer travel delays;
- 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.

A multitude of reports (e.g. OECD 2016)[165] state that the economic costs of extreme weather due to climate change, storms and floods are very high and are increasing. 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. However, it is necessary to incorporate measures to prevent or mitigate the effects of climate change as early as possible into maintenance, renovation and construction, in order to prevent high costs due to damage that could have been prevented. Depending on the type of effect and its characteristics, climate change may cause high repair costs and/or user costs of infrastructure though, due to a lower availability of the infrastructure. Soil subsidence affects roads at a slow pace and therefore cause little user costs, but higher repair costs in the long term. Poor sight due to heavy rainfall will cause little to no repair costs, but higher user costs due to a lower availability of the infrastructure. Compared to the change in the levels of use (increased traffic, heavier vehicles), climate change contributes little to wear and tear of pavements, proceeding as it does at a slow pace compared to the frequency of regular maintenance work of road infrastructure.

The impact on the availability of infrastructure due to extreme weather, and consequently on user costs, could be higher as well. The effects of low river discharges could become an important factor in water transport. 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, and also impacts road and rail transportation indirectly. In the long run, this situation may lead to a shift in transport modality.

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.

Opportunities resulting from climate change arise because costs are avoided (e.g. less winter maintenance), because future developments can accommodate known causes of

[165] Adapting Transport to Climate Change and Extreme Weather: Implications for Infrastructure Owners and Network Managers, ITF Research Reports, OECD Publishing, Paris 2016

climate change (e.g. integrated planning, smart vehicles suitable to adapt to climatic conditions), and because innovation with associated 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)[166].

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 high societal and economic impact. The cost to prevent 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.

[166] 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.

In addition, the fuel mix used in power generation will change in the decades to come; the share of renewable energy such as wind and solar power has grown rapidly over the past years (Figure 6.4). These resources may reduce the power supply's vulnerability by reducing the dependence on cooling water, 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.

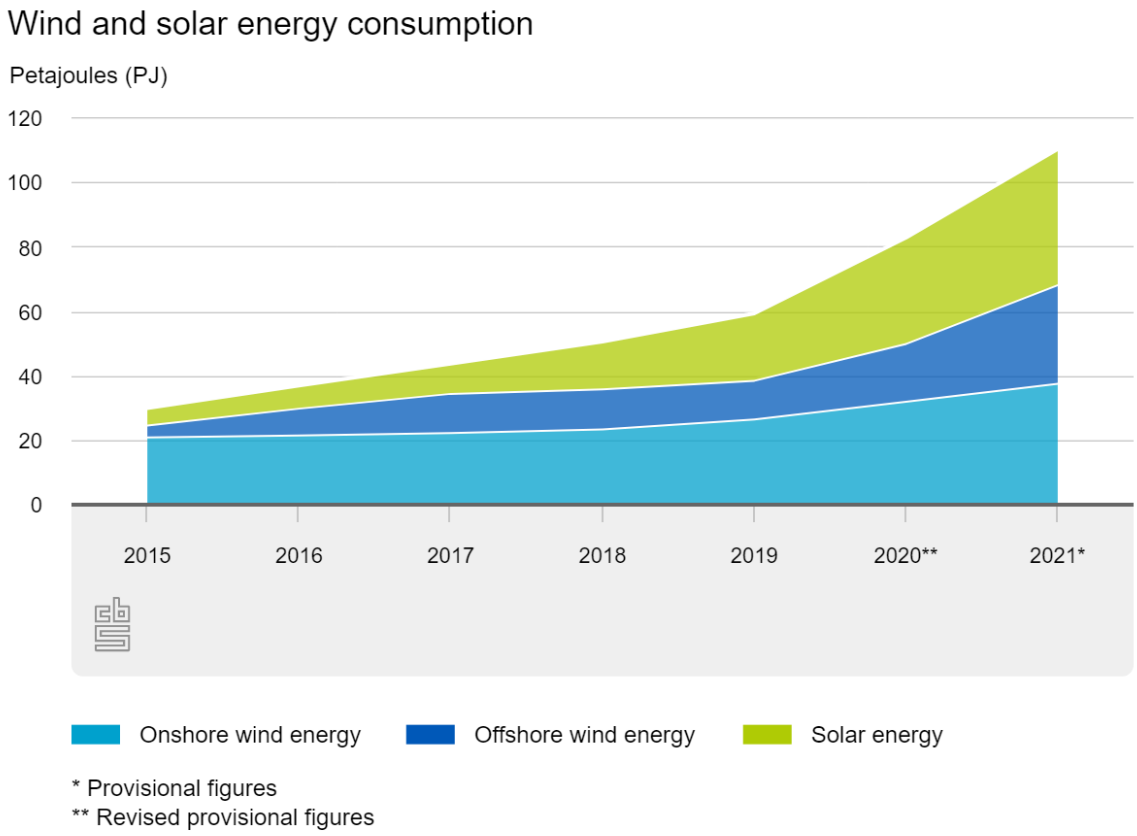


Figure 6.4 Wind and solar energy consumption (CBS, 2022)[167]

6.1.9 International context

Climate change does not respect national boundaries. Climate change in the world has multiple consequences for the Netherlands in terms of how the country functions. The Netherlands is home to a delta of four of Europe's major rivers (Rhine, Meuse, Scheldt, and Ems). Consequently, climatic risks to the country – both in terms of flooding and drought – can result from changes in upstream weather patterns (including increased precipitation, drought or the melting of Alpine glaciers) as well as adaptation and climate change policies of upstream countries. Additionally, as a country with an open economy,

[167] Available from: https://www.cbs.nl/en-gb/news/2022/26/lower-renewable-energy-share-despite-more-solar-and-wind-energy

partially reliant on international trade and value chains for its wealth, the Netherlands is also vulnerable to climate change-associated economic shocks and instability abroad. The Netherlands is thus vulnerable to the effects of climate change elsewhere.

To get a clear picture of the nature of the international context of climate change vulnerability, the PBL published a report[168] on the risks and opportunities of international climate effects for the Netherlands. The report 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, but high impact, changes in the global climate also affect the Netherlands. 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. Based on this, the PBL report outlines the main international risks for the Netherlands – differentiating between the European and the global level.

Risks on the European level

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.

Firstly, power supply and IT services form a challenge in the face of climate change. As grids and networks are becoming increasingly closely connected 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 other countries in Europe; for example, by doing climate stress tests.

Secondly, the Netherlands has an extensive delta programme aimed at minimising the risk from climate change in regards to flooding. However, in July 2021, extreme rainfall caused regional flooding in Germany, Belgium and Luxembourg, and the Dutch province

[168] Worldwide climate effects. Risks and opportunities for the Netherlands. Eds. M. Vonk, A. Bouwman, R. van Dorland & H. Eerens, PBL, 2015

of Limburg, culminating in a crisis of unprecedented proportions in the Netherlands and neighbouring countries. Flooding from streams and high water levels in the Meuse resulted in a great deal of damage and misery for local residents, businesses and organisations in the stricken regions. Houses were left uninhabitable, possessions swept away, campsites flooded and harvests ruined – and that was not the worst of it. In neighbouring countries, lives were also lost. As the Netherlands is a delta county and thus vulnerable to climatic events occurring upstream in rivers like the Meuse, Rhine, Ems and Scheldt, transnational cooperation is crucial in adapting to increasingly frequent extreme weather events – such as the heavy precipitation causing the 2021 floods. Cooperation with upstream countries is institutionalised in the Meuse, Rhine, Ems, and Scheldt commissions. These commissions focus, amongst other topics, on flood prevention. As the floods of 2021 show, there is a needs to further strengthen resilience in these riverine areas. In response to the floods, the Netherlands has sought dialogue with German and Belgian national and regional authorities at various levels to improve the resilience of the riverine areas to extreme weather events.

Thirdly, climate change implications in terms of public health can be considered in direct impacts such as increased morbidity and mortality due to heat stress, but also indirect health consequences through emerging zoonoses such as West Nile virus or malaria and an increase of vector-transmitted diseases such as Lyme disease. The outbreak of COVID-19 has been a major public health threat and disrupted much of public life around the globe. In this regard COVID-19 has shown the importance of European cooperation in disease preparedness and response. Dutch systems for infectious disease preparedness will be evaluated and strengthened in light of the lessons drawn from the COVID-19 pandemic.

Risks on the global level

The most relevant risks of climate change impact on the Netherlands from a global perspective are related to (1) disruptions of economic chains and (2) international stability.

Firstly, 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. Of relevance in this regard is that the Netherlands has the ambition to change its economy from a linear economic system to a circular economic system. Goals have been set to reach 50% circularity in 2030 and 100% circularity by 2050. Increased circularity of the economic system helps reduce vulnerability to disruptions of the supply and distribution of raw materials, as it reduces the need for raw material input in the economy.

Secondly, the Netherlands could also become affected when climate change/extremes would affect international stability. 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.

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.

6.2 (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). PBL is currently working on an update of this assessment. The results of the assessment will be available in 2024 (regarding the current climate impact and risks) and 2025 (future impact and risks). The latter will be based on the revised climate scenarios for the Netherlands that the KNMI will publish in 2023.

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[169].

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.

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.

[169]In many publications the term 'probability' is used instead of 'likelihood'

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

- transport and infrastructure,
- the power supply system,
- IT networks,
- public health,
- nature,
- agriculture and
- 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 (2015).

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 6.6a).
2. Precipitation is increasing (it becomes wetter, see Figure 6.6b).
3. Periods of drought are increasing in summer (it becomes drier, see Figure 6.6c).
4. The sea level is rising (see Figure 6.6d).

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. These diagrams will be further refined and updated with the results from the PBL study mentioned in the introduction of section 6.2. Based on these diagrams, further detailed diagrams were already developed in 2020-2021 specified for each of the following sectors: water management, nature, agriculture, health, recreation and tourism, infrastructure, energy, IT and telecommunications, safety, built environment and spatial planning[170].

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 6.5).

[170] Available diagrams per sector: https://klimaatadaptatienederland.nl/thema-sector/ (in Dutch)

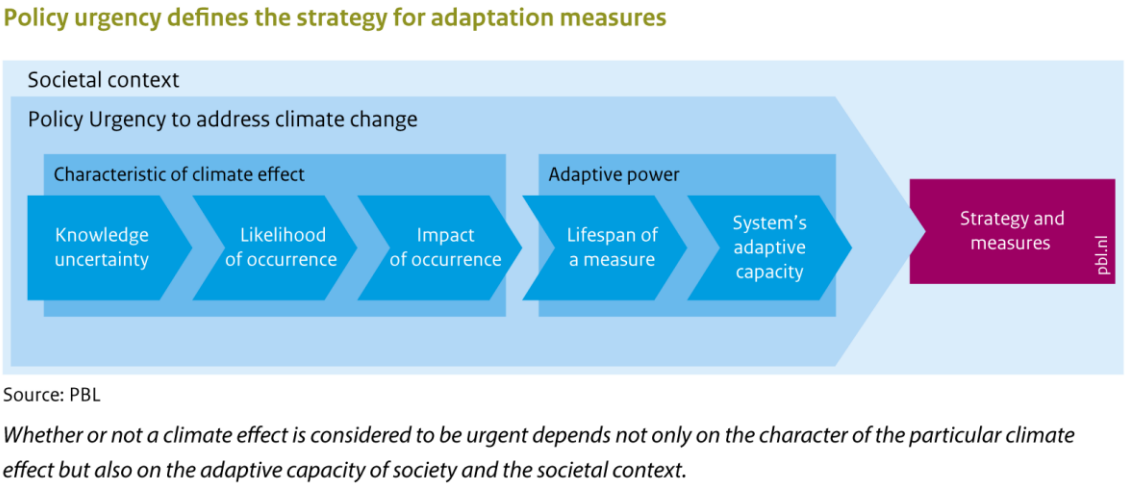


Figure 6.5: Criteria to determine urgency.

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 led 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.

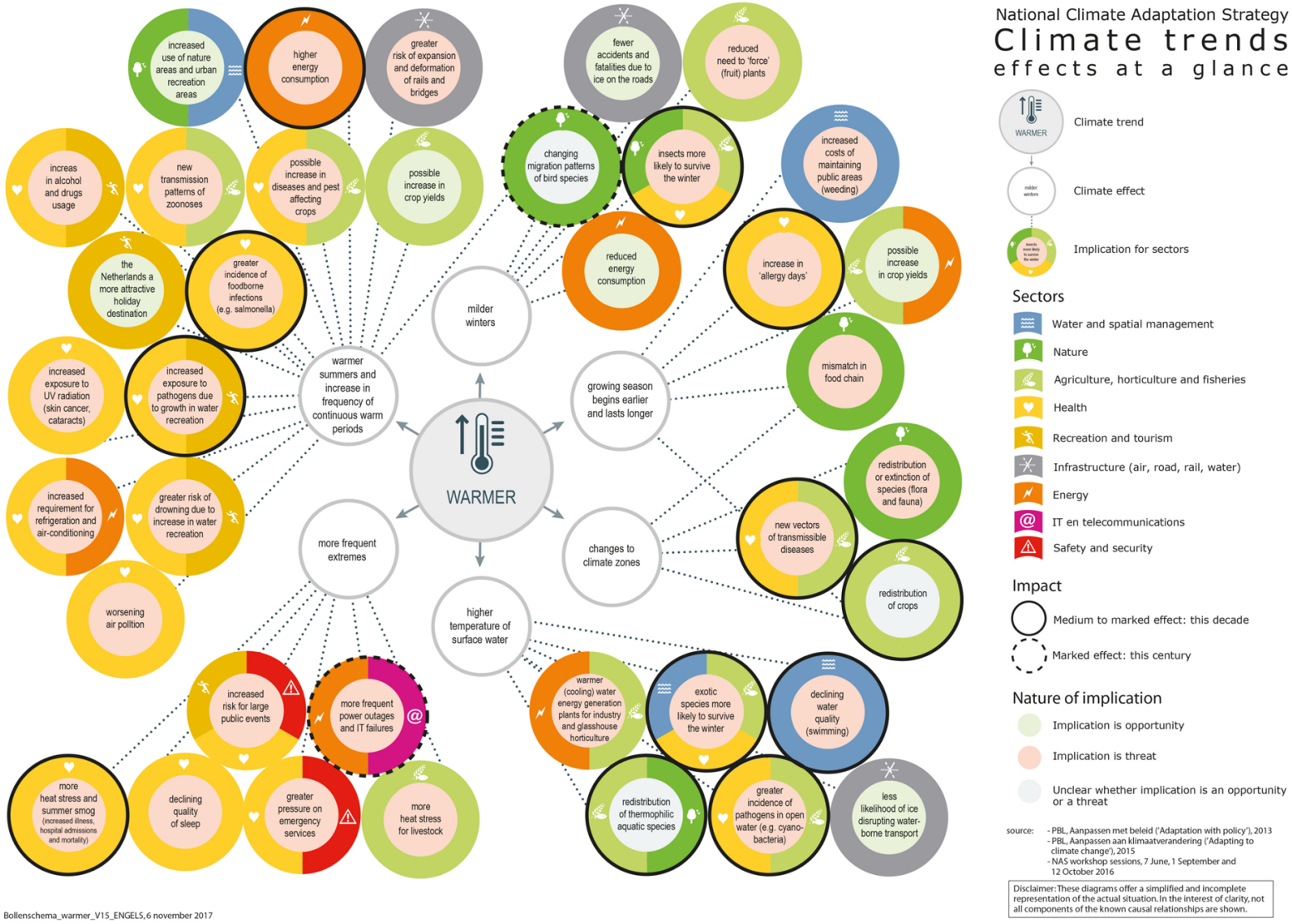


Figure 6.6a: Overview of climate trends in the Netherlands: temperatures are rising (available in higher resolution here: [Climate Adaptation Knowledge Portal])

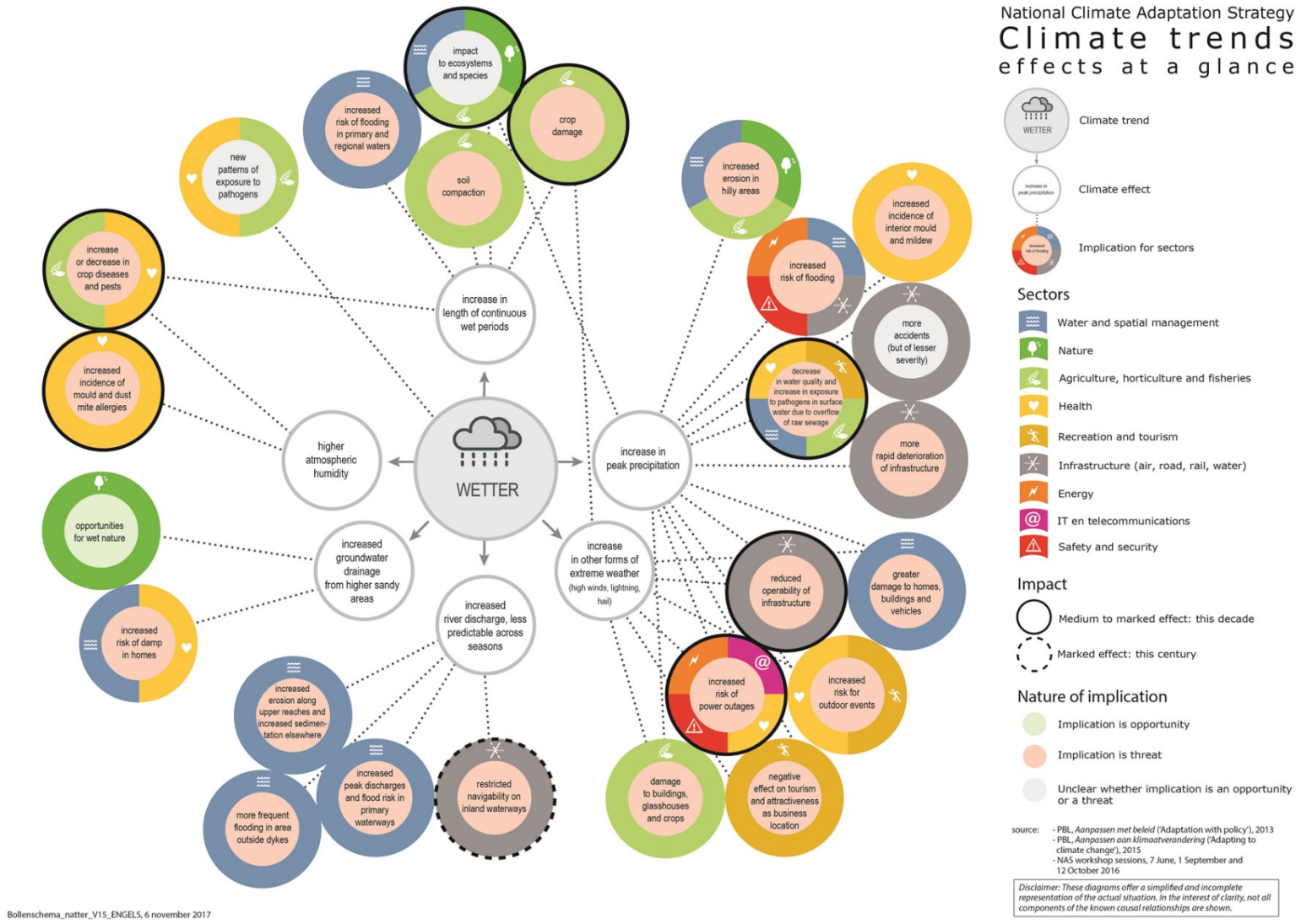


Figure 6.6b: Overview of climate trends in the Netherlands: precipitation is increasing (available in higher resolution here: [Climate Adaptation Knowledge Portal])

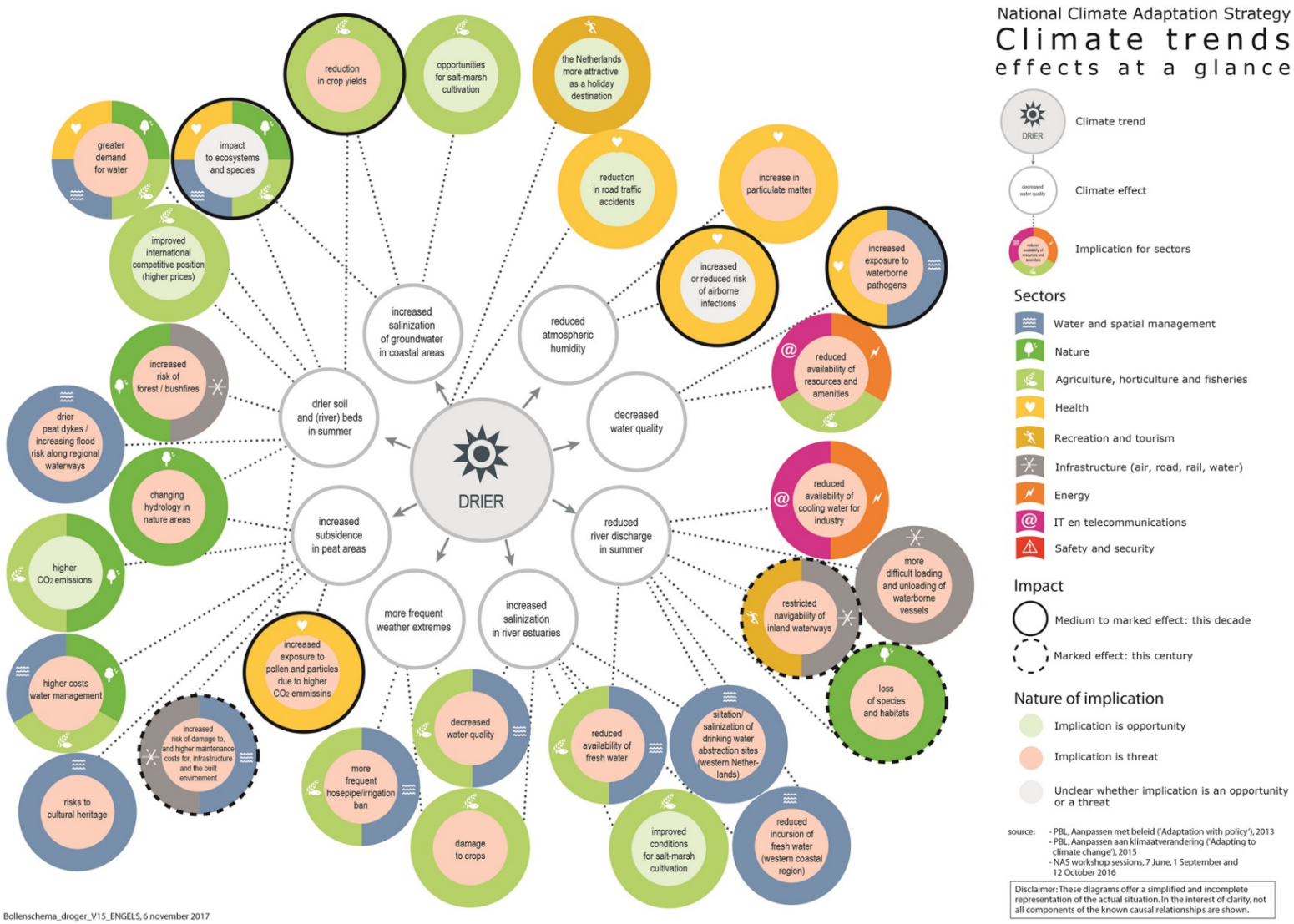


Figure 6.6c: Overview of climate trends in the Netherlands: periods of drought are increasing in summer (available in higher resolution here: [Climate Adaptation Knowledge Portal]())

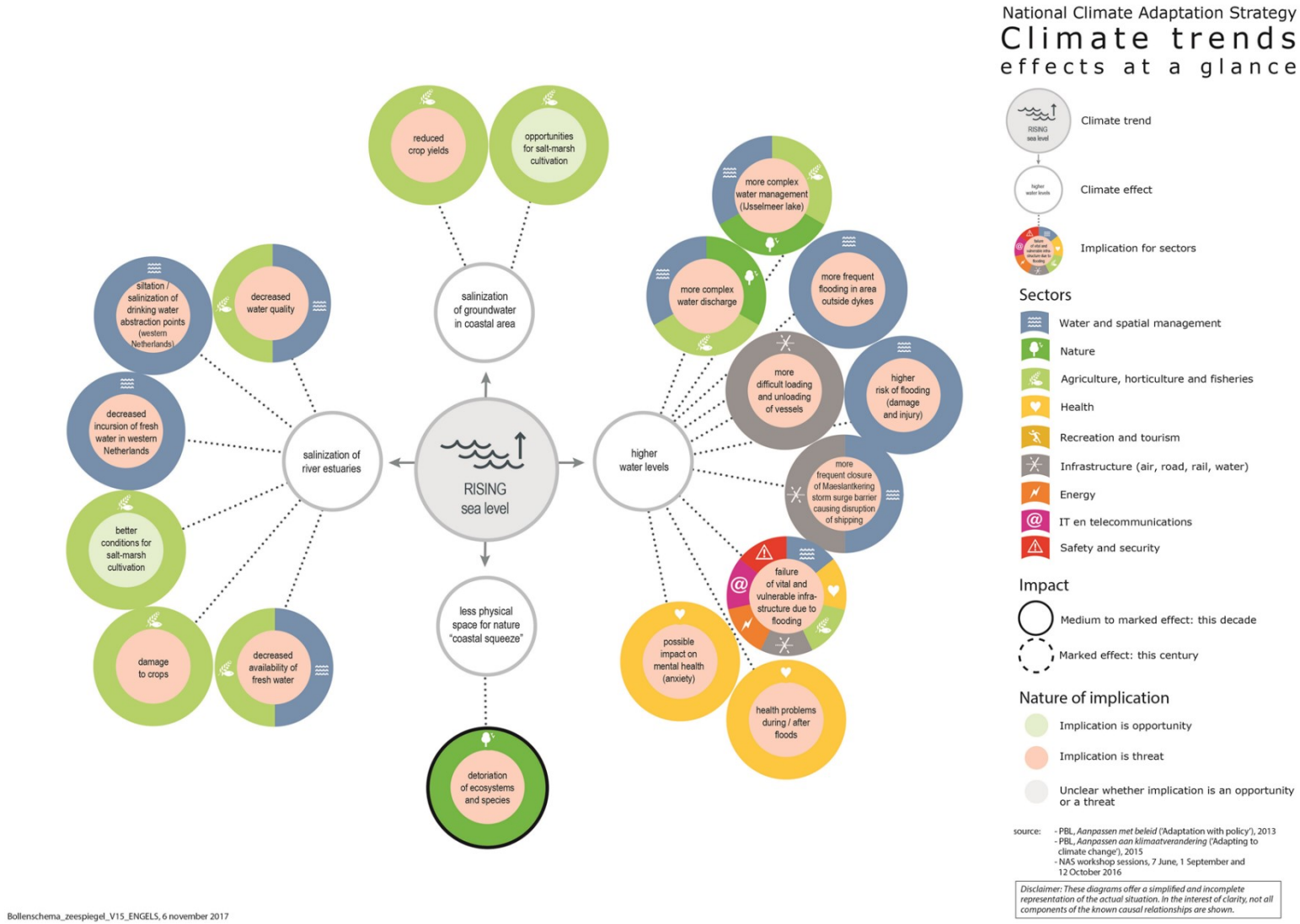


Figure 6.6d: Overview of climate trends in the Netherlands: the sea level is rising (available in higher resolution here: [Climate Adaptation Knowledge Portal]())

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 NAS has a broad approach to climate adaptation, focusing on sectors and systems. For water and spatial adaptation, climate adaptation has a special programme in place: the Delta Programme (see Box 6.1 for general information about the DP; 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),[171] and it is based on recent insights into climate risks and vulnerabilities as well as socioeconomic developments. The National Climate Adaptation Strategy 2016 was presented to the House of Representatives. It also met the European Commission's request for Member States to produce a climate adaptation strategy no later than 2017.

171

Climate Agenda: resilient, prosperous and green. Summary, Ministry of Infrastructure and the Environment, September 2014

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 of addressing 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 stimulates and initiates 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' underpins 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 Water Management. 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 Adaptation Strategy explicitly calls for broad participation of government departments, the business community and individual households. Figure 6.7 illustrates the approach taken in the National Climate Adaptation Strategy 2016 to climate-proof the Netherlands.

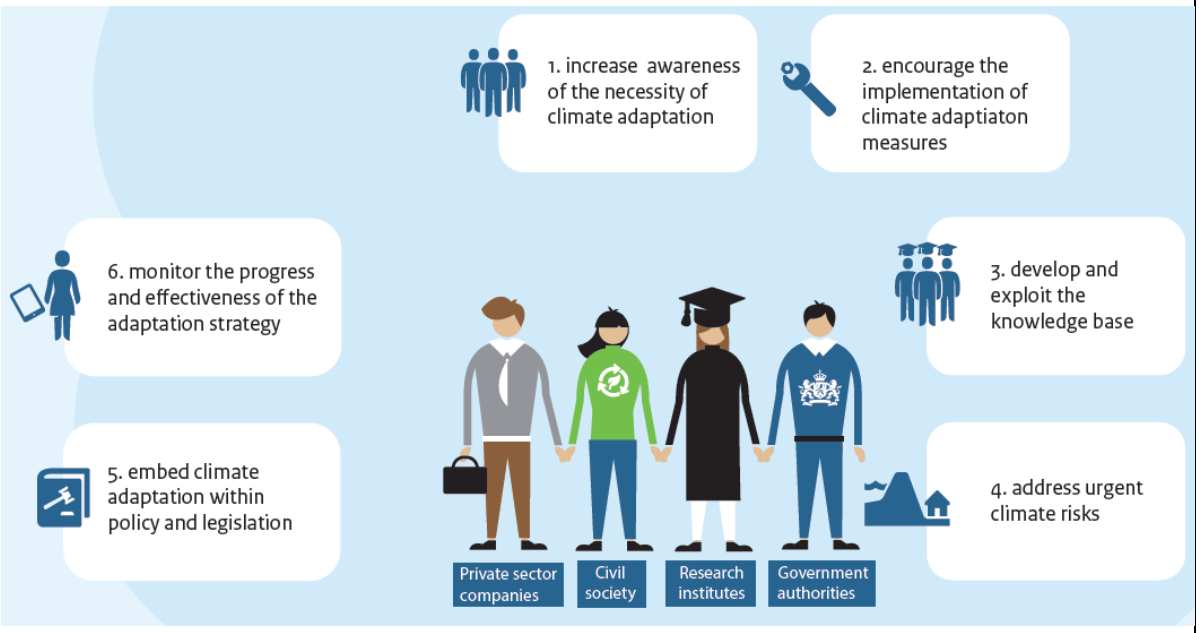


Figure 6.7: The approach of the National Adaptation Strategy to climate-proof the Netherlands

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: flood risk management, 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.

Flood risk management

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.[172] 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 the most important part in keeping the Netherlands safe from flooding. The Third Safety Assessment (2014) of the existing primary flood defence system acknowledged 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. The first safety assessment based on the new standards will be published in 2023.

In addition to the reinforcement of dykes, other more integrated solutions are taken into consideration. An example is the Room for the River programme[173] (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 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)[174]. 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

[172] For more information, see: https://www.helpdeskwater.nl/onderwerpen/waterveiligheid/primaire/nieuwe-normering/
[173] For more information on the Room for the River programme, see: https://www.rijkswaterstaat.nl/en/water/water-safety/room-for-the-rivers
[174] Delta Programme 2014. Working on the Delta: Promising solutions for tasking and ambitions, Delta Commissioner 2013.

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.

Adaptation measures

Over the past decades, enormous investments have been made to improve the water safety of the Netherlands. Those investments are mainly policy driven: e.g. the new standards for flood protection, or better knowledge on failure of levees leading to a need to reinforce. While reinforcing, climate change is taken into account, making for a 'future proof' design.

- 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 (such as the 'Sand Motor' project, an artificial sand bank created off the coast of The Hague to let ocean currents, wind and waves gradually spread the sand[175]). In addition, the cabinet is opting for a cohesive approach to spatial development

[175] For more information, see: https://dezandmotor.nl/en/about-the-sand-motor/

of the coastal zone which allows for a balanced development of nature, economy and accessibility in the existing coastal areas.

- Rivers: within 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 on water management issues so as to increase effectivity.
- Sea level rise is an issue of specific interest for the Netherlands. The speed and amount of SLR after 2050 are highly uncertain, and determine the effort required to keep the Netherlands safe in the long run. This is why in 2019, a research programme on sea level rise was launched by the national government. In this programme, government authorities and knowledge institutes work together to develop knowledge relevant for future adaptation of the Netherlands. It addresses subjects like the effects of SLR of up to five meters on the current flood management and fresh water availability approach, and the development of possible alternative strategies for the more distant future.

Freshwater supply

Overall national policy outline

The Delta Decision on Freshwater Supply and the associated Delta Plan on Freshwater Supply are intended to foster 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.[176]

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 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 help 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 (steps in the process of becoming climate-proof) (Figure 6.8):

1. mapping out vulnerabilities;
2. conducting a risk dialogue and drawing up a strategy;
3. drawing up a programme of measures;
4. capitalising on opportunities for linkages with other spatial development initiatives;

[176] As described in the year Delta Programme. See for instance: Delta Programme 2022, Every new development climate-proof, Delta Commissioner, September 2021

5. improving the knowledge basis and encouraging and facilitating local governments and private parties (including network organisations);
6. regulating and embedding;
7. improving the responsiveness to calamities.

Figure 6.8: 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 (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.[177] These different water plans together offer opportunities for water-inclusive planning.

[177] The National Water Plan 2016 – 2021, Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, December 2015

Measures coordinated by the Delta Programme

Each year a Delta Programme report is sent to the Dutch parliament containing an update on the actual situation with regard to climate adaptation and forecasting the programmes of measures (reports available in English). 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 6.4). 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[178]; the Climate Impact Atlas[179]; and follow-up on the 'climate stress tests' carried out by regional governments, municipalities and network organisations between 2019 and 2020. Finally work is carried out through national and international cooperation between the business community and the international Delta Alliance (2013).

A number of municipalities have developed or 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[180]). Many more examples exist, as can be seen on the map showing examples of climate adaptation measures which is available on the national climate 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 (Watertoets) and Building Act (Bouwbesluit) in technical standards and in the instruments that will become part of the new law on spatial planning, the Environment and Planning Act (Omgevingswet).

[178] Available from: http://ruimtelijkeadaptatie.nl/english/
[179] Available from: http://www.klimaateffectatlas.nl/en/
[180] For more information, see: https://www.rainproof.nl/English

Box 6.4. 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 process. 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 are based on the existing Partners for Water (Partners voor Water) programme. Box 6.5 offers some examples from the Sustainable Water Fund (Fonds Duurzaam Water). 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 6.5. Examples of adaptation cooperation with developing countries: Sustainable Water Fund

The Sustainable Water Fund (Fonds Duurzaam Water, FDW) is a Dutch subsidy programme facility stimulating public-private partnerships (PPPs) to accelerate support for water safety and water security in developing countries. FDW contributes to the achievement of SDG 6 (clean water and sanitation), SDG 8 (inclusive and sustainable economic growth, employment and decent work for all), and SDG 17 (global partnerships for sustainable development). To achieve the goals set by the programme and to deliver on comprehensive, well-planned climate change adaptation and mitigation, it is imperative to cooperate and collaborate closely with multiple stakeholders. FDW integrates this approach by working through PPPs that must include at least a government agency, a private partner, and an NGO but can also include a knowledge institution, of which at least one partner is Dutch. All partners contribute to inclusive, sustainable and extensible projects.

FDW has provided €150 million in subsidies since 2012. Partners are expected to co-finance 30–40%. With this budget FDW supported 42 PPP projects in 24 countries.

These are projects within the fields of drinking water and sanitation (WASH), including waste; efficient water use in agriculture; and integrated water management (IWRM). Through these PPPs, the projects aim to contribute to climate change adaptation and mitigation, sustainable economic growth, self-reliance, and poverty reduction.

A few examples of how the Netherlands supports climate adaptation and mitigation through FDW include the following project cases:

Rwanda: Scaling universal access to safe and climate-resilient water services

In Rwanda, FDW co-finances a project to ensure sustainable water supply in the near future and strengthen awareness and capacities of central and district governments, the Water and Sanitation Corporation (WASAC), and urban communities on (the effects of) climate change. The project objectives are threefold. First, to support WASAC – the National Water and Sanitation service provider – to align its national master planning and investment programme for horizon 2050 with climate resilience investment planning through capacity building. Moreover, it will enhance the potential to take mitigating measures in a wide variety of water-related sectors in addition to water supply. This includes water provision for the agricultural sector and industry. Secondly, to develop and implement Water Safety Plans as a useful instrument for documentation and prioritising of climate change-related risks and hazards, hence strengthening adaptation to climate change in relation to water quality control. In addition, the project is introducing a risk-based framework to better inform and guide decision making for infrastructure management and rehabilitation based on climate change-related impacts. Last, the project will also endeavour to enhance water retention by introducing rainwater harvesting at schools.

India: Water Efficiency in Sustainable Cotton Production System

FDW supports a PPP on sustainable cotton production in India. In terms of adaptation, the project stimulates increased water efficiency and good agricultural practices in the production of organic cotton. This supports farmers in increasing their profits as well as making them more resilient towards the negative impacts stemming from climate change (including prolonged droughts). Additionally, the project introduces a social hydrologic model. This model aims to aid farmers to predict effects of introducing water efficiency interventions on their incomes. Moreover, this model helps the farmers to visualise the effects of the present decisions regarding farm management on future income on the organic cotton market, taking into account climate variability.

Importantly, the introduction of technologies and techniques to harvest, conserve and re-use rain water will reduce the organic cotton footprint on groundwater abstraction/depletion. It is envisioned this will make farmers much more resilient to the expected risks of climate change in years to come.

Ethiopia: Improved water allocation and irrigation efficiency in Ziway-Shalla basin

The project contributes to adaptation in the Ziway-Shalla basin, an area facing particular water stress due to climate change and (recent) slow economic development. The project focuses on supporting climate adaptation by strengthening the capacity of the water authority in various regards. This helps achieve successful water management in order to combat the negative implications stemming from climate change, including prolonged droughts and deteriorating agricultural conditions. The project has the following end goals in strengthening the water authority: first, to develop a water allocation plan including permitting, licensing as well as the pricing of (irrigation) water; second, to increase water efficiency in the horticultural sector; and third, to take anti-erosion measures and watershed interventions.

Indonesia: Securing eroding delta coastlines, Building with Nature

FDW supports at-scale implementation of a 'Building with Nature' pilot, which provides coastal security and supports revitalisation of at least 6,000 ha of aquaculture ponds along a 20 km shoreline in Demak district (central Java). This enhances the resilience of 70,000 people living along the coast.

Northern Java's deltaic shorelines suffer from severe erosion and related flooding hazards, caused by mangrove conversion for aquaculture, groundwater extraction and infrastructure development. Over 30 million people in Java are at risk. The agricultural sector (mainly rice and aquacultures), an engine for economic growth, has suffered multi-billion dollar losses. Conventional hard-infrastructure solutions have been found to be ineffective, expensive and unable to adapt to climate change ('maladaptation'). Furthermore, they fail to bring back the economic, environmental and social benefits that healthy mangrove coastlines offer.

The project introduces the Building with Nature approach to accomplish resilience along eroding delta coastlines. This innovative approach combines civil engineering with mangrove rehabilitation to build safe and adaptive coastlines, while simultaneously introducing sustainable land use. The Building with Nature approach is

mainstreamed in policies, plans and budget allocations for lowland development, disaster risk reduction, climate change adaptation and water safety in Indonesia. This helps ensure the sustainability of the project, thereby increasing the long-term resilience of the shoreline of the Demak district in central Java.

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.

Since 2016, various parties have been working on climate adaptation and nature within the framework of the National Climate Adaptation Strategy (NAS). Parallel to this, the Drought Policy Table was established after the dry summer of 2018. From this moment on an action programme for climate adaptation for both agriculture[181] and nature[182] has been worked on within the framework of the NAS. The Drought Policy Table has recommended including climate resilience of nature in the joint nature ambition of the central government and the provinces and linking it to the nature and development tasking.

The national government and the provinces have a major task in realising the obligations of the Birds and Habitats Directives (VHR). The Nature Pact and the Nature Programme, including the 'Nature Inclusive Agenda' are aimed at achieving this task. Climate-proof nature is the basis for realising that task. In general, the Dutch nature policy adapts by:

1. Achieving 70% of the VHR targets in and around the protected nature areas by 2030. This is done by focusing on more acreage for natural systems, creating robust connections and by improving conditions so that nature becomes more resilient.
2. Promoting the basic quality of nature in a broader sense by working together with other programmes towards a nature-inclusive society.

[181] For information on the agriculture action programme, see: https://www.rijksoverheid.nl/documenten/publicaties/2020/01/30/actieprogramma-klimaatadaptatie-landbouw
[182] For information on the nature action programme, see: https://www.rijksoverheid.nl/documenten/rapporten/2021/03/31/actielijnen-klimaatadaptatie-natuur

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)[183];
- scenarios for nature-inclusive agriculture and a new 'collective' approach to agro-environmental schemes;
- integration of nature objectives in water management and infrastructure;
- the Nature Inclusive Agenda[184].

The Nature Inclusive Agenda stems from the ambition document 'Netherlands Nature Positive' (2019) and the Nature Programme that followed. This programme sets the stage for the restoration and strengthening of nature in and around protected nature areas and for the realisation of a nature-inclusive society in 2050.

The resilience of the natural environment is expected to increase through these innovations 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.

[183] MinEZ 2013. Natuurambitie Grote Wateren 2050 en verder [*Ambition for nature in large water bodies 2050 and beyond*]
[184] https://agendanatuurinclusief.nl/de-agenda/#Agenda1

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').[185]

The climate buffer programme[186] 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 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 Representatives 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. In the subsidy conditions, the government included the provision 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 was completed later. These projects are permanent sources of inspiration. Thanks to the successes and the promising experience, a new start was made in 2017 and the coalition was expanded to include the Nature and Environmental Federations, now with financial support from the European LIFE IP programme (duration until 2022) and the Ministry of Agriculture, Nature and Food Quality. Six different types of climate buffers are designed:

- Ecosystem engineers: Use of organisms to establish sediment and/or slow down waves
- Carbon sinks: Carbon sequestration in organic material, formation of marshes and salt marshes
- Green air conditioning: Temperature reduction from wetlands in and around the city

[185] Natuurlijk verder Rijksnatuurvisie 2014, Ministerie van Economische Zaken, 2014
[186] More information on the programme can be found here: www.klimaatbuffers.nl

- Natural sponge: Water retention in natural areas on higher ground
- Living coast: Natural dunes with shifting sand, sandbanks and expanding salt marshes as coastal protection
- Room for nature and water management: Natural inundation areas store the water when there is heavy precipitation and peak discharge

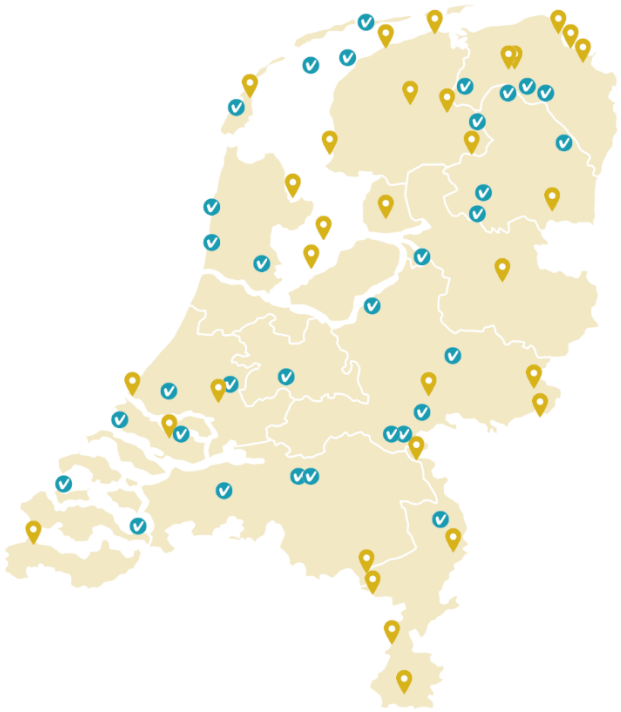


Fig 6.9: Climate buffers in the Netherlands, with completed projects marked in blue and projects under development in yellow.[187]

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 longer growing seasons, higher yields and 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.

[187] Details for each specific project can be found on the climate buffer website (in Dutch)

To prepare all Dutch entrepreneurs in agriculture and horticulture to deal with climate change sustainably and effectively, the Action Programme for Climate Adaptation in Agriculture was set up by the Ministry of Agriculture, Nature and Food Quality in 2020 in collaboration with stakeholders. Central to achieving this goal are the five pillars: water system, soil system, crops and cultivation systems, livestock farming, and supporting instruments, consisting of a regional approach, risk management, and knowledge and innovation.

Pillar 1. The water system encompasses climate adaptation actions aimed at increasing the resilience of the water system in order to be better prepared for drought, flooding and deterioration of water quality, such as salinity and nutrient pollution, now and in the future. National, regional and local cooperation minimises damage caused by climate change. In this pillar, there is structural cooperation with the Delta Programmes Freshwater and Spatial Adaptation, the Drought Policy Table, and the High Water and Flooding Policy Table and use is made of the experience of farmers and water boards.

Pillar 2. The soil system encompasses climate adaptation actions aimed at improving the health of agricultural soils by applying soil measures to, among others, increase the water storage, water infiltration, and the water purification capacity of the soil, as described in the National Programme for Agricultural Soils. In addition, improving soil quality (physical, chemical and biological) can support crops in coping with extreme weather conditions. Sustainable soil management can include, for example, using organic and green manure, lighter machines or drones, and permanent grassland.

Pillar 3. The crops and cultivation system encompasses climate adaptation actions aimed at making crops and cultivation systems more resilient to climate change as described in the Vision for the Future of Plant Protection by 2030. Climate-resilient crops are, for example, crops that are more resistant to diseases and pests, drought, salt or flooding, such as certain maize varieties, sorghum, cranberries and wine grapes. In 2022 the National Grow Fund funds the CROP-XR project to develop robust and extra-resilient agricultural crops.[188] In addition, this pillar aims to gain knowledge about adaptive cultivation systems and, where necessary, to improve regulations that restrain measures, such as hail covers, to protect crops against frost and extreme showers.

Pillar 4. Livestock Farming encompasses climate adaptation actions *aimed at making livestock, such as dairy cattle, pigs and poultry, more climate-proof,* as described in the Benchmark for Sustainable Livestock Farming, the action plan for heat stress and the

[188] For more information, see: Stand van zaken en vervolg Actieprogramma klimaatadaptatie landbouw

policy on new barn systems. Due to climate change, farm animals experience more heat and UV radiation. In addition, livestock gets exposed to new animal diseases due to climate change. Adaptation measures can include grazing and transport during the night, ventilators, and places with shadow in the meadow.

Pillar 5. Supporting Instruments consist of three supporting instruments: 1) a regional approach, 2) knowledge and innovation, and 3) risk management. These instruments cut across the four pillars and provide integral support for the objectives of these pillars. An example of a supporting instrument is the Broad Weather Insurance which agricultural entrepreneurs can use to insure against damage resulting from weather extremes.

Adaptation measures

The extreme weather events of the last couple of years have increased the urgency of implementing adaptation measures. For example, in 2016, high-intensity rainfall caused crop failure on many potato fields in South Brabant, in 2017 hail damaged crops and greenhouses, in the last five years droughts impacted agricultural productivity, and in 2021 the flooding in Limburg damaged agricultural fields. Most adaptation measures need to be implemented at the farm level, such as different cultivation methods, and measures to decrease water use or increase water retention and infiltration. However, a higher level of planning is also required for some measures, for example, farmers can adapt to high-intensity rainfall by improving drainage, but the impact on crop yields also depends on regional water management. Besides, farmers need to be assisted by research and innovation at the sector level, specifically for the development of heat-resistant or pest and disease-resistant varieties. Therefore, a dynamic knowledge agenda has been developed in collaboration with the sector on the basis of which knowledge projects are carried out and knowledge is disseminated to the agricultural and horticultural sectors and regional parties.

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 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, and was updated in 2015.[189] It now offers a range of specific measures that can be taken

[189] Nationaal Hitteplan, versie 2015. W.I. Hagens, M. van Bruggen, RIVM 2014

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[190]. The updated Climate Impact Atlas disseminates knowledge and best practices.

Fig 6.10 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

[190] See: https://english.deltaprogramma.nl/three-topics/spatial-adaptation/delta-decision

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. 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[191] has been updated accordingly and a National Climate Portal has been built to disseminate both knowledge and best practices.

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 and maintenance. 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. Rijkswaterstaat has also produced its own Climate Impact Atlas,[192] showing the hotspots related to national road and water infrastructure. Rijkswaterstaat has also prepared an implementation programme for the next three years[193]. 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. ProRail has recently published an implementation agenda with respect to climate adaptation.

[191] Available from: http://www.klimaateffectatlas.nl/en/
[192] The Rijkswaterstaat Climate Impact Atlas is available here: Rijkswaterstaat Klimaateffectatlas (rws.nl)
[193] Uitvoeringsagenda Klimaatbestendige Netwerken, Ministry of Infrastructure and Water Management, March 2022

Water & inland shipping

Municipalities, water authorities, provinces and central government are working together on the ambitions from the Delta Plan on Spatial Adaptation (DPRA) to act climate-proof from 2020 and to be climate-proof by 2050. To this end, the Climate Resistant Networks programme maps out the risks of climate change for the main water system, main road network and the main waterway network. The first results of the stress tests have resulted in the Climate Resistant Networks Implementation Agenda, which was prepared this spring. This shows that drought in combination with soil erosion leads to bottlenecks for navigability in inland waterways. Climate change will also make very dry years become more prevalent, such as previously in 2018 and currently in 2022. The navigability of the main waterways therefore requires extra attention. Making inland waterways climate-proof necessitates an integrated approach to flood risk management, navigability, freshwater availability, water quality, nature and an (economically) attractive living environment in the Integrated River Management (IRM) programme. This programme will lay out, among other things, the choices regarding the intended riverbed position and sediment management, discharge and storage capacity on the Meuse and the Rhine tributaries before 2050. Formal decisions about this programme are expected in 2023.

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[194,195]. 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

[194] As described in the NAS: http://ruimtelijkeadaptatie.nl/english/nas/

[195] 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.

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.

6.4 Implementation of adaptation actions and plans

6.4.1 Progress and results achieved

As mentioned throughout the present chapter, the National Climate Adaptation Strategy is the core document outlining priorities within the Netherlands' climate adaptation policy. In order to review the progress made and the results achieved in the Dutch climate adaptation policy, the 2016 NAS was evaluated in 2022 (expected publication date: autumn 2022). Its findings will give insight into the speed and effectiveness of adaptation efforts at the national level. These findings include both the progress made as well as the barriers and challenges encountered; the findings are summarised in both section 6.4.1 and 6.4.2.

Since the NAS was formulated in 2016, the following progress has been made in the Dutch climate adaptation policy:

- All Dutch regions have assessed their climate risks.
- Various local, regional and national authorities have started addressing knowledge gaps and implementing adaptation measures regarding agriculture, nature, critical infrastructure, built environment and health.
- Awareness and commitment to climate change adaptation has increased among a wide range of stakeholders (local and regional authorities, economic actors and the general public), for instance via stakeholder consultations, stress tests, dialogues and knowledge-sharing.

6.4.2. Barriers, challenges and gaps related to the implementation of adaptation

In its national climate adaptation policy, the Netherlands – like any country – faces barriers, challenges and gaps in the implementation of adaptation actions. In order to arrive at a better understanding of what those challenges are and, ultimately, overcome such challenges, the NAS evaluation has sought to identify the challenges experienced in

Dutch adaptation policy. Concretely, this evaluation has found the following challenges, barriers and gaps:

- A lack of concrete targets for most of the sectors paired with a lack of an MER system hampers insight in progress made and to be made.
- Mainstreaming of adaptation in large programmes and transitions needs to be accelerated, e.g. energy transition, housing schemes and agricultural reform.
- The governance structure of the NAS should be strengthened in order to better integrate adaptation and responsibilities need to be defined more clearly, especially for themes that have no clear 'owner', such as heat.
- More attention should be paid to social, environmental and cultural aspects of climate change adaptation.

In addition, the Netherlands would like to get more insight into the effectiveness of tools and measures, hence we are taking steps from pilots to upscaling and involving the private sector, particularly the financial sector. More knowledge is necessary regarding possible measures regarding drought and heat as well the effects of shift of climate zones.

In order to tackle the abovementioned findings, the NAS Implementation Programme for 2023–2030 will be developed in 2023 and the NAS will be fully updated in 2026, based on the upcoming meteorological scenarios (2023) and consequent climate risk analysis (2025). This NAS will contain a vision for 2100; concrete interim milestones and targets; and a corresponding set of instruments and governance arrangements.

6.4.3. Good practices, lessons learned and information sharing

In its striving to adapt to climate change, the Netherlands is implementing a wide variety of climate change adaptation actions. These measures are undertaken at various levels of government, in all parts of the country, to combat various climate change-related challenges. In order to ensure transparency, as well as to learn from ongoing adaptation actions, a website has been created which comprises a large number of climate change adaptation measures[196]. The website currently presents 269 examples of different types of adaptation actions, and has been made publicly available. The website does not only list the various examples of adaptation measures, but also includes a description for all projects, in which significant background information about the project is included. For finalised projects a discussion on results and lessons learned is also included. This not

[196] This website with examples of different types of adaptation actions is available from: https://klimaatadaptatienederland.nl/en/examples/

only increases the transparency of our adaptation policy, but also helps identify important factors for success and good practices regarding adaption.

6.4.4. Monitoring and evaluation

The drafting of a national monitoring scheme for climate adaptation started in autumn 2021, based on the study of the Netherlands Environmental Assessment Agency (PBL) 'Navigating towards a climate-resilient country' (Navigeren naar een klimaatbestendig Nederland), describing options for short and long-term monitoring and evaluation of climate adaptation policies. It entails monitoring the progress of the implementation programme, monitoring the extent to which climate adaptation measures are effective in terms of risk reduction and monitoring the development of climate change risks to all sectors. The results will be added to the website klimaatadaptatienederland.nl. This monitoring scheme will be fully operational in 2026 and will guarantee a structured monitoring of the progress on climate adaptation.

There are already several (sectoral or local/regional) monitoring schemes in place in the Netherlands. The monitoring programme of the Dutch Delta Programme ('Monitoring, Analysing, Acting') focuses on the questions whether the implementation (1) is on schedule and within budget (output), (2) is achieving the set goals (outcome), (3) is addressing the tasks in an integrated manner and (4) takes place with participation of other parties (authorities, companies, NGOs and citizens).

The national agency Rijkswaterstaat is responsible for measuring all kind of parameters with regard to the North Sea, coastal waters and the main rivers, including the water levels along the coast and in the main rivers. Rijkswaterstaat provides online information on water levels along the coast and in the main rivers and predicts these six hours before they occur.

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

7.1 Introduction

The Netherlands' support for climate action in developing countries is an integral part of its international cooperation policy. Our new policy note 'Do what we do best' (Dutch Ministry of Foreign Affairs, 2022) sets out the development and trade agenda, the overall aim of which is to address the root causes of poverty, terrorism, irregular migration and climate change, and to achieve the United Nations Sustainable Development Goals (SDGs). In addition, the Netherlands recently developed a government International Climate Strategy to steer our climate diplomacy and climate action international.

The Netherlands will increase its investments in Official Development Assistance (ODA) with a focus on those themes in which our country has particular expertise, such as water, agriculture and sexual and reproductive health and rights. Climate change, gender and private-sector development are cross-cutting themes. Believing that Dutch knowledge and expertise can contribute to innovative solutions for some of the biggest challenges of our time, such as climate change, the Netherlands combines development cooperation with encouraging and supporting foreign trade and investments. In the field of development cooperation, the government will focus in particular on 22 countries in the Sahel, the Horn of Africa, the Middle East and North Africa: Mali, Niger, Burkina Faso, Yemen, the Palestine Territories, Uganda, Ethiopia, South Sudan, Sudan, Burundi, Mozambique, Benin, Bangladesh, Egypt, Kenia, Jordan, Lebanon, Iraq, Afghanistan, Somalia, Chad and Tunisia. In 14 so-called combination countries, the Netherlands will follow a combined trade and development cooperation approach with particular focus on sustainability and digitisation: Egypt, Ghana, Morocco, Nigeria, Senegal, Ivory Coast, Kenia, South Africa, Bangladesh, India, Indonesia, Vietnam, Colombia and Ukraine.

Multilateral organisations and (climate) funds will 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.

The government will increase the ODA budget by 300 million euros a year in the period 2022 to 2024, and structurally by 500 million euros a year from 2025 onwards. In the coming years, the Netherlands will also invest considerably more in international climate action, having committed to a significant increase in climate finance (private and public)

from EUR 1.25 billion in 2021 to EUR 1.80 billion in 2025. Public climate finance is almost completely in the form of grants and more than half of it will be spent on climate change adaptation, with a focus on the poorest and most vulnerable countries in the world. Additional budget will also be made available for major problems in food shortages as a result of geopolitical conflicts and climate change.

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. The Netherlands is currently developing a Feminist Foreign Policy and gender has been an important cross-cutting issue, as climate action is most effective when it builds on the capacities and addresses the needs as well as the vulnerabilities of all, including, not least, women and girls.

The results of Dutch development cooperation, including our support for climate action, are reported to Parliament and published online.[197] Some quantitative results of Dutch climate finance reported in 2021 were:

- an additional 3.2 million people gained access to clean energy, bringing the total to 15.5 million people since 2015;
- more than 4.0 million hectares of forest were brought under improved sustainable management;
- 1.8 million people benefitted from improved water management and safe deltas;
- 9.7 million people received support in making their agricultural production systems more sustainable and resilient to climate change.

[197] Home - OS Portaal 2021 | NL Ontwikkelingssamenwerking

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. Table 7.1 below provides a summary of public and mobilised private finance over the years 2013–2020. Detailed information on public climate finance in NC8 reporting years 2019–2020 is provided in CTF Tables 7, 7a and 7b.

For mobilised private finance, the details for 2019–2020 are presented in section 7.2.8. Regarding the latter, it should be noted that the Netherlands started to track private climate finance mobilised by public finance in 2015 only, in accordance with the 'Joint Statement on Tracking Progress Towards the USD 100 Billion Goal', which major donors adopted that year. As data and methodological limitations are still a serious constraint, the reported amounts should be considered as best estimates.

Funding type and channel	Year of disbursement							
	2013	2014	2015	2016	2017	2018	2019	2020
Public Climate Finance through multilateral channels	89.90	134.50	243.44	256.14	152.18	139.04	217.28	224.31
Public Climate Finance through bilateral and regional channels	284.98	386.78	324.31	256.79	312.97	415.17	465.99	458.48
Total Public Climate Finance	374.88	521.28	567.75	512.93	465.15	554.21	683.27	682.79
Total Mobilised Private Finance	NA	NA	98.65	186.11	372.00	467.40	882.40	587.90
Grand Total	374.88	521.28	666.40	699.04	837.15	1,021.61	1,520.67	1,270.69

Table 7.1 Public and Mobilised Private Climate Finance provided by the Netherlands from 2013–2020 (in millions USD)

Over the period 2019–2020, adaptation expenditures amounted to close to 32% of Dutch public climate finance (EUR 377 million) and mitigation expenditures to more than 10% (EUR 113 million). Most public climate finance supported cross-cutting activities (EUR 698 million or 58%), mainly due to substantial contributions through multilateral organisations, in particular multilateral development banks.

7.2.2 New and additional financial support

As reported in the previous Biennial Reports (BR) and National Communications (NC), the Netherlands delivered on its Fast-Start Finance commitment in the 2010–2012 period. Since then, following the growing understanding that development and climate action are best pursued in an integrated manner, we have chosen a more integrated approach in line with our pledge to contribute a fair share to the needed financing of climate action in developing countries. Over the years, we have also actively engaged with the private sector to raise additional funding for climate action, as presented in in Section 7.2.8.

The financial resources disbursed over 2019 and 2020 as reported in this National Communication are considered new and additional to the financial disbursements reported in the Biennial Reports and National Communications over the years 2011–2018. Dutch support for climate action in developing countries is financed from the budget for foreign trade and development cooperation.[198] This budget is approved by Parliament annually, providing new and additional resources to the budgets approved in previous years, whereby formally the financial support to developing countries for climate action provided from this budget in a given year (as reported in CTF Tables 7a and 7b) is considered new and additional.

During the review of previous BRs and NCs, it was recommended that the Netherlands:

- *Provide transparent and detailed information to show how it determines financial resources as 'new and additional'. For example, if such allocation is made in comparison to the budget for previous years, it would be useful to provide the relevant figures.*
- *Provide information on how it took into account the need for adequacy and predictability in the flow of resources.*

Regarding the first recommendation, it is important to note that the public climate finance of the Netherlands consists of over 350 programmes/projects financed from a variety of budget lines. The budget lines with the highest climate relevance are those for climate, water and food security. Listing and analysing all the relevant programmes/projects in itself would not help provide the requested determination. The same goes for listing the budget lines since – depending on the budget line – a budget line contains both climate relevant and non-climate relevant activities.

[198] The core contributions to IDA and AIIB are exceptions financed from the Ministry of Finance's budget.

The Netherlands' total annual climate finance has doubled from USD 666 million in 2015 to some USD 1,270 million in 2020. Concrete examples of substantial new and additional financial commitments made by the Netherlands in recent years include:

- EUR 160 million to the Dutch Fund for Climate and Development (DFCD), for the period 2019–2038;
- EUR 120 million to the Green Climate Fund (GCF), for the period 2019–2023 (first GCF replenishment);
- EUR 124 million to the Global Environment Facility (GEF), for the period 2022–2026 (8th GEF replenishment);
- USD 100 million to the Climate Investment Funds (CIF), for the period 2021–2026;
- USD 44 million to the World Bank's Regional Off-grid Electrification Project in the Sahel for the period 2019–2026;
- EUR 25 million to the Least Developed Countries Fund (LDCF), for 2022;
- EUR 19 million to Climate Energy Response Facility (CERF), for the period 2022–2025;
- USD 20 million to NDC Partnership, including its Partnership Action Fund, for the period 2021-2025;
- EUR 29 million to the Initiative for Sustainable Landscapes of the Sustainable Trade Initiative (IDH) for the period 2021–2025;
- EUR 15 million to the Climate & Development Knowledge Network (CDKN), for the period 2022–2026;
- EUR 15 million to the Amazon Bioeconomy and Forest Management Multi-Donor Trust Fund of the Inter-American Development Bank (IDB) for the period 2022–2026;
- EUR 14 million to Central African Forest Initiative (CAFI), for the period 2022–2024;
- EUR 35.6 million for the AGRI-3 Fund for the period 2020–2039;
- a total of about EUR 220 million for strengthening civil society organisations active in lobby and advocacy in the areas of climate (justice), nature, biodiversity and sustainable/resilient WASH and Food Security for the period 2021–2025.

In addition to public climate finance, our contribution to international climate finance also includes private climate finance mobilised by public means. As further elaborated in section 7.2.8, the Netherlands has, with the help of external companies, been measuring and reporting the annual amount mobilised in line with OECD guidelines. These data are

published each year in publicly accessible reports. Although the Netherlands did have a policy to mobilise private climate funding also before Copenhagen, it now has a policy and accompanying measures to also do so for climate action specifically.

On the second recommendation, regarding adequacy and predictability, it is not possible to provide meaningful commentary on the adequacy of the flow of resources at aggregate level, since no formal decision exist on the share (of the USD 100 billion) to be borne by each country. In 2020, when the USD 100 billion agreed to in Copenhagen and Paris was due, the Netherlands contributed about USD 1.3 billion in public and mobilised private climate finance (not including its share of climate financing through the EU). Although we believe that this constitutes a reasonable, fair share of the total due by developed countries, we recognise that there is a wide variety of calculations.

Since, at the programme and activity levels, budgets are based on programme proposals and requests, and also formally committed through contracts and/or grant decisions, we believe that budgets are generally both adequate and predictable.

7.2.3 Assistance to parties from developing countries particularly vulnerable to climate change

The Netherlands' support for climate action in developing countries is an integral part of its international cooperation policy. Since Dutch public climate finance is all financed from ODA, our bilateral activities and contributions to multilateral institutions and development banks are primarily intended to support the poorest and most vulnerable countries and communities. The Netherlands furthermore targets more than half of its public climate finance for adaptation (note: this is based on the assumption that in addition to the 32% reported in section 7.2.1, a substantial part of the 58% reported for cross-cutting activities also addresses adaptation).

Of the Dutch partner countries, mostly situated in the Sahel, the Horn of Africa, the Middle East and North Africa, most are least developed countries (LDCs), many are fragile and conflict-affected states and all of them are vulnerable to climate change.

An evaluation of climate finance in the period 2010–2019 was carried out and published by the Evaluation Department in 2021.[199] According to the report, 60% of the public climate finance evaluated reached the poorest countries. For mobilised private climate

[199] https://english.iob-evaluatie.nl/

finance that percentage was 50%. To further improve the focus on the most vulnerable people, women and girls, the report furthermore presented a number of practical recommendations for programme identification, design and monitoring and evaluation.

To address the needs of our partner countries, 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.

With regards to (earmarked) bilateral activities funded with public climate finance, we require implementing organisations to carry out context, problem and stakeholder analyses, and in that process also refer to climate profiles such as those published by IPCC, prepared by the Ministry itself or available at other organisations such as USAID, AfDB, WB, UNDP, and not least also to National Determined Communications (NDCs), National Adaptation Plans (NAPs) and other relevant national policies and strategies. In the programme Theory of Change and Monitoring, Evaluation and Learning (MEL) strategy, implementing organisations funded by the Netherlands are expected to explain how the programme intends to address climate risks and vulnerabilities, and with what results.

Considerable part of the Netherlands' climate finance is provided through (core) contributions to multilateral (climate) funds such as GCF and GEF, to multilateral organisations such as WFP, UNICEF, UNDP and UNEP, and to multilateral development banks. In those cases, the Netherlands does not have direct control of the selection of programmes and (focus) countries but has been playing an active role, through scheduled board meetings and dialogues and direct communications, in asking those organisations to increase the climate relevance of their activities, to direct their activities towards the poorest and most vulnerable countries, and to also develop the necessary processes, safeguards, guidelines, manuals, etc. in that regard.

Fund managers receiving Dutch funds aiming at supporting and mobilising private sector finance and investments are provided with instructions regarding objectives, scope and focus, and are expected to report and be evaluated accordingly. For the Dutch Fund for Climate and Development (DFCD),[200] for instance, there is a requirement that 65% of the investments is directed at adaptation in the poorest and most vulnerable countries.

[200] https://thedfcd.com/

7.2.4 Public financial support: contribution through multilateral channels

Multilateral climate change funds to which the Netherlands contributed include the Green Climate Fund (GCF), the Global Environment Facility (GEF), the Least Developed Countries Fund (LDCF) and the Climate Investment Funds.

The Netherlands continues to play an active role in the GCF through its commitment of EUR 100 million at the Initial Resource Mobilisation in 2014 and EUR 120 million at the First Replenishment in 2019. The Netherlands shares a GCF Board seat with Denmark and Luxembourg. In the GCF board, our priorities are focused on: mobilising private sector engagement and funding; facilitating access to the fund (e.g. by diminishing administrative burdens), enhancing access for the most vulnerable countries, such as LDCs; enhancing the role of civil society, and making sure that adequate policy frameworks are in place that should rank as global *best practices*, e.g. on gender, integrity, accountability, ESS etc.

The Netherlands also continues to provide active support to the GEF with a contribution of EUR 84 million at the 7th Replenishment in 2018, EUR 124 million at the 8th Replenishment in 2022 and via an active Council Seat, shared with Finland. Within GEF, Dutch priorities are very similar to those in the GCF: enhanced access for LDCs, mobilising private finance, adherence to adequate fiduciary standards, etc. The Netherlands agrees with the current strong focus on biodiversity within GEF.
Finally, the Netherlands is a regular donor to the Least Developed Countries Fund (LDCF) that is wholly dedicated to climate adaptation activities in LDCs.

The Netherlands continued to provide active support for the Climate Investment Funds (CIFs) and the Trust Fund Committees of the CIFs.

The Netherlands is also a major donor of core funding to multilateral development banks, United Nations' agencies and funds that provide significant support to climate action in developing countries. The Netherlands reports on the climate-specific part of these core contributions in CTF Table 7(a). Under our thematic priorities, key multilateral organisation programmes that we supported include the World Bank's CGIAR (originally known as the Consultative Group for International Agricultural Research), the World Bank's Energy Sector Management Assistance Program (ESMAP), the Clean Cooking Alliance, the Central African Forest Initiative (CAFI), and the World Bank's Cooperation in International Waters in Africa (CIWA).

As reported in CTF Table 7(a), the total climate specific contributions through multilateral channels amounted to EUR 184.7 million in 2019 and EUR 199.6 million in 2020. CTF Table 7(a) gives further details of Dutch multilateral climate finance disbursed in 2019 and 2020. A summary of the total provision of public climate finance support through multilateral channels in 2013–2020 is provided in the Table 7.2 below (figures in millions USD).

Allocation channel of public financial support for climate action	Year of disbursement							
	2013	*2014*	*2015*	*2016*	2017	2018	2019	2020
Climate-specific contributions through multilateral channels, including:	40.16	18.21	12.40	31.83	36.60	55.00	65.49	106,92
Global Environment Facility	14.53	15.05	0	15.77	15.20	28.19	16.23	19.49
Least Developed Countries Fund	25.00	0	0	0	0	9.10	8.00	15.50
Montreal Protocol	631.05	3.16	3.34	3.34	4.07	3.73	3.73	3.73
Green Climate Fund	0	0	9.05	12.72	17.33	13.98	37.53	58.20
Climate Investment Fund	0	0	0	0	0	0	0	10.00
Financial institutions, including regional development banks:	44.02	93.50	188.82	161.56	66.12	155.73	129.73	97.12
World Bank	43.74	13.93	133.84	139.50	22.84	113.32	95.67	51.31
International Finance Corporation	0	13.11	6.07	2.40	5.05	9.88	0	13.38
African Development Bank		55.70	37.84	13.25	15.83	11.89	18.42	31.92
Asian Development Bank	0	0.53	4.05	0.40	3.92	1.99	1.46	0.51
European Bank for Reconstruction and Development	0.03	0	0	0	0	0.91	0	0
Other – Asian Infrastructure Investment Bank	0	0	0	0	18.48	17.73	14.18	0
United Nations bodies, including:	5.72	22.79	42.22	62.75	49.45	28.31	22.06	20.26
United Nations Development Programme	3.59	1.96	1.64	1.52	1.91	1.89	1.76	1.12
United Nations Environment Programme	1.78	1.87	2.90	1.68	1.71	0.73	2.52	2.41
World Food Program	0	0	0	0	5.69	4.55	5.29	6.03
Food and Agriculture Organisation of the United Nations	0.31	0.33	1.12	6.00	12.14	12.80	0	0
International Fund for Agricultural Development	0	12.68	18.07	39.39	22.22	0	11.46	9.25
Other	0.03	0	1.85	1.42	5,78	8.34	1,57	1.45
Grand Total	89.90	134.50	243.44	256.14	152.18	139.04	217.28	224.31

Table 7.2 Total provision by the Netherlands of public climate finance support through multilateral channels in 2013–2020 (figures in millions USD)

7.2.5 Provision of public financial support: contribution through bilateral, regional and other channels

In addition to our core contributions through multilateral channels, the Netherlands also worked 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 and offering climate-resilient WASH services. In many cases, these programmes also targeted countries or regions beyond the focus of the Netherlands' development cooperation.

As reported in CTF Table 7(b), the total contributions through bilateral, regional and other channels amounted to EUR 396.1 million in 2019 and EUR 408.0 million in 2020. CTF Table 7(a) provides a detailed overview of Dutch climate finance through bilateral, regional and other channels disbursed in 2019 and 2020. A summary of the total provision of climate-specific public finance contributions through multilateral channels in 2013–2020 is provided in Table 7.3 below (figures in millions USD).

	Year of disbursement							
	2013	*2014*	*2015*	*2016*	2017	2018	2019	2020
Climate-specific contributions through bilateral, regional and other channels	284.98	386.78	324.31	256.79	312.97	415.17	465.99	458.48

Table 7.3 Total provision by the Netherlands of climate-specific financial contributions through bilateral, regional and other channels in 2013–2020 (figures in millions USD)

7.2.6 Mitigation

In the period 2019–2020, a total of USD 128 million was spent on climate change mitigation in some 35 activities. Of these 18 activities had climate change mitigation as a principal objective and 17 as a significant secondary objective. Furthermore, over the same time period, USD 804 million of climate finance was spent on 91 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
In 2015, the Dutch government adopted the objective to help 50 million people gain access to renewable energy between 2015 and 2030. In 2022, the new Dutch government has now increased that goal to 100 million people.

The bulk of the funds are channelled through bilateral, often multi-donor, projects and programmes executed by multilateral agencies ('worldwide' and 'regional'). Given the focus on market development, co-operation with the private sector is an important component of the renewable energy programme.

The Netherlands works closely with Germany, Norway and Switzerland on the provision of access to renewable energy in the Energising Development Partnership (EnDev) in 20 countries. EnDev started as a German-Dutch initiative implemented by GIZ and has grown into a multi-donor, multi-implementer programme co-managed by GIZ and RVO. 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 projects within the Dutch renewable energy programme are SDG7 Results, which is based on the principle of results-based finance, meaning that subsidies are only provided after independent verification of the results. Another example is the Africa Biogas Component that has been developed in association with EnDev and builds on the experiences and lessons of the Africa Biogas Partnership Programme. This programme on biogas aims to strengthen the market for biodigesters in five African countries, providing households with clean cooking fuel, improved sanitation and an excellent organic fertiliser. In general, the Netherlands strives to cooperate with the private sector and encourages its non-governmental partners to do the same. One example is the Access to Energy Fund (AEF), which has existed since 2007. Managed by the Dutch development bank FMO, the fund aims to increase access to renewable energy in developing countries. It does so by investing in promising projects which are still too risky for the private sector to fund without public support. The AEF is a revolving fund, which means that successful investments ensure that money eventually returns to the fund so that it can be reinvested. Another example is Climate Investor One, managed by Climate Fund Managers. This renewable energy fund has adopted an innovative life-cycle approach for financing large scale energy projects such as windfarms, hydropower and solar fields.

Climate Investor One has attracted many investors and mobilised more than USD 800 million in public and private finance.

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 (including clean cooking), renewable energy, energy efficiency and improved energy sector management, e.g. through reforming fossil fuel subsidies.

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 regarding deforestation associated with agricultural commodities 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 in improving 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 and IUCN.

A complete and detailed list of all projects is included in CTF Table 7(b). Further information on the projects is also published by the Netherlands through the International Aid Transparency Initiative (IATI) and/or can be obtained from the programmes' websites. Below is a short list of examples illustrative for the Netherlands' support for mitigation, both at regional and country levels.

Project Number and Name	**Recipient/ Focus**	**Description and Link to Website**
24463 - Climate Investor One	Global	Climate Investor One (formerly the Climate Development and Finance Facility) facilitates early-stage development, construction financing, and refinancing to fast-track renewable energy projects in developing countries (https://climatefundmanagers.com/funds/#CIO).

Project Number and Name	Recipient/ Focus	Description and Link to Website
28721 - WEF Secretariat TFA2020	Global	Aims to mobilise and coordinate actions by the private sector, governments and civil society through the TFA secretariat in support of reduced deforestation related to key agricultural commodities such as palm oil, soya, beef, paper & board (https://www.tropicalforestalliance.org/).
4000000171 - Energy Transition Facility (ETF)	Algeria, Egypt, Jordan, Lebanon, Morocco, Mozambique, the Palestinian Territories, Tanzania and Tunisia	With the Energy Transition Facility, the Netherlands Ministry of Foreign Affairs aims to contribute to promoting energy transition in the countries around Europe. The Energy Transition Facility is commissioned by the Netherlands Ministry of Foreign Affairs and implemented by the Netherlands Enterprise Agency. The Energy Transition Facility (ETF) supports countries in the MENA region with their transition to a more sustainable energy supply. Projects are focused on collaboration at policy level. National governments can request the support of the ETF to acquire Dutch expertise, technical assistance or investments on energy transition. The Energy Transition Facility is open to the following countries: Algeria, Egypt, Jordan, Lebanon, Morocco, Mozambique, the Palestinian Territories, Tanzania and Tunisia (https://projects.rvo.nl/programme/nl-kvk-27378529-4000000171/).
4000000486 - European Forest Institute FLEGT & REDD facility	Global	Supporting the implementation of the Forest Law Enforcement Governance and Trade Action Plan, strengthening forest governance (https://flegtvpafacility.org/).
4000001398 - Landskap	Indonesia	Supporting Indonesia, through UNEP, to restore peat landscapes by promoting new sustainable peatland business and governance models.

Project Number and Name	Recipient/ Focus	Description and Link to Website
4000001666 - Global Energy Transformation Pr-GET.Inv.	Global	GET.Invest is the private sector module of the Global Energy Transformation Programme (GET.pro), a European multi-donor platform delivering on energy and climate targets. The objective of GET.Invest is to stimulate investments in renewable energy in developing countries by pipeline development and private sector mobilisation. It does so by providing demand-driven coaching and advisory services for project development, including in-depth technical assistance (where required), and by generating and making available market information on business opportunities. The programme works across different market segments of decentralised renewables, such as small on-grid independent power producers (IPPs), mini-grids, solar home systems and clean cooking solutions. GET.Invest has a focus on sub-Sahara Africa but can also be deployed in other regions (https://www.get-invest.eu/).
4000002085 - RBF facility for energy access	Global	The facility will incentivise private sector players that provide access to renewable energy to expand their business activities to poorer customer segments and regions, by cushioning the associated risks and lowering the associated cost. Grants for incentives are paid ex-post, i.e. after independent verification of the number of poor households provided with sustainable access to renewable energy. The facility aims to provide access to renewable energy for a minimum of 2 million poor people in developing countries (https://english.rvo.nl/sites/default/files/2019/04/TG_120140_Factsheet_SDG-RBF.pdf).
4000002087/3566 - Energising Development (EnDev) 2019-2022	Global	EnDev is an energy access implementation programme currently financed by six like-minded donor countries: the Netherlands, Germany, Norway, United Kingdom, Switzerland and Sweden. Through EnDev poor households, social institutions and small and medium-sized enterprises in selected developing countries gain sustainable access to renewable energy technology and services (https://endev.info/).

Project Number and Name	Recipient/ Focus	Description and Link to Website
4000002627 - Clean Cooking Alliance	Sub-Sahara: Ghana, Kenya, Rwanda and Uganda, Ethiopia and Nigeria	Nearly three billion people lack access to clean cooking solutions, with the most striking numbers coming from sub-Saharan Africa. The impacts of traditional cooking on the environment, health, economies and women's empowerment are enormous. Estimates of the WHO indicate close to four million die each year from household air pollution from inefficient cooking practices. Unfortunately, progress on improving access to clean cooking remains slow. The programme aims to dramatically boost progress on clean cooking through a market strengthening programme that builds a stronger, sustainable clean cooking sector. The programme is based on four pillars: (i) build the pipeline of investable business, (ii) enhance category level demand, (iii) improve the policy environment, and (iv) increase investment community participation. The programme focuses its efforts in four countries that have the fundamentals required to make meaningful progress toward a competitive market in the next four years: Ghana, Kenya, Rwanda and Uganda. In addition, special attention will be paid to Ethiopia and Nigeria, which show high potential though less firm market foundations. Furthermore, it is expected that these 'proof points' will allow for progress in neighbouring countries and beyond (https://cleancooking.org/).
4000002910 - AGRI3 FUND	Global	Contribution to the AGRI3 Fund, which aims to stimulate banks, other financial institutions and agribusinesses to develop business models that include (acceleration of) forest protection and reforestation and implementation of innovative agricultural solutions, whilst improving the living standards of local farmers and smallholders. The Fund will provide guarantees and technical assistance, parallel to private loans from commercial banks, in order to mitigate the risks of investing in sustainable agriculture and re-forestation in developing countries by providing long-term loans (https://agri3.com/).

Project Number and Name	Recipient/ Focus	Description and Link to Website
4000003964 - Access to Energy Fund	Global	The Access to Energy Fund (AEF), managed by the Dutch Development Bank FMO on behalf of the Dutch Government, was set up to support the creation of sustainable access to renewable energy for people in developing countries. AEF does so by providing risk-bearing funding. However, AEF recognises that in order to have impact, there is a strong need also to proactively strengthen businesses, share knowledge and set up partnerships. Therefore, out of the total fund size, about 5% is set aside specifically for capacity development and monitoring and evaluation. Capacity building includes advisory services that enable clients (enterprises and funds investing in renewable energy) to better understand, manage and mitigate certain risks or develop strategic opportunities linked to its core business (https://www.fmo.nl/aef).
4000003982 - WB-ESMAP	Global	The activity includes provision for the creation of and training for clean and green (energy) jobs. A Digital Academy will be established to, among other objectives, identify and transfer emerging global knowledge, best practices, and deliver training in key areas of next generation utilities. Knowledge exchange, workshops and trainings will be offered on market deployment and Power System Planning, and internal and external knowledge exchange fora will be organised on Energy Subsidy Reforms. Training will furthermore include topics such as women's leadership in the decarbonization of the public sector and end uses in developing countries, and innovative technology, business, and financing approaches in clean cooking (https://www.esmap.org/).

7.2.7 Adaptation

The Netherlands aims to spend half of its public climate finance on adaptation. In the period 2019–2020, a total of USD 434 million was spent on climate change adaptation in some 175 activities. Of these activities, about 28 activities had climate change adaptation as a principal objective and 147 as a significant secondary objective. Furthermore, over

the same time period, USD 804 million of climate finance was spent on 91 cross-cutting activities – as also mentioned in the section above – many of which also had a substantial focus on adaptation. 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.

Human-induced climate change is causing dangerous and widespread disruption in nature and is affecting the lives of billions of people around the world, despite efforts to reduce the risks. People and ecosystems least able to cope are being hardest hit. Increased heatwaves, droughts and floods are already exceeding plants' and animals' tolerance thresholds, driving mass mortalities in species such as trees and corals. These weather extremes are occurring simultaneously, causing cascading impacts that are increasingly difficult to manage. They have exposed millions of people to acute food and water insecurity, especially in Africa, Asia, Central and South America, on small islands and in the Arctic. To avoid mounting loss of life, biodiversity and infrastructure, ambitious, accelerated action is required to adapt to climate change, at the same time as making rapid, deep cuts in greenhouse gas emissions. So far, progress on adaptation is uneven and there are increasing gaps between action taken and what is needed to deal with the increasing risks, the new IPCC report on Impacts, Adaptation and Vulnerability[201] finds. These gaps are largest among lower-income populations

The Netherlands supports climate change adaptation through specific adaptation programmes such as Partners for Resilience, as well as through the integration of climate change concerns, particularly in programmes for water and food security, and more recently also in private sector development programmes and programmes focusing on education, sexual and reproductive rights, and strengthening of civil society.

To support this process of climate mainstreaming, guidelines for integrating climate-smart actions into development policies and activities were developed and/or adapted from existing (in particular OED/DAC) guidelines. 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

[201] IPCC Sixth Assessment Report on Impacts, Adaptation and Vulnerability: https://www.ipcc.ch/report/ar6/wg2/

actions in the activity's appraisal document and in the assignment of climate Rio markers. To assist embassies and their partners in the first two steps of this process, climate profiles were developed for a number of partner countries whereas, more and more, reference is also made to relevant IPCC reports, country NDCs and NAPs, and country climate profiles developed by other partners such as USAID, GIZ, UNDP, etc.. To support programme developers, the Netherlands furthermore actively partners and cooperates with organisations such as WRI and CDKN.

A detailed list of all projects is included in CTF Table 7(b). Further information on the projects is also published by the Netherlands through the International Aid Transparency Initiative (IATI) and/or can be obtained from the programmes' websites. Below is a short list of examples illustrative of the Netherlands' support to climate change adaptation, both at regional and country levels. Other examples of activities supported under the Sustainable Water Fund (SWF) are also presented in Chapter 6.

Project Number and Name	**Recipient/Focus**	**Description and Link to Website**
23710/24011 Sustainable Water Fund Phases I and II	Global	This public-private partnership facility in the field of water and sanitation aimed to contribute to water safety and water reliability in developing countries, including through innovative technological solutions. Themes included climate-relevant topics such as efficient water usage, safe deltas and improved basin management (https://english.rvo.nl/subsidies-programmes/sustainable-water-fund-fdw).
4000000768 – Dutch Disaster Risk Reduction	Global	The Dutch Disaster Risk Reduction Team 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 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 (https://english.rvo.nl/subsidies-programmes/dutch-risk-reduction-team-drr).
25484 - G4AW Faciliteit	Global	Geodata for Agriculture and Water Facility 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. (https://g4aw.spaceoffice.nl/en/).

Project Number and Name	Recipient/Focus	Description and Link to Website
29296 - COT - Omidelta - GIRE - Multi	Benin	This activity focused on the Ouémé river delta in Benin, and more specifically urban and surrounding areas. Disaster risk reduction was addressed through the introduction of the Dutch Delta approach, while support for the National Water Institute (INE Benin) reinforced national and regional capacity to cope with the uncertain effects of climate change. INE Benin aims to develop capacity on data collection, hydraulic modeling, and advisory services (https://www.netherlandswaterpartnership.com/regions/africa/benin).
29715 - MAP IMPLEM. BEIRA MASTERPLAN	Mozambique	The implementation of the 'Beira Masterplan' is supported by the Netherlands with the aim to limit the impact of floods and climate change through urban and economic development.
4000000819 - Climate Resilient Agribusiness for Tomorrow	Regional Africa: Kenia, Tanzania, Uganda	This programme promotes inclusive market-led business development for climate smart sustainable intensification of arable food farming in Kenya, Tanzania and Uganda, based on partnership between East African, Dutch and international stakeholders (https://snv.org/project/climate-resilient-agribusiness-tomorrow-craft).
4000001091 - Climate & Development Knowledge Network	Global	The Climate and Development Knowledge Network is a demand-driven network that supports developing countries in Africa, Asia and Latin America with knowledge, research and technical assistance for climate resilient development. As a network organisation, CDKN generates good and relevant information, adapted to specific contexts. CDKN strengthens South-South cooperation (https://cdkn.org/).
4000001352 - Joint Cooperation Program III (JCP III)	Indonesia	This cooperation programme between Dutch and Indonesian knowledge institutes seeks to enhance the resilience to climate change of urban deltas in Indonesia through development of climate datasets and capacity building for improved river basin management, and for operational activities such as urban flood forecasting, drought early warning, supporting Climate Field Schools for farmers and development of a Hydro Informatics Centre (https://www.jcp-indonesia.org/over).
4000001489 - Support to Implementation of Bangladesh Delta Plan	Bangladesh	With the support of the Netherlands and others, the Government of Bangladesh has been engaged in the development of a long-term Delta Plan (BDP2100) to address future development challenges, including the effects of climate change. The objective of this activity is to support Bangladesh in the operationalisation of the Bangladesh Delta Plan by strengthening the capacity of the General Economics Division of the Ministry of Planning with a view to the establishment of a competent Delta Wing to coordinate BDP2200's implementation as well as of a Delta Fund and of the broader institutional structure required. Furthermore, the activity focuses on strengthening the capacity of key implementing organisations (https://www.netherlandsandyou.nl/your-country-and-the-netherlands/bangladesh/bangladesh-delta-plan-2100).

Project Number and Name	Recipient/Focus	Description and Link to Website
4000001952 - Joint Cooperation Programme Bangladesh	Bangladesh	To operationalise the Bangladesh Delta Plan (BDP2100) a knowledge agenda has been established to address the BDP2100's knowledge needs, including needs linked to climate change adaptation. The Joint Cooperation Programme Bangladesh is a cooperation programme between two knowledge institutes in the Netherlands (Deltares and Wageningen University & Research) and two in Bangladesh (Institute for Water Management and Centre for Environmental Impact Assessment) that aims to contribute to the knowledge agenda. The programme focuses, among other aspects, on strengthening knowledge institutes in Bangladesh in the field of adaptive water management in view of uncertainties posed by climate change (https://jcpbd.nl/).
4000002027 - MAP/ Maraza Land Development Pilot Project	Mozambique	The problems confronting urban deltas are complex and require an all-embracing approach. The Dutch Government and the delta city of Beira agreed to enter into a medium-term partnership to enhance the city's resilience to flooding and assist it in adapting to climate change. In a participatory process, a plan was developed which was adopted by the City council in 2014, the Beira Masterplan. Part of the plan was a list of priority projects among which the development of the Maraza New Town Area. Maraza is an undeveloped swamp area of 350 ha inside the city of Beira. The Maraza pilot project envisages to prove that through organised extension of residential areas, suitable land can be made available to end users for affordable prices in areas which are currently inhabitable due to regular flooding. The Municipality of Beira will establish a mechanism to organise this: the Land Development Company (LDC) – an autonomous entity that will raise, level and drain terrains to reach economies of scale. In the statutes of the LDCs it is stipulated that all revenues will return to the LDC and that part of the area will be used for social housing. With the proposed EKN contribution and an equivalent contribution of the municipality of Beira a pilot will be carried out to create a 'fly wheel effect' for the business case. An area of 3 hectares will be landfilled, 125 plots delineated and granted with secured land rights as well as basic infrastructure (access roads, utilities, drainage system). The British social investor REALL will be the launching customer. After scaling up the number of houses, it will become possible to build houses in the range of USD 10,000 per unit, giving the lower income groups an alternative to the present situation of forced habitation in flood-prone areas (https://sdubeira.co.mz/en/wp-content/uploads/2021/04/FOUNT-20210406-Maraza-Project-Workshop-slides-FINAL-v2.pdf).

Project Number and Name	Recipient/Focus	Description and Link to Website
4000002034 - Securite Alimentaire Resilience à Mopti	Mali	The second phase of the programme *Appui à la sécurité alimentaire et à la résilience des populations aux crises climatiques et sociales dans la région de Mopti* (PASARC II) aims to improve the food security and resilience of rural populations in the 5th region of Mali to shocks related to climate change and social crises. This vision is articulated around three impact areas: 1) poverty incidence reduced from 64.4% to 55% among direct beneficiaries at the end of the project; 2) improved food security from 34.7% to 60% of the population having 3 meals a day; 3) decrease in the prevalence of conflicts related to water management and NRM by 80% (https://www.food-security.net/projet/appui-a-la-securite-alimentaire-et-a-la-resilience-des-populations-aux-crises-climatiques-et-sociales-dans-la-region-de-mopti-phase-ii-pasarc-ii/).
4000002036 - STAMP +	Mali	STAMP Plus is an extension of the STAMP project (initiated in the context of the Geodata for Agriculture and Water component, G4AW, managed by the Netherlands Space Office) which aims at the socio-economic improvement of pastoralists in northern Mali in the context of climate change (https://snv.org/project/stamp-building-success).
4000002112 - KIG/Sebeya Landscape Restoration Pilot	Rwanda	The activity is aimed at developing replicable and scalable approaches to landscape restoration that are relevant to the Rwandan context (https://www.rwb.rw/updates/news-detail/conservation-of-sebeya-catchment-end-of-woes-for-nyabihu-and-rubavu-communities).
4000002457 - Char Development and Settlement Project	Bangladesh	The protection of the char areas south of Noakhali, the people living there and their livelihoods against the impact of extreme climate variability (cyclones, floods) and climate change (sea level rise) as well as specific water-related threats is the key objective of the project. A major focus of the CDSP programme has always been the development of adequate institutions and organisations in the new land area. This is achieved by strengthening the nascent government structures and partly by establishing stakeholder organisations for agricultural development (Farmer forums), sanitation and water supply and participatory water management. During this bridging phase a new objective is the design and establishment of a permanent institutional framework and organisation for Char Development in the Delta which will be responsible for the strategic planning of char development, project planning and implementation (https://cdsp.org.bd/).
4000002458 - Urbanising Deltas of The World	Bangladesh	The activity will implement communication, capacity development and innovation activities. These activities will enhance the use of UDW research results for the implementation of the knowledge agenda of the Bangladesh Deltaplan 2100 (https://www.nwo.nl/en/researchprogrammes/urbanising-deltas-world-udw).

Project Number and Name	Recipient/Focus	Description and Link to Website
4000003124 - CIWA World Bank	Regional Africa	Climate resilience is one of the overarching objectives of the Cooperation in International Waters in Africa (CIWA). The impact of climate change on the water cycle is increasingly felt in large parts of Africa. Better water resources management – at all scales, from the individual plot of a farmer to the transboundary basin – is needed for climate adaptation and resilience. CIWA is an effective mechanism to address that large scale; strengthening climate smart information, institutions, and infrastructure to cope with the effects of climate change, with a long-term horizon, long-term commitment, building on the World Bank's convening and staying power as well as credibility. Sometimes the interventions that CIWA supports are as simple as better cross-border coordination between the operators of a cascade of large dams. Just informing the downstream colleagues of an imminent release of floodwaters can help prevent thousands of casualties and damages. But such coordination does not happen spontaneously. CIWA creates platforms for this purpose (https://www.worldbank.org/en/programs/cooperation-in-international-waters-in-africa).
4000003400 - Drylands Sahel Program	Global	The overarching goal (impact) of this subsidy instrument is ecologically sustainable land use in arable farming and (semi-)nomadic livestock farming resulting in sustainable production and improvement of incomes of farmers and livestock keepers in a coherent area in the agro-ecological Sudan-Sahel zone of Burkina Faso, Mali and Niger.
4000003468 - KAI Strengthening Climate Resilience and Food Security in Southern Egypt	Egypt	The aim of the activity is to strengthen the capacity of smallholders through access to improved agricultural technologies and practices, as well as information, markets and institutional services, to help strengthen their livelihoods and resilience to climate change. The activity will focus on increasing water efficiency in agriculture, among other aspects, doubling the income and productivity of farmers, strengthening ecological sustainability and increasing the climate resilience of ecosystems and livelihoods (https://www.netherlandsandyou.nl/your-country-and-the-netherlands/egypt/projects).
4000003601 - BAM MODHEM +	Burkina Faso	MODHEM+ is a new phase of the Mobile Data for Moving Herd Management and better incomes (MODHEM) project. This project aims to strengthen complementarity and synergy with the 'Sustainable Technology Adaptation for Mali's Pastoralists' project , which aims to create a mobile phone information system that makes agro-meteorological information, product prices and advice on financially sustainable agro-pastoral exploitation (GARBAL+) accessible to farmers and herders. It aims to improve productivity and increase incomes, resilience and food security of agro-pastoral populations (https://g4aw.spaceoffice.nl/en/g4aw-projects/g4aw-projects/4/modhem.html).

Project Number and Name	Recipient/Focus	Description and Link to Website
4000003671 - NAI - LISTEN	Kenya	The Laikipia, Isiolo, Samburu Transforming the Environment through Nexus (LISTEN) project seeks to contribute to the goal of enhancing resilience of food, nutrition and water security in the three selected Arid and Semi-Arid Lands (ASAL) counties (https://snv.org/project/listen-laikipia-isiolo-samburu-transforming-environment-through-nexus).
4000004109 - RAM HUNA Wheatmax	Palestinian Authorities	A project involving Hebrew University (Israel) and Biodiversity Education Research Center (Palestinian Territories) focusing on maximising crop-use efficiency to support a climate-resilient wheat cropping system (https://wheatmax2020.wixsite.com/website).
4000004636 - Food Systems Resilience West Africa 1	Regional Africa	Under the activity the capacity of selected stakeholders (ECOWAS and others) to identify and design regional flagship initiatives in resilient food systems will be fostered in order to prepare for a large WB West Africa programme. The activity will focus on developing strategy and partnerships; evidence, analytics and delivery mechanisms, and learning and capacity building in support of the design of the programme indicated (https://projects.worldbank.org/en/projects-operations/project-detail/P172769).

7.2.8 Mobilised private climate finance

Climate change cannot be addressed by governments alone. The private sector must take part in the transformative change that is needed for low-carbon, climate-resilient development. The knowledge and the financial resources from private sector sources are indispensable.

The Netherlands focuses on the mobilisation of blended and/or innovative finance through its private sector development portfolio, its cooperation with MDBs and FMO and through the development of specific funds tailored to public-private cooperation. In the new foreign trade and development cooperation strategy for the coming years, the Netherlands strives to further increase the mobilised private finance for climate.

For example, Dutch activities such as Climate Investor One, the Dutch Fund for Climate and Development, Solidaridad, IDH, the AGRI-3 Fund, Geodata for Agriculture and Water, Sustainable Development Goals Partnership are designed to mobilise and attract private investors, as well as FMO delegated state funds like MASSIF, AEF and Building Prospects.

On top of these commitments we support innovative, interdisciplinary initiatives such as the Global Innovation Lab on Climate Finance to scale up private and innovative climate finance in developing countries and innovative programmes working on the lower end of the mobilisation scale, like the Mobilising More for Climate programme which is combining local efforts to protect vulnerable ecosystems with the development of fundable business propositions to support the livelihoods of local stakeholders.

We are aware that at the global level most private finance mobilised is in support of mitigation. Therefore, the Netherlands has decided to focus explicitly on mobilising the private sector for adaptation in programmes such as the Dutch Fund on Climate and Development. Recently the Global Innovation Lab on Climate Finance opened specific windows supporting the mobilisation of climate finance for adaptation of vulnerable sectors such as agriculture and water management.

Following years of work in the Research Collaborative on Tracking Private Climate Finance – which the Netherlands also supported – major donors adopted the Joint Statement on Tracking Progress Towards the USD 100 Billion Goal in September 2015, agreeing on a common understanding of mobilised private climate finance and a common methodology. Since then, the Research Collaborative further refined methodologies in collaboration with the OECD DAC. Using these methodologies, the Netherlands can now report that it mobilised EUR 750 million in private climate finance in 2019 and another EUR 523 million in 2020. Tables 7.4 and 7.5 present more detailed information. Data limitations still presented serious constraints in some cases, so the reported amounts should be considered as best estimates. All information on the Netherlands' mobilization efforts is also published yearly in reports that are available to the public.[202]

[202] https://www.government.nl/topics/development-cooperation/documents/reports/2020/05/12/mobilised-private-climate-finance-report-2019 and https://www.government.nl/documents/reports/2021/07/09/report-on-mobilisation-of-private-climate--biodiversity-finance-for-developing-countries-by-dutch-public-interventions-in-2020

Mobilised private climate finance 2019		
	In millions EUR	In millions USD
Through Multi-donor Funds	126	148.2
Green Climate Fund (GCF)	11	12.9
Global Environment Facility (GEF)	3	3.5
Global Agriculture and Food Security Program (GAFSP)	1	1.2
Sustainable Trade Initiative (IDH)	10	11.8
Climate Investor One	66	77.6
One Acre Fund	6	7.1
Private Infrastructure Development Group (PIDG)	29	34.1
Through Bilateral Programmes	12	14,2
Solidaridad	1	1.2
Sustainable Development Goals Partnership	7	8.2
Orange Corners	0.1	0.1
Geodata for Agriculture and Water	4	4.7
Through FMO	352	414.1
State Funds (AEF-I, IDH, IDF)	118	138.8
FMO-A	234	275.3
Through Multilateral Development Banks (excluding EIB)	260	305.9
Total	750	882.4

Table 7.4 Private climate finance, 2019

Mobilised private climate finance 2020		
	In millions EUR	In millions USD
Through Multi-donor Funds	153.6	172.6
Green Climate Fund (GCF)	15.1	17.0
Global Environment Facility (GEF)	5.5	6.2
Global Water Security & Sanitation Partnership (GWSP)	0.2	0.2
Global Agriculture and Food Security Program (GAFSP)	0.1	0.1
Private Sector Development in MENA	5.7	6.4
IDH ISLA	0.4	0.4
Sustainable Trade Initiative (IDH)	7.5	8.4
IDH Farm Fit Fund	9.2	10.7
One Acre Fund	5.9	6.6
Private Infrastructure Development Group (PIDG)	4.1	4.5
Climate Investor One	99.9	112.2
Through Bilateral Programmes	59.4	66.7
Solidaridad AfC and PfC	0.6	0.7
Sustainable Development Goals Partnership	4.6	5.2
Geodata for Agriculture and Water	3.2	3.6
CRAFT	26.7	30.0
2SCALE	6.0	6.7
Dutch Fund for Climate and Development (DFCD)	11.9	13.4
Clean Cooking Alliance	1.1	1.1
AGRI3	5.3	6.0
Through FMO	53.9	60.6
AEF-I	0.6	0.7
MASSIF	17.2	19.3
Building Prospects	22.0	24.7
FMO-A	14.1	15.9
Through Multilateral Development Banks (excluding EIB)	256.3	288.0
Total	523.2	587.9

Table 7.5 Private climate finance, 2020

7.2.9 Methodology used for reporting on financial resources

General remarks

The Netherlands reports on disbursed climate-specific ODA. All ODA consists of grants. In CTF Tables 7(a) and 7(b), 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 agencies;
- the climate-specific share of our non-core contributions to multilateral organisations for worldwide programmes.

The climate-specific share of our non-core contributions to multilateral organisations for country-specific or region-specific programmes are reported under CTF Table 7(b) for contributions through multilateral, bilateral, regional and other channels, in line with the OECD DAC definition of bilateral ODA. In CTF Table 7(b), the additional information provided in the last column generally also includes information on the contracting party. In many cases, the contracting party is also the main implementing agency.

The Netherlands uses an annually established corporate currency exchange rate. This rate was EUR 0.85 per USD for 2019 and EUR 0.89 per USD for 2020.

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.

Multilateral public climate finance

To determine the climate-specific share of our core contributions to multilateral organisations, the Netherlands applies weighted averages from the OECD DAC imputed climate-related shares to our relevant core contributions to multilateral organisations. In this report, we have used the figures available at the moment of our original climate finance reporting to the EU.

For a number of multilateral organisations carrying out climate-relevant work, such as the UNDP, UNEP, UNICEF, FAO, WFP and UNCCD, the 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 or general contributions. These figures range between 1% and 37%.

Private climate finance

To measure the volume of private finance mobilised by the Netherlands, we have followed the OECD DAC methods developed over the past years or still under development.[203] For the private finance mobilised by the Netherlands through its share in MDBs, we have calculated the best possible estimate based on the data available. The annual measurement and analysis of mobilised private finance are carried out with the assistance of a consultant and the results are published on the government's website.[204] A summary of the results for 2019 and 2020 is presented in this report in section 7.2.8.

7.3 (B) Provision of support for technology development and transfer

The Netherlands is at the forefront of innovative and sustainable techniques in many of these sectors and also actively contributes to the further dissemination of this knowledge and technology, in order to promote climate mitigation worldwide. The government is not alone in this, knowledge institutions and companies are also participating. For example, the Netherlands Organisation for Applied Scientific Research, TNO, has its own Tech Transfer programme and also an Innovation for Development programme, which focuses on low and middle-income countries.

[203] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-Methodologies-on-Mobilisation.pdf
[204] https://www.government.nl/topics/development-cooperation/documents/reports/2020/05/12/mobilised-private-climate-finance-report-2019 and https://www.government.nl/documents/reports/2021/07/09/report-on-mobilisation-of-private-climate--biodiversity-finance-for-developing-countries-by-dutch-public-interventions-in-2020

Support for technology development and transfer makes an integral part of many activities related to climate change mitigation or adaptation, encompassing both hardware (equipment) and software (know-how, methods, practices). The private sector and several knowledge institutes partner 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.

Technology transfer and knowledge transfer are important tools for economic growth in developing countries. However, technology transfer and transfer of knowledge never stand alone, and can only take place successfully if other elements and preconditions such as the presence of a regulatory framework, the capacity to absorb knowledge and low transaction costs are met. This also applies to climate. In order to facilitate technology transfer and the transfer of knowledge regarding the climate transition, the Netherlands is therefore also contributing to capacity building in developing countries (see section 7.4). Often the dividing line between technology or knowledge transfer initiatives and capacity building is not very clear and programmes contribute in several ways to strengthening the decisiveness of developing countries in the field of climate action. For example, by focusing on technology transfer, the aim is to also contribute to capacity building, developments in innovation and the sharing of knowledge. Technology transfer is not seen as an end in itself, but as a means to achieve increased climate ambitions.

International Cooperation

The Netherlands is active in several international partnerships to stimulate technological development in the essential sectors for the climate transition in emerging economies and developing countries. Below are some examples:

Glasgow Breakthroughs: at the United Nations COP26 climate summit in Glasgow in 2021, initiatives were launched aimed at international cooperation to accelerate the development and roll-out of clean and sustainable technologies. In this context, the Netherlands has joined the Glasgow Breakthroughs for clean energy, for zero-emission vehicles and for affordable and sustainable hydrogen.

International Energy Agency (IEA): The IEA conducts research, collects data, analyses and reports. The information this provides plays an important role in international energy and climate policy. At the request of the Ministry of Economic Affairs and Climate Policy, advisors from the Netherlands Enterprise Agency (RVO) are using their expertise to participate in a number of *Technology Collaboration Programmes* (TCPs) of the IEA. A

TCP is a group of (international) experts that deals with one energy technology and helps governments and industries worldwide to further develop this technology. Each TCP in which the Netherlands participates has its own mission that fits within the goals of the IEA, including energy security, environmental protection, economic growth, and engaging influential organisations. In this way, these TCPs accelerate the global transition to a cleaner energy future. In addition to participating in TCPs, the Netherlands has contributed financially to several research reports under the IEA's *Clean Energy Transitions Programme*. This programme focuses on accelerating the energy transition in developing countries.

*Clean Energy Ministerial (CEM):*The Netherlands is a member of the CEM, which aims to stimulate existing clean energy technologies in an international context in order to combat climate change. This is done through campaigns and initiatives involving both public and private parties. The business community and knowledge institutions are involved in this as much as possible. Over the past year, the Netherlands has been actively involved in working groups and campaigns on, among other things, the roll-out of technologies for solar and wind energy, in which cost reduction is an important spearhead. Linked to the CEM is the international partnership *Mission Innovation*, in which innovation is central. Through this context, the Netherlands is, for example, working with India on innovative solutions to accelerate the commercialisation of integrated biorefineries. The goal is to replace ten percent of fossil raw materials and chemicals with bio-based alternatives by 2030.

The Netherlands' support to Developing Countries

CTF Table 8 lists the activities at the implementation phase in 2019–2020 that included support for technology development and transfer. Based on this table, a list of examples is also included at the end of this section. The activities listed are those in which, based on the description of the programme in its appraisal memorandum and where relevant a further check with the responsible project officer, components with technology development and transfer aspects were identified.

Following the review of the BR4 and NC7 reporting, the ERT reiterated their recommendation that the Netherlands provide a description of the indicators relevant to the tracking of technological and capacity-building support, or, if not possible, provide relevant explanations. Following the NC7 review, the Netherlands was also encouraged to report on (impact on) GHG emissions. As clarified during the BR4 review, the national results framework for development cooperation, of which climate action is an integral part, does not include specific indicators for capacity building or technology transfer

support for climate change (including on GHG emissions), as these are usually one element of more wide-ranging activities. We furthermore explained that our indicators are generally geared towards measuring the results of the activity as a whole rather than individual elements of it. Although the Netherlands is intending to review the results and reporting framework, the above situation has not changed for now.

Good examples of support for the development and enhancement of endogenous capacities and technologies include a range of programmes implemented by the Netherlands Enterprise Agency such as the Energising Development Partnership Programme (EnDev) and the Energy Transition Facility (ETF). Other examples are the Energy Sector Management Assistance Program (ESMAP) and the Consultative Group for International Agricultural Research (CGIAR). More information on these programmes is presented below and can also be obtained on their websites.[205]

Energising Development (EnDev): In collaboration with other development partners, efforts are being made to ensure access to renewable energy for the poorest households in developing countries, who currently do not have access to electricity or clean cooking. EnDev is a strategic partnership consisting of various donors and partners, including the Netherlands, Germany, Norway and Switzerland. It invests in capacity building and technology transfer for market development for decentralised energy solutions such as solar energy systems and clean cooking solutions. The programme focuses on households, social institutions and small and medium-sized enterprises in developing countries and supports market development for modern energy facilities, particularly in rural areas. EnDev aims to facilitate access to sustainable energy for 27.5 million people by the end of 2022. By 2021, this programme will provide access to modern energy for 25.8 million people, 30,900 social infrastructures and 81,700 businesses.

Energy Sector Management Assistance Program (ESMAP): ESMAP (a World Bank program) helps governments in developing countries with knowledge, policy support and project preparation to accelerate the energy transition and achieve universal access to energy. ESMAP thus makes an important contribution to giving developing countries access to sustainable energy technology and investments, including in the field of solar and wind, geothermal energy, electricity storage, clean cooking and green hydrogen.

[205] www.endev.info, https://terravivagrants.org/energy-transition-facility/, https://www.esmap.org/, https://www.cgiar.org/

Consultative Group for International Agricultural Research (CGIAR): The Netherlands has been supporting the CGIAR financially for a long time and has recently (November 2021) committed itself to doing the same for the period 2022–2027. The CGIAR's new 2030 strategy focuses on climate change as a context for research in the field of food security. It aims to advance agricultural science and innovation for the development and uptake in developing countries of new agricultural knowledge and practices so as to ensure food security in the face of climate change and other challenges. Since 2017, a specific partnership programme has been added that connects Dutch science, private sector cooperation and knowledge and expertise to the CGIAR research for global food security. This partnership is managed by the Netherlands Organisation for Scientific Research (NWO).

Energy Transition Facility (ETF): With this programme, the Netherlands has supported countries in the Middle East and North Africa in the transition to sustainable energy from 2017 to early 2022. Dutch diplomatic missions, together with countries, focused on concrete solutions that fit well into the local context. This was done through knowledge sharing, policy advice and capacity building on themes such as solar energy, circular economy, offshore wind energy and renewable hydrogen.

CTF Table 8 lists the activities at the implementation phase in 2019–2020 that included support for technology development and transfer. We considered it appropriate to also show activities that were included in previous Biennial Reports, if these activities were still ongoing in 2019–2020. Relevant columns plus additional information on the activities are provided in the table below.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	18315 Energising Development Partnership Programme (EnDev) www.endev.info	EnDev contributes to making local, renewable energy accessible to mainly rural and peri-urban populations, social institutions, and small and medium-sized enterprises in 26 developing countries in Africa, Asia and Latin America. This is done by establishing economically sustainable energy solutions and distribution schemes, mainly for rural communities. More detailed information on the technology cooperation projects within EnDev is available on their website.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	23710 and 24011 Sustainable Water Fund I and II ; The facility is closed for new applications. A number of ongoing projects will continue to be carried out until 2025–2026 https://english.rvo.nl/subsidies-programmes/sustainable-water-fund-fdw	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.
Global	25484 - Geodata for Agriculture and Water https://g4aw.spaceoffice.nl/en/about-us/	G4AW aims to provide the right information at the right time to the most important actors in the food production chain: farmers, fishermen and pastoralists. Food producers can help to improve and increase food production sustainable. G4AW supports initiatives where geodata, such as satellite and mobile data, are converted to relevant information on climate, weather and hazards and even timely agricultural advice, thus empowering food producers and other stakeholders in developing countries to make better decisions based on reliable real-time data. Also, micro-insurances and/or microloans combined with information services can help guarantee the continuity of food production and improve self-reliance.
Global	26393 Water Grand challenge: Securing Water for Food (SWFF) https://securingwaterforfood.org/	Water scarcity is one of the main challenges facing developing countries, a challenge that will be further exacerbated by climate change. To help developing countries in facing 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 regard: a) water efficiency and reuse; b) water capture and storage and c) salinity and water intrusion. The activity catalyses new investments by business, governments at all levels, NGOs, and others to address water scarcity in the food value chain by providing financial and technical support and innovation acceleration support.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Ghana	26945 Ghana Climate Innovation Centre (GCIC) https://www.ghanacic.org/	The GCIC, supported by infoDev/World Bank Group, helps local small and medium enterprises (SMEs) in clean technology and climate innovators commercialise and scale the most innovative private sector solutions to climate change. The GCIC provides clean technology entrepreneurs with the knowledge, capital, and access to markets required to launch and grow their businesses. The success of these enterprises leads to emissions reduction and improved climate resiliency, while also enabling developing countries to capture greater value in the innovation value chain, build competitive sectors, and create jobs.
Kenia	27179 – Nai horIMPACT https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-27179?tab=summary	The unique hortIMPACT approach entails cooperation with Dutch and Kenyan entrepeneurs, small and medium-sized farmers, input providers, exporters and traders in so called business cases. Business cases benefit from advanced but appropriate technologies and products, improved agricultural practices and market linkages. 'Solutions' related to the three themes (inclusiveness, food safety and food losses) are being demonstrated and evaluated in the business cases.
Burundi	27741 Supporting Agricultural Productivity in Burundi (PAPAB); Supporting Agricultural Productivity in Burundi (PAPAB) – IFDC	The PAPAB project aims to sustainably increase food production in Burundi by promoting market-oriented, climate-resilient and sustainable agricultural techniques, supported by targeted fertiliser subsidies. The 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 UR, Oxfam Novib and ZOA. In addition, over 10 local organisations are involved (including Adisco, OAP, Consedi, Burundi and Réseau 2000+) as well as Dutch organisations (HealthNetTPO, Soil Cares and Trimpact).
Global	29278 Energy Sector Management Assistance https://www.esmap.org/	ESMAP supports, among others, 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 also builds upon the experience of countries with a track record in geothermal development (Indonesia, Kenya, Philippines and Turkey) that are open to sharing lessons with peer countries in the South.
Uganda	29417 Integrated Seed Sector Development (ISSD) Plus Programme in Uganda http://issduganda.org/	The project aims to build the capacity of local seed groups to become local seed businesses which produce improved drought/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.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Kenia	29466 Kenya Market-led Dairy Programme (KMDP, finished) https://snv.org/update/kmdp-creating-systems-change-kenyan-dairy-sector	Implemented by SNV, this activity seeks to reduce enteric methane emissions through improved feed and forage and through manure management (including biogas digestion). To help manage the impacts of climate change and variability, the projects look to build resilience through improved breeds, increased capacities for conserving feed including post-harvest storage, improved soil and water management and use of biogas for agricultural production.
Global	4000000183 NL-CGIAR Partnership 2017-2021 https://www.cgiar.org/	CGIAR (originally known as the Consultative Group for International Agricultural Research) works to advance agricultural science and innovation for the development and uptake in developing countries of new agricultural knowledge and practices so as to ensure food security in the face of climate change and other challenges.
Global	4000000768 Disaster Risk Reduction Programme; Dutch Risk Reduction Team https://english.rvo.nl/subsidies-programmes/dutch-risk-reduction-team-drr	Climate change will increase water-related risks. The Netherlands is renowned for its expertise on water management and risk prevention, and we aim to make this knowledge available to other countries. This is why the Dutch government together with the Dutch water sector founded the 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, to prevent disasters or to rebuild after water-related disasters.
Bangladesh	4000000785 Water Management Knowledge and Innovation programme https://www.mybangladelta.org/	The Southern Coastal Region of Bangladesh is subject to major changes in its water and land resources and systems because of climate change and environmental mismanagement in the upstream river system. Through this programme, the Netherlands and Bangladesh cooperate to enhance their joint capacity and knowledge on these changes and possible solutions, including technological solutions. The activity is implemented by Deltares of the Netherlands and the Institute of Water Modelling of Bangladesh in collaboration with selected knowledge institutes from the Netherlands and Bangladesh (WUR Wageningen, Centre for Environmental Impact Assessment and GIS Bangladesh).

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Indonesia	4000000978 Horticulture Indonesia Next Level VegIMPACT NL https://vegimpact.com/about-vegimpact-nl/	Objective of this programme that Wageningen University & Research undertakes in collaboration with other Dutch private sector parties is to stimulate and facilitate innovation in the horticulture sector in Indonesia with a view to achieving sustainable, responsible, climate-smart and profitable vegetable production in Indonesia. This is achieved by providing farmers with better access to up to date knowledge and new technologies and through support for vocational education in this field in Indonesia.
Argentina, Benin, Burkina Faso, Colombia, Eswantini, Ethiopia, Ghana, Kenya, Mali, Mozambique, Palestine Areas, Peru, Romania, South-Africa and Vietnam	4000001624 Blue Deal 2018-2030 https://dutchwaterauthorities.com/blue-deal/	The Blue Deal programme aims to ensure that 20 million people in 40 watershed areas are provided with access to clean and sufficient water and better protection against floods, taking into account the current and long-term risks of climate change. In the programme Dutch Water Authorities and the Ministries of Infrastructure and Water and of Foreign Affairs support local and national water authorities through capacity building and institutional strengthening with a focus on technical knowledge and capacities as well as institutional/organisational and social aspects required for improved water management. The countries in which partnerships are being developed are: Argentina, Benin, Burkina Faso, Colombia, Eswantini, Ethiopia, Ghana, Kenya, Mali, Mozambique, Palestine Areas, Peru, Romania, South-Africa and Vietnam.
Ethiopia	4000001786 Building Rural Income through Inclusive Dairy Business Growth in Ethiopia (BRIDGE) https://snv.org/assets/explore/download/BRIDGE%20milk%20cooler%20survey%20brief.pdf	Implemented by SNV, this activity seeks to reduce enteric methane emissions through improved feed and forage and through manure management (including biogas digestion). To help manage the impacts of climate change and variability, the projects look to build resilience through improved breeds, increased capacities for conserving feed including post-harvest storage, improved soil and water management and use of biogas for agricultural production.
Bangladesh	4000001952 Joint Cooperation Programme Bangladesh https://jcpbd.nl/	To operationalise the Bangladesh Delta Plan (BDP2100) a knowledge agenda has been established to address the BDP2100's knowledge needs, including needs linked to climate change adaptation. The Joint Cooperation Programme Bangladesh is a cooperation programme between two knowledge institutes in the Netherlands (Deltares and Wageningen University & Research) and two in Bangladesh (Institute for Water Management and Centre for Environmental Impact Assessment) that aims to contribute to the knowledge agenda. The programme focuses, among other aspects, on developing databases, instruments for decision making and analysis and user applications.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	4000002111 Least Developed Countries Fund (LDCF) https://www.thegef.org/what-we-do/topics/least-developed-countries-fund-ldcf	The LDCF of the Global Environment Facility, set up in 2001 as a financial mechanism under UNFCCC, supports the world's most vulnerable countries in their efforts to adapt to the effects of climate change. It focuses on technology transfer, risk management, mainstreaming of climate change adaptation in other GEF activities and supports national authorities in the preparation and implementation of National Adaptation Plans.
Uganda	4000002135 Farm with SolarNow https://www.solarnow.eu/about-us/	The activity 'Farm with SolarNow' accelerates demand-driven supply of solar powered quality agricultural appliances to 6,000 farming households in Uganda. The aim of the activity is to contribute to increased incomes and food security of smallholder farming households. The project aims to support small and medium holder farmers by increasing their access to solar powered agricultural appliances. With better access to these appliances, households will be able to increase their production, being less dependent on seasonal circumstances (off-season) and, eventually, increase their resilience to (economic) shocks such as failed harvest and droughts. It also contributes to adaption and mitigation of climate change in the agriculture sector.
Bangladesh, Indonesia, Colombia, South Africa, Chile, Ethiopia, Kenya, Republic of Korea, Mexico, Vietnam	4000002466 Partnering for Green Growth and the Global Goals 2030 (P4G) https://p4gpartnerships.org/	P4G is an international initiative supported by countries, businesses, international organisations, academia including research organisations and civil society. The initiative is co-created by Denmark in collaboration with international partners including the partner countries Bangladesh, Indonesia, Colombia, South Africa, Chile, Ethiopia, Kenya, Republic of Korea, Mexico and Vietnam, as well as businesses and civil society organisations. P4G, hosted by WRI, aims at contributing to delivering innovative market-driven green solutions to meet the SDGs in at least 10 countries through public-private partnerships. P4G will achieve this by harnessing the strengths of the public and private sectors, and facilitating them towards concrete action. Climate is an integral element of the initiative.
Bangladesh, Mali, Niger, Ghana, Benin, Mozambique, Rwanda, Kenya, Ethiopia, South Sudan, India, Tanzania, Uganda	4000002750 Making Water Count – PPP Innovation 2.0 https://aquaforall.org/services/our-strategy-framework/	Aqua for All focuses on development and scaling of innovative, sustainable WASH & IWRM concepts in focus countries with the aim of accelerating structural (including climate-resilient) access to water and sanitation. Specific attention is given to climate change adaptation by increasing the water buffer capacity through the 3R (Recharge-Retention-Reuse) innovation track. The activity covers a total of 13 countries: Bangladesh, Mali, Niger, Ghana, Benin, Mozambique, Rwanda, Kenya, Ethiopia, South Sudan, India, Tanzania, Uganda.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	4000002938 Global Water Partnership 2019–2025 https://www.gwp.org/	GWP is a unique global network of public and private actors aiming at improving water management for food and energy security, safe deltas, sustainable ecosystems and resilient cities in the context of, among others aspects, climate change. The partnership focuses among other interventions on knowledge development and policy advice of (local) governments. Climate is one of the priority areas for GWP for the period 2020–2025. The partnership supports countries in their efforts to improve or achieve water security by making available and transferring its knowledge and experience and by providing advice in the management of water resources.
Madagascar, South Africa, Mali, Burkina Faso, Georgia, Armenia, Guinea, Liberia, Indonesia	4000002939Climate Smart Mining Facility https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000002939?tab=summary	The objective of the Facility is to assist mineral-rich developing countries to respond to the growing demand for minerals needed to manufacture clean energy technologies by responsibly and sustainably developing their strategic mineral resources while decarbonising and reducing the material footprint of their mining sector.
Iraq	4000003256 Iraq Horticulture Development Programme http://www.iraq-horti.org/home/index.html	The intervention will contribute to sustainable and climate sensitive farming practices through developing and disseminating knowledge on new systems and technologies in the face of a changing climate (more irregular rainfall, recurrent droughts). The innovations include introducing new varieties, improving irrigation efficiency, and using protected farming under greenhouses.
Global	4000003402 Challenge Fund Water and Energy for Food (WE4F) https://we4f.org/	The WE4F programme's mission is to support the development of new or the sustainable scale-up of existing innovations from the previous programme that impact the sectors of food and water, food and energy, or all three sectors at the nexus (food, water, energy). The aim is to increase the sustainability of agricultural food value chains and address environmental and climate resilience in developing countries and emerging markets, with a particular focus on the poor and women. Innovators and innovations are expected to have a positive impact on the environment, climate and biodiversity (and not only applying a do no harm approach), taking a holistic view on the management of natural resources and ecosystems, and the sustainable withdrawal and supply of water in particular. One of the indicators related to the output level is the 'Number of strategies, guidelines or projects of international, regional or local organisations that disseminate the climate-friendly, energy and/ or water-efficient innovations promoted by WE4F'.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Egypt	4000003468 Strengthening Climate Resilience and Food Security in Southern Egypt https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000003468?tab=summary	The aim of the activity is to strengthen the capacity of smallholders through access to improved agricultural technologies and practices, as well as information, markets and institutional services to help strengthen their livelihoods and resilience to climate change. The activity will among other aspects focus on increasing water efficiency in agriculture, doubling the income and productivity of farmers, strengthening ecological sustainability and increasing climate resilience of ecosystems and livelihoods.
Kenia	4000004027 Development Smart Innovation through Research in Agriculture (DeSIRA) https://europa.eu/capacity4dev/desira/wiki/icsiapl-kenya	The project seeks to stimulate economic growth and enhance livelihoods of agro-pastoralists communities through improved forage production and livestock husbandry, building on commercialisation of climate-smart innovations and sustainable landscape management in Taita Taveta, Kajiado and Narok counties in Kenia. The project will offer support in investing in adoption and upscaling of appropriate technologies and innovations. It will furthermore strengthen the knowledge base, planning, implementation and coordination capacity of county governments, community organisations and other relevant institutions on integrated landscape management, climate change and sustainable use of strategic resources.
Egypt	4000004228 Strengthening Climate Resilience and Food Security in Southern Egypt Phase II https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004228?tab=summary	WFP and Solidaridad's proposed intervention aims at realising integrated rural development in 60 of the most underprivileged villages in Upper Egypt through capacity building of smallholder farmers on modern irrigation, crops production techniques, optimal utilisation of resources and use of ethical digital inclusive tools, contributing thereby to the Egyptian Government's vision for inclusive economic growth and shock-resilient households and communities.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Egypt	4000004400 Joint Cooperation in Applied Research Programme on Water https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004400?tab=summary	The JCAR aims to support the Egyptian Ministry of Water Resources to prepare a clear path and agenda for Egypt to deal with current future water challenges. The activity furthermore aims to reach a well-developed capacity in MWRI, NWRC, Agriculture Research Centre (ARC) of the Ministry of Agriculture and Land Reclamation (MALR), and other relevant agencies, and to create partnerships between Egyptian and Dutch institutes, to address the knowledge questions that stem from the NWRP 2037. This is meant to enhance the state-of-the-art and the knowledge base of the Egyptian agencies involved, and will strengthen the capacity in Egypt to plan, develop and manage its water resources now and in the future.
Kenia, Niger, Mali	4000004444 EnDev Biogas Project https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004444?tab=summary	Biogas technology and training in design and construction. EnDev will put emphasis on the facilitation of prefabricated bio-digester technologies in the market. Prefabricated technology has already proven to be more scalable in Kenya, to a large extent due to the fact that prefabricated suppliers sell their products on a 'lease to own' basis. Quick installation, constant quality and warranties have further helped to scale this market in Kenya. It is expected that with the right support this success can be replicated in other countries as well. Design and construction training for new biogas masons will only be provided in Niger and Mali in the small scale biogas segment and in Kenya for the medium scale segment. Entrepreneurship will be an important selection criterion for taking part in this training.
Niger	4000004732 Projet d'Innovations Digitales pour les Agro-Pasteurs du Niger, IDAN https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004732?tab=summary&search=4000004732	The Digital Innovations Project for Niger's Agro-Pastoralists (IDAN) is oriented towards a market-centric approach and supports the expansion of an integrated digital platform, already in place in Mali and Burkina Faso. The general objective is to increase the resilience and food security of agricultural and pastoral households through the generation of economic (productivity gains, income) and social benefits (including avoided costs) linked to the use of a range of digital solutions integrated into an innovative service. The IDAN project, in the period from 2021 to 2023, will facilitate access to the offered digital solutions for 35,000 farmers and pastoralists (including 15% women and young people) in the Tahoua, Tillabéri and Dosso regions of Niger, and thanks to interoperability, of 5,000 pastoral farmers in the cross-border space of Liptako Gourma.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	4000004908 DUPC3 (2021–2027) / Transformations to inclusive and sustainable water futures https://www.un-ihe.org/dupc3-ihe-delft-partnership-programme-water-and-development	This knowledge and capacity development programme contributes to innovative interventions that enhance improved water management with reduced inputs like energy, increased capacity of a wide range of (non-) governmental stakeholders on inclusive and sustainable water management, and timely and transparent decision making on water resources management enabled through data, lessons learnt, knowledge and analytical tools.
Ethiopia, Ghana, Senegal, Benin, Mali, Ivory Coast, Myanmar	4000004917 Netherlands Trust Fund V: A New Netherlands and ITC Partnership to Generate Long-Term Socio-Economic Impact https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004917?tab=summary	The programme aims at achieving systemic change in services sectors to make selected African countries more trade competitive. The approach will allow for upgrading of the sector to more environmentally and socially sustainable principles and methods of production. Among other aspects, the programme provides services to set up a digitised traceability system and most importantly a more efficient, sustainable and responsible agribusiness value chain. In the digital technology sector, activities focus on more business-friendly tech ecosystems, in particular strengthening support organisations such as tech hubs, equipping tech start-ups and SMEs with resilient business models, linking them to business and investment opportunities and digitalisation of traditional SMEs. Agribusiness services sector activities focus on identifying resilient and sustainable business and production models, strengthening public-private alliances and support ecosystems, building capacity for value chain operations in areas such as market development, climate smart operations, value addition, quality, access to finance, digitalisation and developing investment strategies to ensure leveraging of investment.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Global	4000005270 - CGIAR 2022–2027 https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000005270?tab=summary	The mission of the Consortium of International Agricultural Research Centers (CGIAR) is to deliver the science and innovation to transform food, land and water systems in the present climate crisis. It carries out food systems research at the macro, meso (farming systems) and micro (genetic innovation of food crops) levels. Its impact focus is on poverty, nutrition, gender, climate and environment. Climate adaptation is achieved through adapted breeds and varieties (e.g. heat tolerant livestock breeds, strains and crosses etc.), and inclusion of long-term accession in gene banks to provide solutions (genetic material) for future climate adaptation. CGIAR research contributes considerably to global food security with a focus on smallholder farmers. There is a strong focus, not only in farming systems and resilience, but also in policy research, on adaptation to climate change. It also mitigates climate change and thus works in environmental protection by providing scientific evidence, climate-smart solutions and innovative finance that feeds national, regional and global processes for governing land use, land restoration, forest conservation, and resilience to floods and droughts, contribution to climate change, peace and action.
Jordan	4000005402 Design and implementation of water https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000005402?tab=summary	This proposal is dedicated to the integration of water harvesting as an integral water management and climate adaptation intervention for Jordan's resiliency efforts. The consortium of partners and experts make the case and methodology for instituting water harvesting with complementary policy and capacity building action, as a sustainable approach to enhancing the resiliency of communities and ecosystems most vulnerable to the impacts of climate change and population growth in Jordan. The project is implemented over a 36-month period to focus on supporting a sustainable water management approach, by reducing water use of unsustainable sources (by reducing water losses and increasing water use efficiency) and by increasing water supply from sustainable sources (by supporting water harvesting and promoting the use of non-conventional sustainable water resources). Furthermore, the intervention aims to be aligned with national and local water policy and management systems, as well as provide innovative design tools to allow for water harvesting practices in Jordan to continue to improve and react to changing climate conditions.

Recipient country and/or region	Project Name and Link to Website	Measures and activities related to technology transfer
Kenya, Tanzania, Uganda	400000819 Climate Resilient Agribusiness for Tomorrow (CRAFT) https://snv.org/project/climate-resilient-agribusiness-tomorrow-craft	SNV's CRAFT programme aims to contribute to achieving food security in Kenya, Tanzania and Uganda by promoting ecologically sustainable food systems. The programme promotes inclusive business development for climate-smart sustainable intensification in arable farming and supports smallholder farmers that produce nutrition relevant food crops to become more resilient and productive. Involving Dutch, international and East African government and knowledge institutes as well as civic and private sector partners, the aim is explicitly to engage in joint learning, knowledge sharing as well as scaling of the business cases and climate smart technologies and practices tried and tested within the programme.

7.4 (C) 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 or adaptation. The Netherlands identifies activities with capacity-building aspects based on the description of the activity in its appraisal memorandum and a further check with the responsible project officer.

As also clarified in section 7.3, the national results framework for development cooperation, of which climate action is an integral part, does not include specific indicators for capacity building or technology transfer support for climate change, as these are usually one element of more wide-ranging activities. Our indicators are generally geared towards measuring the results of the activity as a whole rather than individual elements of it. Although the Netherlands is intending to review the results and reporting framework, the above situation has not changed for now.

Capacity-building support is focused on individuals, institutions as well as at the systemic level. At the systemic level, the Netherlands supports the NDC Partnership, which has a key role to play in building the capacity of governments to formulate and implement enhanced Nationally Determined Contributions. As one of the founding members (and former co-chair in 2019 and 2020), the Netherlands has focused on further strengthening the NDCP through both political and financial support.

Examples of programmes supporting partnerships between Dutch and local knowledge institutes aiming at local institutional development and capacity building include the Joint Cooperation Partnerships (JCPs) in Indonesia, Bangladesh and Egypt. Under the newly

started 'Power of Voices' (POV) Grant Programme, the Netherlands also supports a number of partnerships with a strong focus on strengthening local civil society organisations involved in both local and international lobbying and advocacy for climate action. Such partnerships include the Global Alliance for Green and Gender Action (GAGGA), the African Activists for Climate Justice (AACJ), the Amplifying Voices for Just Climate Action (VCA) Programme and the Green Livelihoods Alliance Forests for a Just Future Programme.

CTF Table 9 includes activities with capacity-building aspects that were at the implementation phase in 2019–2020. We considered it appropriate to also include activities that were included in previous Biennial Reports, if these activities were still ongoing during 2019–2020. Relevant columns listing and describing the activities are provided in the table below.

Recipient country / region	Programme or project title	Description of programme or project (and link to the development cooperation site of the Ministry of Foreign Affairs)
Global	24709 - Urbanising Deltas of the World	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 apply this new knowledge, e.g. in the design of interventions and in the formulation of new policies. E.g. in the Mekong Delta one of the research consortia is developing an integrated package of tools to better understand the interrelations between increased land subsidence, sea level rise, reduced river flows, increased flood risk and salinisation of the delta's fresh water system. The package helps decision makers to assess the pros and cons of different interventions in land use, water management and infrastructure in an integrated manner. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-24709?tab=summary
Indonesia	25280 - JAK PPP Geothermie	Capacity building in geothermal energy in Indonesia. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-25280?tab=summary

Recipient country / region	Programme or project title	Description of programme or project (and link to the development cooperation site of the Ministry of Foreign Affairs)
Regional Africa	25925 - Cooperation in International Waters in Africa (CIWA)	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 to aid sustainable climate resilient growth. It supports transboundary cooperation in rivers, lakes and groundwater bodies focusing among other aspects on capacity development in transboundary institutions such as river basin authorities or the nucleus of such organisations that riparian countries are in the process of establishing. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-25925?tab=summary
Regional Africa	26010 - African Biogas Partnership Program (ABPP)	The African Biogas Partnership Program (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 to apply domestic biogas as a climate-friendly solution for energy, organic fertiliser and livestock keeping. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-26010?tab=summary
Ethiopia	26389 - Small-scale and micro irrigation support project (SSMISP) in Ethiopia	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. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-26389?tab=summary
Tanzania	26718 – Tanzania Dutch Energy Capacity Building Programme (TDECB)	The aim of the activity is to strengthen and/or establish educational structures and curricula relevant to the renewable energy and gas sectors. With this, the Netherlands is committed to enabling Tanzania to develop its own local capacity to address technical, international and domestic energy and gas challenges. This should ultimately contribute to sustainable exploitation of the domestic renewable energy potential and off-shore gas resources, with the revenues benefiting development and poverty alleviation in Tanzania. The Dutch contribution focuses on strengthening higher and vocational education in subjects in which the Netherlands has specific expertise to offer. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-26718?tab=summary

Recipient country / region	Programme or project title	Description of programme or project (and link to the development cooperation site of the Ministry of Foreign Affairs)
Rwanda	26817 - Integrated water resource	The programme focuses primarily on institutional strengthening and capacity development for IWRM. Next to 'classroom' training at national level, in selected demonstration sites IWRM interventions are prepared and implemented which address water management-related issues in their local context. The integrated nature of water management implies that the identified issues are being addressed in the broader context of land use, ecosystems and needs of different stakeholders, adopting a landscape approach. The demonstration sites are meant as a learning platform where stakeholders are supported to put in practice the required negotiation, planning and coordination efforts and deploy the required technical skills and tools at local and national level. At the same time the programme assists in establishing an enabling environment by raising awareness on IWRM and building an institutional framework which facilitates coordination efforts and exchange of knowledge. The demonstration sites also provide key lessons in this respect, which feed into policy development. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-26817?tab=summary
Mali	26989 - Integrated Water Resource Management Programme in the Niger Basin (GIRE) in Mali	This programme aims, among other aspects, to improve knowledge on available water resources and to promote sustainable water allocation and monitoring to various sectors (energy, drinking water, fisheries, livestock, irrigation etc.), 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. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-26989?tab=summary
Kenya	27179 – Nai horIMPACT	The unique hortIMPACT approach entails cooperation with Dutch and Kenyan entrepreneurs, small and medium-sized farmers, input providers, exporters and traders in so-called business cases. Business cases benefit from advanced but appropriate technologies and products, improved agricultural practices and market linkages. 'Solutions' related to the three themes (inclusiveness, food safety and food losses) are being demonstrated and evaluated in the business cases. https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-27179?tab=summary

Recipient country / region	Programme or project title	Description of programme or project (and link to the development cooperation site of the Ministry of Foreign Affairs)
Global	27253 - Clean Cooking Promotion	Promote a market for clean cooking facilities by making start-up capital available for start-up companies. Supporting the national institutions responsible for the development and coordination of clean cooking facilities in Ghana (GHACCO), Kenya (KCCA) and Bangladesh / SREDA through capacity development and institutional capacity development and institutional strengthening. Strengthening Research & Development centres. Strengthening the Dutch contribution to the clean cooking sector. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-27253?tab=summary
Global	27551 - Partners for Resilience (PfR)	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 to strengthen their capacities to reduce the impact of disasters. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-27551?tab=summary
Kenya	28056 - 3R Kenya	As part of the Embassy's transition strategy from aid to trade, Wageningen University and Research Centre (Wageningen UR) proposes a project that assesses and validates to what extent good practices from the Embassy's agriculture and FNS programme can be scaled up and better anchored within Kenya. The project also includes the experiences of other related centrally funded programmes in Kenya. To successfully validate scalability and scale up good practices, the project also supports stakeholder networks to enable results validation, scaling up and policy outreach (e.g. capacity development and stakeholder alignment). Specifically, the project supports partnership and innovation networks between producer organisations, public agencies, civic organisations and knowledge institutes from Kenya (and their Dutch counterparts) that anchor knowledge and capacities for impact. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-28056?tab=summary

Recipient country / region	Programme or project title	Description of programme or project (and link to the development cooperation site of the Ministry of Foreign Affairs)
Global	28325 - IGG - IHE Delft Institute for Water Education Programmatic Cooperation	IHE Delft Institute for Water Education supports capacity building in the water sector in developing countries through education, research and partnerships programmes. Climate change is an integral part of the programmes. The geographical focus is on the focus regions in the Dutch development cooperation and 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 to cope with the effects of climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-28325?tab=summary
Global	28677 - Netherlands Red Cross Response Preparedness II	This programme focuses on building the response preparedness capacity of national Red Cross and Red Crescent societies in Mali, Central African Republic, Lebanon and Zambia so that they can better respond to disasters, including climate-related disasters, e.g. by translating early warning information into early pro-active action. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-28677?tab=summary
Ethiopia	28735 - Support to ATA in Ethiopia	The Agricultural Transformation Agency (ATA) is responsible for addressing issues that limit productivity at the farmer's level and/or hamper markets while also addressing underlying systemic issues. Climate change adaptation and mitigation are cross-cutting issues. Building the capacity of the Ministry of Agriculture and Natural Resources, the Ministry of Livestock and Fisheries and other key partners is part of ATA's mandate. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-28735?tab=summary
Indonesia	28862 - Study in the Netherlands V (StudNed V)	The 'Study in the Netherlands V' (StudNed V) aims to contribute to the development of Indonesia by strengthening the human resources capacity of Indonesian nationals through 1 or 2-year master's programmes, short courses and tailor made training programmes. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-28862?tab=summary
Palestine	29135 - Palestinian-Dutch Academic Water Cooperation	This cooperation programme between 10 Dutch and Palestinian universities aims to tackle key challenges facing the Palestinian water sector both on a policy and practical level while enhancing the capacity of Palestinian academic institutions throughout the activities. Key challenges include increasing water productivity in the agricultural sector and improving river basin management and safe deltas, which both contribute to increasing resilience to climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-29135?tab=summary

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Global	29215 - Women Delegates Fund	The Women Delegates Fund aims to increase the effective participation of women from developing countries, mostly LDCs, in the UNFCCC climate negotiations. The Fund combines the payment of travel costs with a capacity building programme. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-29215?tab=summary
Benin	29296 - OmiDelta programme in Benin	This activity focuses on the Ouémé river delta, and more specifically 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. INE Benin aims to develop capacity on data collection, hydraulic modeling, and advisory services. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-29296?tab=summary
Mozambique	29748 - Institutional support to FIPAG in Mozambique	The Netherlands provides capacity building support to the 'Fundo de Investimento e Patrimonio do Abastemento de Agua' (FIPAG), the asset manager of water supply infrastructure in the major cities in 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. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-29748?tab=summary
Global	4000000043 - WaterWorX	This activity aims at contributing to improved access to safe drinking water supply and sanitation for at least one million people by strengthening the operations of a minimum of 15 local water utilities through water operator partnerships between local and Dutch water companies. Institutional strengthening and capacity building is core to the activity and addresses, among others, climate risks assessments, the development and implementation of energy audits, implementation of source protection measures and development of climate robust investment plans by the participating water utilities. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000043?tab=summary

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Myanmar	4000000070 - ISSD Myanmar	The objective of the project is to contribute to food and nutritional security and climate resilience of smallholder farmers in the Dry Zone of Myanmar, by improving smallholder farmer access and uptake of quality seed of improved and well adapted varieties. The project, among other aspects, builds the professional capacities of 180 local seed business (LSBs) and six domestic and international seed companies to produce significant volumes of quality seed of seven different crops: rice, pigeon pea, chickpea, mung bean, sunflower, sesame and groundnuts. It also builds the capacity of agricultural policy makers and extension services to develop a good policy framework for the seeds sector. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000070?tab=summary
Global	4000000072 - CREWS	The CREWS initiative has been contributing to the climate resilience of the poorest countries. It focuses specifically on Least Developed Countries (LDCs) and Small Island States that are also developing country (SIDS). CREWS helped these countries by strengthening local weather institutes so that they gain insight into the risks of climate change. That insight helps the government and the population of these countries to prepare, take measures and warn in the case of (imminent) extreme weather situations, which will increasingly occur as a result of climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000072?tab=summary
Global	4000000183 - NL- CGIAR Partnership 2017-2021	CGIAR (originally known as the Consultative Group for International Agricultural Research) works to advance agricultural science and innovation for the development and uptake in developing countries of new agricultural knowledge and practices so as to ensure food security in the face of climate change and other challenges. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000183?tab=summary
Mozambique	4000000267 - Support to inclusive and sustainable agricultural development in the Zambezi Valley (ISA-II)	ISA-II continues to support the Zambezi Agency in Mozambique to help achieve inclusive and sustainable agricultural development in the Zambezi Valley. The Agency's Water Productivity pilot aiming at obtaining 'more crop per drop' is an important intervention for climate change adaptation and resilience. Capacity building focuses on the Zambezi Agency and is directed to the educational centers and business development services providers. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000267?tab=summary

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Israel, Palestinian Territories, Jordan	4000000333 - Middle East Desalination Research Centre (MEDRC) 'Transboundary Capacity Building Programme'	MEDRC requests funding for (i) Transboundary Capacity Building Programme, (ii) MEDRC Water Research Fellowship Programme and (iii) Core Institutional Support. The MEDRC Transboundary Capacity Building Programme focuses on trilateral training projects for Israeli, Palestinian and Jordanian officials to improve their knowledge of transboundary water resource and conflict management, and to build trust at the senior level. In addition, the application consists of funding for the MEDRC Water Research Fellowship Programme and institutional support. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000333?tab=summary
Global	4000000441 - VNG DEALS	VNG deals aims to improve the quality of life of the urban poor (living on less than USD 1.25 a day) by enhancing inclusivity, safety, resilience and sustainability on the basis of plans developed by the local authorities. The programme includes support for capacity building of local authorities in cities where climate change is leading to water management challenges, such as in Pathein (Myanmar) and in Manilla (Philippines). https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000441?tab=summary
Bangladesh	4000000785 - Water Management Knowledge and Innovation programme	The Southern Coastal Region of Bangladesh is subject to major changes in its water and land resources and systems because of climate change and environmental mismanagement in the upstream river system. Through this programme, the Netherlands and Bangladesh cooperate to enhance their joint capacity and knowledge on these changes and possible solutions. The activity is implemented by Deltares of the Netherlands and the Institute of Water Modelling of Bangladesh in collaboration with selected organisations and knowledge institutes from the Netherlands and Bangladesh (WUR Wageningen, Centre for Environmental Impact Assessment and GIS, Bangladesh, NL Waterboard (Waterschap) Brabantse Delta). https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000785?tab=summary

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Regional Africa	4000000806 - Organic Markets for Development (OM4D)	This programme aims to promote the adoption of organic agricultural principles through enhancing know-how, raising consumer awareness and influencing policy in four countries in West Africa with a view to creating opportunities for smallholder farmers through their inclusion in domestic and international organic markets. Empowerment and capacity building of smallholder farmers and other value chain actors is an important element of the programme. Organic agriculture has positive effects on soils, ecosystems, water quality and agro-biodiversity in the region, and therefore enhances resilience in the region. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000806?tab=summary
Myanmar	4000000861 - Farming Systems Sustainability	The Farming Systems for Sustainability in Myanmar project aims to contribute to food and nutrition security of smallholder farmers in Shan state and the Dry Zone of Myanmar, by identifying, testing and developing farming strategies for farming systems in Myanmar that can meet the demands of the future, being robust, and resilient to climate change, sustainable with increased productivity as basis for profitability. The project is implemented by a joint effort of Wageningen University & Research in collaboration with the Ministry of Agriculture, Livestock and Irrigation (MOALI) of Myanmar and a consultancy company based in Myanmar. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000861?tab=summary
Indonesia	4000000978 – Horticulture Indonesia Next Level	The objective of this programme that Wageningen University & Research undertakes in collaboration with other Dutch private sector parties is to stimulate and facilitate innovation in the horticulture sector in Indonesia with a view to achieving sustainable, responsible, climate-smart and profitable vegetable production in Indonesia. This is achieved by providing farmers with better access to up-to-date knowledge and new technologies and through support for vocational education in this field in Indonesia. Aim of the Indonesia-NL cooperation on Revitalisation of Vocational Education and Training in the Agriculture Sector in Indonesia (of which the Vocational Education Track of VegImpact is a part) is to improve the vocational education and training in agriculture by delivering competent graduates that fit labour market needs. By empowering vocational schools, students, farmers and industry the programme contributes to the economic development in Indonesia and supports young people to lead the development of the horticulture sector in the coming decades. This with a focus on institutional strengthening, curriculum development, teacher training and management. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000978?tab=summary

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Global	4000001091 - Climate Development and Knowledge Network (CDKN)	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 focusing on knowledge management, research, partnership, technical assistance and services. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001091?tab=summary
Indonesia	4000001352 - Joint Cooperation Program III Indonesia	This cooperation programme between Dutch and Indonesian knowledge institutes seeks to enhance the resilience of urban deltas in Indonesia to climate change through development of climate datasets and capacity building for improved river basin management, and for operational activities such as urban flood forecasting, drought early warning, supporting Climate Field Schools for farmers and development of a Hydro Informatics Centre. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001352?tab=summary
Bangladesh	4000001489 - Support to the implementation of Bangladesh Delta Plan	With the support of the Netherlands and others, the Government of Bangladesh has been engaged in the development of a long-term Delta Plan (BDP2100) to address future development challenges, including the effects of climate change. Objective of this activity is to support Bangladesh in the operationalisation of the Bangladesh Delta Plan by strengthening the capacity of the General Economics Division of the Ministry of Planning with a view to the establishment of a competent Delta Wing to coordinate BDP2200's implementation as well as of a Delta Fund and of the broader institutional structure required. Furthermore, the activity focuses on strengthening the capacity of key implementing organisations. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001489?tab=summary

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Argentina, Benin, Burkina Faso, Colombia, Eswantini, Ethiopia, Ghana, Kenya, Mali, Mozambique, Palestine Areas, Peru, Romania, South-Africa and Vietnam	4000001624 - Blue Deal 2018–2030	The Blue Deal programme aims to ensure that 20 million people in 40 watershed areas are provided with access to clean and sufficient water and better protection against floods, taking into account the current and long-term risks of climate change. In the programme Dutch Water Authorities and the Ministries of Infrastructure and Water and of Foreign Affairs support local and national water authorities through capacity building and institutional strengthening with a focus on technical knowledge and capacities as well as institutional/organisational and social aspects required for improved water management. The countries in which partnerships are being developed are: Argentina, Benin, Burkina Faso, Colombia, Eswantini, Ethiopia, Ghana, Kenya, Mali, Mozambique, Palestine Areas, Peru, Romania, South-Africa and Vietnam. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000000785?tab=summary
Global	4000001666 - Global Energy Transformation Programme – promoting investments in Renewable Energy (Get.invest)	GET.Invest is the private sector module of the Global Energy Transformation Programme (GET.pro), a European multi-donor platform delivering on energy and climate targets. The objective of GET.Invest is to stimulate investments in renewable energy in developing countries by pipeline development and private sector mobilisation. It does so by providing demand-driven coaching and advisory services for project development, including in-depth technical assistance (where required), and by generating and making available market information on business opportunities. The programme works across different market segments of decentralised renewables, such as small on-grid independent power producers (IPPs), mini-grids, solar home systems and clean cooking solutions. GET.Invest has a focus on sub-Sahara Africa but can also be deployed in other regions. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001666?tab=summary
Ethiopia	4000001768 - BRIDGE	This activity implemented by SNV and Wageningen University & Research aims to build rural income through inclusive climate-smart dairy business growth in Ethiopia, while at the same time contributing to climate change adaptation and mitigation. To this end it is strengthening the capacities of farmers, agro-input providers, cooperatives, processors and extension services. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001768?tab=summary

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Bangladesh	4000001952 - Joint Cooperation Programme Bangladesh	To operationalise the Bangladesh Delta Plan (BDP2100) a knowledge agenda has been established to address the BDP2100's knowledge needs, including needs linked to climate change adaptation. The Joint Cooperation Programme Bangladesh is a cooperation programme between two knowledge institutes in the Netherlands (Deltares and Wageningen University & Research) and two in Bangladesh (Institute for Water Management and Centre for Environmental Impact Assessment) that aims to contribute to the knowledge agenda. The programme focuses, among other aspects, on strengthening knowledge institutes in Bangladesh in the field of adaptive water management in view of uncertainties posed by climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000001952?tab=summary
South Sudan	4000002055 - Feeder Road Improvement and Maintenance Project (FRIMP)	One of the major challenges hindering the development of the agriculture sector in South Sudan is poor infrastructures across the country. Poor road conditions prohibit farmers from accessing markets to sell their produce or buy inputs and demotivate farmers to produce above subsistence level. This activity mainly focuses on the feeder roads connecting agricultural markets to the trunk road network and to regional centres, allowing inputs and agricultural services to reach the agricultural markets throughout the year, and agricultural produce to be collected and transported to regional centres and other destinations. Where relevant, the project also targets feeder roads connecting large numbers of rural people to the agricultural markets, facilitating their access to these markets. The project links its interventions with the Cordaid Program of Food Security through Agri-business South Sudan. The sustainability of the activity is ensured through strengthening the capacities of the local communities such as employing women and youth. The local state government also has a role in the maintenance component with the aim to develop and introduce suitable sustainable maintenance mechanisms. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002055?tab=summary

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Uganda	4000002094 - Nutrition and Income Generation Intervention (NIGI)	This project works within the agro sector and aims at contributing to healthier lives and more resilient livelihoods of refugees and hosts in the areas of the West Nile Region of Uganda, which struggles with a shortage of locally produced nutritious food. The intervention focuses on improving access to and consumption of nutritious crops, and increasing income for refugees and hosts in refugee settlement areas in the West Nile Region. A consortium including a link with the private sector aims to ensure that the agro sector is sustainably transformed. Interventions focus on 1) household nutrition: improving access to and consumption of nutritious food; 2) market & business development: increasing income & employment from production and marketing; 3) capacities & uptake: enhancing human, organisational and institutional capacity; 4) system innovation: development of innovative activities to improve access and consumption in protracted refugee situations. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002094?tab=summary
Global	4000002101 - Support NDCP work programme 2018-2020	The activity supports the NDC Partnership Work Programme 2021–2025 as well as the Partnership Action Fund. The NDC Partnership has successfully concluded its first Work Programme 2018–2020 and has continued its growth in terms of membership, support activities and impact. NDCP now comprises over 200 members, including more than 120 countries and over 80 institutions. The Partnership, which is supporting a growing body of knowledge exchanges, is making a critical contribution to the implementation of the Paris Agreement and is serving as a vehicle to help its members effectively coordinate their resources to achieve maximum impact. The NDC Partnership currently supports 76 countries to enhance the quality, increase the ambition, and speed up implementation of their NDCs. As such, it aims to catalyse transformational change towards resilient, sustainable, and low- emission development. https://ndcpartnership.org/
Global	4000002111 - Least Developed Countries Fund (LDCF)	The LDCF of the Global Environment Facility, set up in 2001 as a financial mechanism under UNFCCC, supports the world's most vulnerable countries in their efforts to adapt to the effects of climate change. It focuses on technology transfer, risk management, mainstreaming of climate change adaptation in other GEF activities and supports national authorities in the preparation and implementation of National Adaptation Plans. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002111?tab=summary

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Rwanda	4000002113 - KIG/Embedding IWRM in Rwanda	The activity aims at the provision of technical assistance, including capacity building of district/line ministry, for the development of replicable and scalable approaches to landscape restoration in Rwanda with a view to achieving sustainable water resources management for Rwanda's socio-economic development and for climate change adaptation. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002113?tab=summary
Global	4000002173 - Working Landscapes	This programme implemented by Tropenbos International aims at strengthening national processes to improve and implement NDCs with an emphasis on the role of forests and trees in achieving climate change adaptation and mitigation. The countries on which the programme focuses include Bolivia, Cameroon, Ghana, Indonesia, Liberia and Vietnam. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002173?tab=summary
Global	4000002350 and 4000003964 (top-up) - Access to Energy Fund – 4	The Access to Energy Fund (AEF), managed by the Dutch Development Bank FMO on behalf of the Dutch Government, was set up to support the creation of sustainable access to renewable energy for people in developing countries. AEF does so by providing risk-bearing funding. However, AEF recognises that in order to achieve impact, there is a strong need to also proactively strengthen businesses, share knowledge and set up partnerships. Therefore, out of the total fund size, about 5% is set aside specifically for capacity development and monitoring and evaluation. Capacity building includes advisory services that enable clients (enterprises and funds investing in renewable energy) to better understand, manage and mitigate certain risks or develop strategic opportunities linked to their core business. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003964?tab=summary

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Bangladesh	4000002457 - DHA/Char development and settlement project (CDSP)	The protection of the char areas south of Noakhali, the people living there and their livelihoods against the impact of extreme climate variability (cyclones, floods) and climate change (sea level rise) as well as specific water-related threats is the key objective of the project. A major focus of the CDSP programme has always been the development of adequate institutions and organisations in the new land area. This is achieved in part by strengthening the nascent government structures and partly by establishing stakeholder organisations for agricultural development (farmer forums), sanitation and water supply and participatory water management. During this bridging phase a new objective is the design and establishment of a permanent institutional framework and organisation for char development in the Delta which is to be responsible for the strategic planning of char development, project planning and implementation. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002457?tab=summary
Bangladesh	4000002458 - Urbanising Deltas of The World	The activity implements communication, capacity development and innovation activities. These activities enhance the use of UDW research results for implementation of the knowledge agenda of the Bangladesh Deltaplan 2100. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002458?tab=summary
Mozambique	4000002894 - Integrated Water Resources Management Fund, Mozambique	The goal of the IWRM Fund is to contribute to the sustainable social and economic development of Mozambique through providing improved water security and water safety for more than 1,500,000 people. The IWRM Fund aims to achieve 1) equitable allocation of water; 2) reduced (climate-related) flood risks; 3) improved water quality and 4) increased availability of water. The activity provides institutional capacity building and demand-based technical assistance to five water management institutions at transboundary, national and decentral levels. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000002894?tab=summary

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Global	4000002938 - Global Water Partnership 2019–2025	GWP is a unique global network of public and private actors aiming at improving water management for food and energy security, safe deltas, sustainable ecosystems and resilient cities in the context of climate change, among other aspects. The partnership focuses among other interventions on knowledge development and policy advice of (local) governments. Climate is one of the priority areas for GWP for the period 2020–2025. The partnership supports countries in their efforts to improve or achieve water security by making available and transferring its knowledge and experience and by providing advice in the management of water resources. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-29380?tab=summary
Regional Africa	4000003124 - CIWA World Bank	Climate resilience is one of the overarching objectives of CIWA. The impact of climate change on the water cycle is increasingly felt in large parts of Africa. Better water resources management – at all scales, from the individual plot of a farmer to the transboundary basin – is needed for climate adaptation and resilience. CIWA is an effective mechanism to address that large scale; strengthening climate-smart information, institutions, and infrastructure to cope with the effects of climate change, with a long-term horizon, long-term commitment, building on the World Bank's convening and staying power as well as credibility. Sometimes the interventions that CIWA supports are as simple as better cross-border coordination between the operators of a cascade of large dams. Just informing the downstream colleagues of an imminent release of floodwaters can help prevent thousands of casualties and damages. But such coordination does not happen spontaneously. CIWA creates platforms to this end. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003124?tab=summary
Iraq	4000003256 - Iraq Horticulture Development Programme	The Iraq Horticulture Development Programme focuses on enhancing the opportunities in the horticulture sector through adopting Climate-Smart Agriculture (CSA) technologies that improve product quality, productivity and water efficiency. One important component in the programme is institutional capacity building. The project aims among other goals to enhance the knowledge and capacities within the public and private sectors to acquire and disseminate knowledge for the development of the sector and the improvement of farming practices. The focus is on the Ministry of Agriculture, Extension Services, academics, researchers or private sector experts. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003256?tab=summary

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West Nile Region	4000003462 - Additional SWA secretariat support	This project works within the agro sector and aims at contributing to healthier lives and more resilient livelihoods of refugees and hosts in the areas of the West Nile Region of Uganda, which struggles with a shortage of locally produced nutritious food. The intervention focuses on improving access to and consumption of nutritious crops, and increasing income for refugees and hosts in refugee settlement areas in the West Nile Region. A consortium including a link with the private sector aims to ensure that the agro sector is sustainably transformed. Interventions focus on 1) household nutrition: improving access to and consumption of nutritious food, 2) market & business development: increasing income & employment from production and marketing, 3) capacities & uptake: enhancing human, organisational and institutional capacity, 4) system innovation: development of innovative activities to improve access and consumption in protracted refugee situations. Support to the SWA secretariat contributes to the attainment of SDG 6.1 and 6.2 by improving political prioritisation for WASH, strengthening government-led national processes, developing and promoting the use of a strong evidence base for decision making, and strengthening regional, national, and local human and institutional capacity. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003462?tab=summary
Egypt	4000003468 - Strengthening Climate Resilience and Food Security in Southern Egypt	The aim of the activity is to strengthen the capacity of smallholders through access to improved agricultural technologies and practices, as well as information, markets and institutional services to help strengthen their livelihoods and resilience to climate change. The activity focuses among other aspects on increasing water efficiency in agriculture, doubling the income and productivity of farmers, strengthening ecological sustainability and increasing the climate resilience of ecosystems and livelihoods. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003468?tab=summary
Kenya	4000003671 - Laikipia, Isiolo, Samburu Transforming the Environment through Nexus (LISTEN) Project	The LISTEN project seeks to contribute to the goal of enhancing the resilience of food, nutrition and water security in the three selected Arid and Semi-Arid Lands (ASAL) counties in Kenia. Training and institutional development is a major component of the project and one of the main expected outcomes is improved institutional capacities and programming frameworks for inclusive climate resilience. Achievements are being measured, among others, through the following indicators: the number of county level institutions formalised for climate change adaptation of communities and the proportion of departments mainstreaming CCA in their plans and budgets. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003671?tab=summary

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Global	4000003751 - Water, Peace and Security partnership	The aim of the Water, Peace and Security (WPS) partnership is to prevent and reduce water-related conflict, and turn the vicious cycle of water insecurity and instability into a virtuous one of sustainable water resources management, stability and peace. Part of the integrated approach of the WPS partnership is to enhance the capacity of local and international actors that are (at risk to be) affected by water-related instability or conflict or are in a position to take action to mitigate and adapt to these risks. The models of the WPS partnership take climate forecasts/models into account and link them to other types of stress, caused by factors such as water over-abstraction or land degradation, as well as to socio-economic and demographic developments. These models and analyses feed into the training, awareness raising and dialogue activities of the WPS partnership. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003751?tab=summary
Nigeria	4000003891 - Collaborative Seed Project	The Collaborative Seed Project contributes to the Nigeria-Netherlands Seed Partnership (NNSP); it is structured along a number of interventions in which Nigerian and Dutch seed sector stakeholders collaborate to enhance the performance of the Nigerian seed sector. The project aims at improving the availability of better seeds which is an essential prerequisite for a future and climate-change-proof food system. The project supports the implementation of an efficient, transparent and effective system of seed variety release that complies with the ECOWAS regulations and takes the specific needs for crop groups into account. It strengthens the capacity of the National Centre for Genetic Resources and Biotechnology (NACGRAB), including the development of a digital support modality, and the capacities of National Agricultural Research Institutes (NARIs), including the National Horticultural Research Institute (NIHORT) on variety trials. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003891?tab=summary

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Regional Africa	4000003935 - Regional Food Resilience Systems in West Africa: Regional Flagship Initiatives	This activity concerns a financial contribution for the 'Regional Food System Resilience in West Africa: Regional Flagship Initiatives' facility, under which a number of advisory services (analytics, capacity building, strategic consultations) are supported to inform a future regional 'West Africa Food System Resilience Programme' to be funded by the World Bank. It is anticipated that this strategic investment in the preparatory phase will be followed up by a further EUR 18.5m co-financing by the Netherlands in the implementation phase of this regional programme targeting concrete results and impact. During the preparatory phase, in which organisations such as ECOWAS, CILSS & other regional organisations will be supported in the design of regional flagship initiatives, capacity building and learning about food security and climate change are an important component. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003935?tab=summary
West Africa	4000003936 - DeSIRA – SafeVeg	This activity promotes the role of vegetables in agricultural research and local food systems in West Africa, thereby contributing to climate resilience across the vegetable value chain, better incomes and sustainable land use for smallholder farmers and ultimately better nutrition for farm families and other consumers. SAFEVEG fosters innovation in agriculture by testing and scaling innovations to promote vegetable demand and supply. The latter includes quality seed of locally adapted and climate-resilient varieties and safe agricultural practices, contributing to more sustainable land use. SAFEVEG also strengthens the capacity of national agricultural research systems and other partners in vegetable research by giving local researchers a leading role in the innovation process and training 24 MSc students and 7 PhD students. Finally, SAFEVEG increases knowledge and evidence to feed development policies and investment decisions by generating better evidence for what works (and what doesn't) in terms of sustainably increasing vegetable production and consumption. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003936?tab=summary

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Benin	4000003975 - Emploi agricole des jeunes au nord Benin	Among other things, the project aims to increase the employability of young people, in particular by strengthening their leadership, entrepreneurial culture, as well as their skills in modern agricultural techniques and practices. Gender, inclusion and climate change are key crosscutting aspects of the project. The project also supports young people to help them explore and benefit from market opportunities, and receive adequate tailor-made support for their access to finance. It also makes them actors and beneficiaries of public and private partnership networks with private and public organisations and local authorities providing an environment favourable to the inclusion of young people around the selected agricultural value chains. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003975?tab=summary
Global	4000003982 - Energy Sector Management Assistance Program FY2021-2028	The activity includes a provision for the creation of and training for clean and green (energy) jobs. A Digital Academy is being established to among other goals identify and transfer emerging global knowledge, best practice, and deliver training in key areas of next generation utilities. Knowledge exchange, workshops and trainings are being offered on market deployment and power system planning, and internal and external knowledge exchange fora on Energy Subsidy Reforms are organised. Training furthermore includes topics such as women's leadership in the decarbonization of the public sector and end uses in developing countries, and innovative technology, business, and financing approaches in clean cooking. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003982?tab=summary
Kenya	4000004027 - Development Smart Innovation through Research in Agriculture (DeSIRA)	The project seeks to stimulate economic growth and enhance livelihoods of agro-pastoralist communities through improved forage production and livestock husbandry, building on commercialisation of climate-smart innovations and sustainable landscape management in Taita Taveta, Kajiado and Narok counties in Kenia. The project offers support in investing in adoption and upscaling of appropriate technologies and innovations. It furthermore strengthens the knowledge base, planning, implementation and coordination capacity of county governments, community organisations and other relevant institutions on integrated landscape management, climate change and sustainable use of strategic resources. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004027?tab=summary

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Global	4000004058 - Plantwise Plus	The activity builds the capacity of agricultural service providers through enhanced programme innovations (e.g. digital learning products and decision support tools), which contribute to reaching large numbers of users, and therefore increase the number of farmers benefiting from high-quality advice on climate-smart pest control and other climate-smart best practices. Furthermore, the programme is adopting training modules for the provision of gender-sensitive advisory services. Through these interventions, the programme expects to increase the number of agricultural information providers able to provide farmers with high-quality and useful advice in line with best agricultural practice. Farmers' groups are furthermore being trained to produce specific food crops in accordance with an existing or, where necessary, newly established production standard based on Integrated Crop Management principles. The capacity of national systems to assess, prioritise and control pest threats are being strengthened by the CABI and partners to implement risk management plans. The system enables plant health stakeholders to prioritise risks and allocate risk management efforts to coordinated, cost-effective responses. As a result of these interventions, it is foreseen that the country's capacity to respond to imminent risks in a cost-effective and efficient way will be increased. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004058?tab=summary
East Africa	4000004100 - DC DeSIRA – FAIR LSC-IS	Boosting Climate-Smart Agriculture in East Africa with FAIR Land, Soil and Crop Information Services. Information on soil, land and crops is crucial to further scale-up the development of climate-smart agriculture in East Africa. This information is currently lacking in a context-specific format; to make this readily available for policy makers, local research institutes and extensions agencies, NGOs, private sector and eventually smallholder farmers, ISRIC and WUR will develop information hubs in collaboration with CGIAR and national research organisations in respective countries, taking existing systems into account. The development of these hubs will follow an iterative process to bring together supply and demand in a useful manner; capacity building and sustainability of these hubs play a large role in this proposal. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004100?tab=summary

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Israel, Palestinian Territories	4000004109 - Hebrew University Netherlands Association – Wheatmax	One of the project's main outputs include an adapted wheat crop that is more resilient to climate change. The project aims to build capacity in breeding processes and efficient crop use among Palestinian researchers, students and breeders. The project is a joint initiative between research institutions in Israel and the Palestinian Territories which will include intensive research, experience exchange and capacity building. Partners strive to create a constructive environment within which researchers from both sides cooperate despite recent political developments, making the project not only scientifically but also socially relevant. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004109?tab=summary
Burundi	4000004168 - Plantwise	Plantwise is a programme, implemented by CABI, that aims to improve the food security and livelihoods of smallholder farmers in Burundi by reducing their crop losses and improving crop quality. Plantwise will improve the plant health system in order to provide farmers with improved access to advice and information on plant health. To achieve this the Plantwise programme will mainly work to improve the quality of extension services and advice available to farmers, while strengthening the links between education, research and agricultural extension at the national level. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004168?tab=summary
Uganda	4000004191 - Skilling in Agripreneurship for Increased Youth Employment (SAY)	The activity which explores opportunities for entrepreneurship along selected agrifood value chains in Uganda will capacitate youths in agribusiness and enable them to earn a living (self or wage employment). This ultimately contributes to their livelihood and to increased food security. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004191?tab=summary
Egypt	4000004228 - Strengthening Climate Resilience and Food Security in Southern Egypt Phase II	WFP and Solidaridad's proposed intervention aims at realising integrated rural development in 60 of the most underprivileged villages in Upper Egypt through capacity building of smallholder farmers on modern irrigation, crops production techniques, optimal utilisation of resources and use of ethical digital inclusive tools, thereby contributing to the Egyptian Government's vision for inclusive economic growth and shock-resilient households and communities. https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000003468?tab=summary

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Somalia	4000004237 - Improving the Social Contract through disaster risk management	The project aims to increase government legitimacy in Somaliland through efficient and effective disaster risk management (DRM) based on access to information, inclusive politics and services. The activity will offer training and a range of other CD inputs to increase the capacity of communities, CSO, public authorities and press to effectively play their respective roles in addressing and/or responding to external shocks and stresses such as desert locusts, flooding and drought, all of which are consequences of climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004237?tab=summary
Global	4000004314 - Catalysing Private Sector Solutions for Sustainable Landscapes	The objective of the activity is to contribute to the protection and restoration of forests and watersheds, the sustainable management of agricultural land and to benefit smallholders and forest communities. The programme aims to contribute to climate change mitigation and adaptation through the reduction and sequestration of greenhouse gases (tCO2eq) and through improving livelihoods and the resilience of farmers in areas affected by climate change. The project will, depending on local conditions and responding to local needs and demands, develop and offer a wide range of tools, documents and training to build capacity at user, (local) government and CSO/NGO levels. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004314?tab=summary
Global	4000004315 - Water Productivity Database Phase 2	The project will facilitate and increase the capacity in countries and of organisations to monitor biomass production and evapotranspiration and to assess land and water productivity in rainfed and irrigated agriculture by using innovative state of the art remote sensing and information and communication technologies. Based on this information, stakeholders at different scales will be able to obtain sustainably increased and secure crop yields with a reduced impact on available freshwater resources and the environment in a changing climate. The project will result in better water and land-management practices in the countries and make them less vulnerable to the adverse effects of climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004315?tab=summary

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Africa, Latin America, Asia	4000004334 - Global Alliance for Green and Gender Action (GAGGA)	GAGGA aims to play a decisive role in climate mitigation and adaption processes by strengthening the voices, leadership and resilience of women from Africa, Asia and Latin America who are on the frontlines of climate action. The scope of CB interventions will include technical capacity on various inclusive, gender-just climate solutions, addressing mitigation and/or adaptation, based on the local context; action-research and documentation capacities to build evidence and a convincing narrative for inclusive, sustainable and gender-just climate solutions; and outreach strategies to showcase evidence-based practices of viable gender-just climate solutions with replicable adaptation and mitigation impact. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004334?tab=summary
Regional Africa	4000004337 - Power of Voices – Stichting Woord en Daad, Benkadi	Information, Education and Communication (IEC), and Behaviour Change Communication (BCC) materials for monitoring of citizen influence will be used to strengthen the capacities of communities and grassroots CSOs, and support them to voice out and monitor the commitments of the state. Particular attention will be paid to the participation of women and young people. The programme furthermore aims to strengthen the capacities of the authorities (locally elected representatives, decentralised technical service, ministries, the National Assembly) for effective citizen involvement in the implementation and monitoring of policies in the field of climate change. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004337?tab=summary
Global	4000004338 - POV/Green Livelihoods Alliance - Forests for a Just Future	The activity aims to contribute to reduced deforestation and increased sustainable land use through providing support to civil society organisations in 12 partner countries in their role of lobbying and advocacy. By exchanging experiences and tailor-made capacity development interventions, the activity will strengthen the lobbying and advocacy capacity of the Alliance, CSO partners and indigenous people and cocal communities at all levels. As a result, IPLCs and CSOs will be better equipped to campaign and advocate effectively at local, national and international level targeting national governments, intergovernmental bodies and dispute resolution authorities. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004338?tab=summary

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Global	4000004339 - The Right to Grow Project	The aim of the project, which will be active in six countries in Asia and Africa, is to strengthen (the 'power of voices' of) CSOs to lobby and advocate for decisionmakers to effectively address undernourishment of children. Recognizing the impact of climate change on food security and WASH, the project among other activities seeks to enhance the understanding and capacity of CSOs to assess the impact of climate change, to identify relevant government services and policies for climate change adaptation (e.g., NAPs), and to successfully identify and collaborate with important climate activists and civic actors. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004339?tab=summary
Global	4000004369 - Amplifying Voices for Just Climate Action	The aim of this programme is to build the capacity of local civil society groups (in 7 countries) so as to enable them to claim a central role as empowered innovators, facilitators and advocates of climate solutions. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004369?tab=summary
Kenya	4000004370 - Catchment to Tap: Working on the Nexus of IWRM and WaSH	This activity aims to improve the access to and availability of clean and safe water in adequate quantities and sanitation services for all users, as well as enhanced climate resilience in the WASH sector. Extensive capacity development is foreseen at all levels to raise awareness about the importance of effective IWRM-WASH approaches and the impact they can have on their constituents and on long-term climate resilience and water needs. Training and skills development will cover subjects such as general IWRM theory; WRM and climate resilience theory; and technical skills such as hydrological modelling, GIS, and data analysis that can be applied to integrated nexus cases. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004370?tab=summary
Egypt	4000004400 - Joint Cooperation in Applied Research Programme on Water	The JCAR aims to support the Egyptian Ministry of Water Resources to prepare a clear path and agenda for Egypt to deal with current and future water challenges. The activity furthermore aims to reach a well-developed capacity in MWRI, NWRC, the Agriculture Research Centre (ARC) of the Ministry of Agriculture and Land Reclamation (MALR), and other relevant agencies, and to create partnerships between Egyptian and Dutch institutes, to address the knowledge questions that stem from the NWRP 2037. This is meant to enhance the state-of-the-art and the knowledge-base of the Egyptian agencies involved, and will strengthen the capacity in Egypt to plan, develop and manage its water resources now and in the future. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004400?tab=summary

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Global	4000004418 - Climate Investment Funds (CIFs)	The programme provides for a Technical Assistance Facility (CIF-TAF), launched in early 2019, to support policy and capacity building through energy policy and regulations, financial policy and regulations and transaction enablers, with the goal of accelerating clean energy investments. The facility is well under implementation in countries such as Bangladesh, Brazil, Mexico, Thailand, etc. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004418?tab=summary
South Sudan	4000004440 - A3-SEED – 'Triple A-SEED'	The project aims to accelerate agriculture and agribusiness in South Sudan for enhanced economic development. A3-SEED will invest in learning and capacity development of project staff and partners (both private and public) through local skills training, strategy partnerships, and action research. The project will invest in capacity building in integrated seed sector development, ISFM, market-led agricultural extension, women's empowerment, and youth employment promotion. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004440?tab=summary
Kenia, Niger, Mali	4000004444 - EnDev Biogas Project	Biogas technology and training in design and construction. EnDev will emphasise the facilitation of prefabricated bio-digester technologies in the market. Prefabricated technology has already proven to be more scalable in Kenya, to a large extent due to the fact that prefabricated suppliers sell their products on a 'lease to own' basis. Quick installation, constant quality and warranties have further helped to scale this market in Kenya. It is expected that with the right support this success can be replicated in other countries as well. Design and construction training for new biogas masons will only be provided in Niger and Mali in the small scale biogas segment and in Kenya for the medium scale segment. Entrepreneurship will be an important selection criterion for taking part in this training. https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000004444?tab=summary
Mozambique	4000004507 - COVID-19 Cash Transfers for inclusive development	One of the main objectives of the Mozambican National Social Protection Strategy (ENSSB 2016–2024) is to support food consumption and resilience of poor and vulnerable families exposed to the effects of adverse shocks. The main instrument in the social protection policy framework to respond to the COVID-19 pandemic is the Cash Transfer Programme Post Emergency (PASD-PE). The programme among other components supports the medium-term role of the social protection system in relation to climate change adaptation as it enhances households' resilience to shocks. Although the activity expands coverage to households affected by COVID-19 crisis, the expansion in beneficiary registries, payment systems, and referral processes builds capacity for future responses to climate change-related shocks at the same time.

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South Africa, Mozambique, Kenia, Somalia, Ethiopia, Burkina Faso, Senegal, Nigeria	4000004774 - Power of Voices – African Activists for Climate Justice (AACJ)	AACJ aims to contribute to a strong and inclusive African movement which mobilises citizens, companies and governments to advance climate justice. Capacity strengthening of local civil society organisations is an important element of the programme. The expertise of consortium partners will enable mutual capacity development trajectories, and will allow the AACJ consortium to tap into a wealth of innovative skills, tools and methods across the programme to, for example, develop new narratives (based on learnings from the African Feminist Macroeconomic Academy and exchanges in summer schools on climate justice), involve traditionally side-lined groups in movement building (based on experience in Mozambique), use ICT-based methodologies for community-driven climate action (based on experience in Ethiopia) and legally empower climate-affected groups (based on tools and protocols developed by Natural Justice). To facilitate exchange and learning the AACJ consortium will build a regional portal to connect frontline activists across countries. It will host events, dialogues, webinars and content on climate justice topics and policy processes, including training videos, tutorials, interactive activities and downloadable content for partner communities and CSOs. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004774?tab=summary
Global	4000004902 - Top-up Initiative for Sustainable Landscapes (ISLA) 2021-2025	A landscape programme focused on conservation and sustainable management of natural resources (forests, watersheds), sustainable production of agricultural commodities and improved livelihoods of smallholder farmers and forest-dependent communities. As part of this top-up additional funds are made available for a) technical assistance in order to develop sustainable business cases and scale up private investments, including through carbon finance and b) further developing a landscape programme in Cameroon that focuses on halting the deforestation frontier through sustainable cocoa production. Capacity building comprises among other aspects training on carbon, policy and markets and setting up networks with local and national experts on carbon themes and regular exchange of information. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004902?tab=summary
Global	4000004908 - DUPC3 (2021 - 2027) / Transformations to inclusive and sustainable water futures	This knowledge and capacity development programme contributes to innovative interventions that enhance improved water management with reduced inputs like energy, increased capacity of a wide range of (non-) governmental stakeholders on inclusive and sustainable water management, and timely and transparent decision making on water resources management enabled through data, lessons learnt, knowledge and analytical tools. https://www.un-ihe.org/dupc3-ihe-delft-partnership-programme-water-and-development

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Yemen	4000004959 - Consolidating the Decentralised Integrated Water Resource Management System in Sana'a Basin, Yemen	The project aims to sustain water resources and rural livelihoods and to consolidate the developed decentralised integrated water resource management system in Sana'a Basin by strengthening the knowledge of stakeholders. It also aims to strengthen the capacity of the WUAs to plan for water resources investments based on economic, environmental, and social aspects to achieve food security and improved nutrition and promote sustainable agriculture and water governance, and to safeguard the water resources from deep aquifers for domestic use for Sana'a City and renewable groundwater for agriculture. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000004959?tab=summary
Bangladesh	4000005006 - Flood and Riverbank Erosion Risk Management Investment programme (Tranche 2)	The programme supports Bangladesh (executing agencies MoWR/BWDB and MoDM&R/DDM) in stabilising selected reaches of the Jamuna river through 1) improving flood and riverbank erosion risk mitigation at priority reaches, 2) strengthening the institutional system for flood and riverbank erosion risk management, and 3) operationalising programme management systems. Among a wide range of capacity development activities at all levels, the programme will support the establishment and training of community-based disaster management units (minimum of 35% women-led), train 40 disaster units (14 units out of 40 led by women) created under the first phase to enhance sustainability, raise awareness on FRERM, and strengthen disaster preparedness and emergency response with a focus on women's participation. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000005006?tab=summary
	4000005008 - Safeguard Young People	Ten countries (including Angola and Mozambique) that have documented policy dialogues held on key emerging issues, including climate change and Adolescents Sexual Reproductive Health and Rights (ASRHR); strengthened capacity of regional and national institutions to design and implement quality, evidence-based, gender sensitive and climate-smart integrated SRHR, GBV and HIV adolescents and youth programmes including comprehensive sexuality education for in and out-of-school youth and its links with access to service. 43,014 (5,000 in Angola and 10,000 in Mozambique) out-of-school boys and girls have been educated on how to respond to effects of climate change, environment and disaster risks as they pertain to SRHR, HIV, GBV and wellbeing.

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Global	4000005029 - Strategic Partnership VNG International	Local governments and their representative bodies are able to shape more sustainable futures for their communities, specifically regarding water. This programme proposes to contribute to the self-reliance of communities to deal with climate and more specifically water-related risks, through improved local governance and governments. For 12 countries local governance support programmes will be developed with a focus on fragile contexts, migration, water and local taxation through a multi-thematic approach. The partnership will support local governments through capacity building for decision making and service delivery, strengthening local leaders, civil servants and citizens and creating an institutional environment by clear mandates and decentralisation processes. VNGi will use their own expertise as well as expertise from Dutch municipalities and local counterparts. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000005029?tab=summary
West Africa	4000005219 - West Africa Food System Resilience Programme	The programme envisages a strengthened natural resource base, increased adaptive capacity to climate change, increased per capita food availability, strengthened food crisis monitoring, prevention systems, and accelerated access to emergency financing. Results include: regional and national consultations on analyses and programme design; stronger partnerships with and capacity of institutions in the region; food system analyses at regional and national levels; a series of studies based on consultations, evidence and existing literature; building blocks for the development of national programmes. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000005219?tab=summary
Ethiopia	4000005254 - One Wash National Programme	A contribution to the World Bank in Ethiopia, which will be disbursed into the Consolidated Wash Account, which will then be used to finance activities, carried out by the Ministry of Water, which are aimed at increasing access to safe water supply, sanitation and hygiene services and strengthening the capacity for water resources management for service delivery.
Bangladesh	4000005317 - DHA Building Water Business	This activity empowers male and female entrepreneurs and strengthens business solutions that provide safe water and adequate sanitation to underserved populations, and aims to reinforce and create new healthy villages in the Patuakhali and Khulna regions. The programme will train and strengthen WASH entrepreneurs and associations, and develop WASH services that compliment and reinforce the use of safe water and adequate sanitation at household level. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000005317?tab=summary

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Jordan	4000005402 Design and implementation of water	This proposal is dedicated to the integration of water harvesting as an integral water management and climate adaptation intervention for Jordan's resiliency efforts. The consortium of partners and experts make the case and methodology for instituting water harvesting with complementary policy and capacity building action, as a sustainable approach to enhancing the resiliency of communities and ecosystems most vulnerable to the impacts of climate change and population growth in Jordan. The proposed project will be implemented over a 36-month period to focus on supporting a sustainable water management approach, by reducing water use of unsustainable sources (by reducing water losses and increasing water use efficiency) and by increasing water supply from sustainable sources (by supporting water harvesting and promoting the use of non-conventional sustainable water resources). Furthermore, the intervention aims to be aligned with national and local water policy and management systems, as well as provide innovative design tools to allow for water harvesting practices in Jordan to continue to improve and react to changing climate conditions. https://www.nlontwikkelingssamenwerking.nl/nl/#/activities/XM-DAC-7-PPR-4000005402?tab=summary
Global	4000005425 - Climate & Energy Response Facility (CERF)	The aim of CERF is to support countries in their climate and energy transition, increasing climate-mitigation ambitions, and accelerating climate action in the area of primary mitigation. The strategy is to support countries in increasing their mitigation ambitions and accelerate climate action in a limited number of (sector) niches that have a high impact and where the Netherlands has an added value.
Central Africa	400003729 - Joint donor contribution to the Central African Forest Initiative	One of the main objectives of the project is to ensure that institutions have the capacity and the legal framework to promote, monitor and enforce sustainable forest management. The project includes provisions for capacity building of all stakeholders, including the administration, to ensure that they respect, enforce and implement these plans. Multi-actor platforms are created or reinforced at each administrative level to monitor the implementation of the plans, identify non-compliance and apply sanctions. https://www.nlontwikkelingssamenwerking.nl/#/activities/XM-DAC-7-PPR-4000003729?tab=summary

7.5 (D) 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 (GHG inventory information), paragraph 3.3. Besides national programmes, the Netherlands also participates in the EU Climate Change and Energy working groups, workshops, and studies on the exchange of experiences and further improvement of inventory aspects, and in G2G projects, for example with Romania, a study tour by Turkey and with Indonesia where further exchange of experiences is implemented.

Domestic and regional programmes (b)
These are described in Chapter 4 (Policies and measures), paragraph 4.2.15 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 8.

Education and training and public awareness (e)
Chapter 9 describes the actions in the Netherlands

7.6 (E) Description of selected projects or programmes that promoted practicable steps to facilitate and/or finance the transfer of, or access to, environmentally sound technologies

Development of Waste to Energy in the Palestinian Territories

Via a sequence of activities in the field of waste to energy (W2E), the Netherlands contributed in the period 2018-2022 to the development of the W2E sector in the Palestinian Territories[206]. Development of the sector can help to reduce CO2 emissions, to increase energy dependence, and to solve issues regarding municipal waste such as ground water contamination and air pollution.

This project is one of the projects within the Energy Transition (ETF), that was commissioned by the Dutch Ministry of Foreign Affairs and implemented by the Netherlands Enterprise Agency in the years 2017-2020. The programme aimed to collaborate at policy level. National governments were supported in their transition to a sustainable energy future. ETF was open for projects in Algeria, Egypt, Jordan, Lebanon, Morocco, Mozambique, the Palestinian Territories, Tanzania and Tunisia. In collaboration with Dutch embassies, the ETF funded and facilitated bilateral knowledge exchange in the field of the energy transition, for example on offshore wind, solar energy, hydrogen and e-mobility.

In 2018, a pre-feasibility study into various waste-to-energy options was carried out by a Dutch expert and provided a technological, social and financial context for policy issues, concluding that direct incineration has the highest potential with regard to production of electricity, but needs serious consideration with regard to needed minimum scale, needed capital and resulting LCOE (levelized cost of electricity). The study enhanced the Palestinian Energy and Natural Resources Authority's (PENRA) insight into making policy choices regarding technology options. This was followed by a feasibility study for W2E technologies in the West Bank, aiming at enabling Palestinian Authorities to set their priorities, and to explore where Dutch knowledge can support these priorities and to initiate a trajectory towards W2E realisation.

Accordingly, a feasibility study and a policy alignment capacity building mission was held, followed by a series of training sessions aiming at conceptual design, operation and financing mechanism for W2E plants. This included by a techno-social-economic analysis of an existing proposal for a 40 MW base load waste-to-energy plant in Zahrat Al Finjan

[206] https://projects.rvo.nl/section/development-cooperation/?view=list&countries=1385&programmes=4554

Landfill. This project was completed in August 2021 with a study tour along Dutch W2E operators, suppliers and investor FMO, giving the PENRA team the opportunity to interact with Dutch projects and gain insight in Dutch experience in the W2E field, in addition to developing relevant relations and network.

In 2022, the trajectory was concluded with the creation of a concept note and prefeasibility study into the best way to use the waste of the Ramallah and Al Bireh governorate in a potential project near the Ramon area, where the organic fraction of the municipal solid waste will be utilized for input of a digestion process generating biogas which in turn is converted into power.

Some main factors led to the project/programme's success. The W2E sector in the Netherlands is highly skilled, and nationally as well as internationally focused. The ETF program coordinated its approach directly with multiple Dutch market players and consultants, as well as the Palestinian stakeholders, allowing for a comprehensive and tailor-made program. Palestinian officials were involved and attended the sessions, up to and including the highest Ministerial level. RVO attended and supervised the majority of meetings and sessions, thus closely monitoring and steering the process while allowing for plenty of direct contact between Palestinian stakeholders and Dutch professionals. Initiatives like the study tour in 2021 contributed strongly to this interaction.

The project was strongly demand driven from the PENRA side, but all players in the future value chain were involved in an early stage, including other local stakeholders (ministries, joint service councils, companies) and possible (inter)national financiers, giving the outcome of the studies more legitimacy while ensuring a fundable result.

The project was focused on a number of aspects concerning waste-to-energy technology implementation: techno-economic feasibility; conceptual plant design; legal and contracting framework; project monitoring and reporting procedures; CSR framework and Stakeholder management.

Working Landscapes (Tropenbos International) (Surinam)

The aim of this project was to strengthen the national processes of improving and implementing Nationally Determined Contributions with an emphasis on the role of forests and trees in achieving climate change mitigation and adaptation in Surinam.

The project strengthened the capacity of Saamaka communities in the Upper Surinam River Area (USRA) to map their territories using Participatory 3-Dimensional Modelling (P3DM), and established connections with the new District Commissioner with the intention to integrate P3DM results in the annual district plan. A platform was created with the different environmental NGO's to strengthen lobby and advocacy efforts, among others to influence the Collective Land-Tenure Rights Act, which is currently being drafted by the national government, and which is expected to provide legal recognition of indigenous and tribal communities' collective land tenure rights. Also, due to the efforts of this project, public sector authorities and local communities are now recognizing the importance of community forestry, particularly in the context of climate change objectives and avoidance of forest degradation. The importance of communities' P3DM capacity (and results) is expected to increase, if and when the Collective Land-Tenure Rights Act is adopted.

Capacity development was the main intervention that led to the outcomes documented for 2020: in three quarters of outcomes an element of capacity building was involved, and in one quarter the outcome resulted from capacity development. Under the WL programme, TBI members and partners are therefore not only facilitating the participation of local actors in multi-stakeholder dialogues, but also building their capacity, so they feel empowered and confident to raise their voice in such settings.

Djibouti Wind

The aim of this project was the construction and operation of a 60 MW windfarm in the Ghoubet area, Djibouti[207]. The Ghoubet Wind Farm represents Djibouti's first renewable energy project, as the country diversifies into clean, renewable sources of energy. The Netherlands provided USD 25 million for the construction of the project. The project sells its electricity under a Power Purchase Agreement (PPA) to 'Electricité de Djibouti', the Djibouti state-owned utility. Assuming a moderate average capacity factor of 40%, the project is expected to avoid approximately 150,000 metric tons CO_2 emissions/year.

ZOLA Electric (Tanzania)

The aim of this project was to support ZOLA Electric[208] in establishing a sustainable credit function and in improving all aspects of credit risk management: from customer selection and collection, to compliance and risk monitoring. ZOLA provides clean and first-time

[207] https://www.fmo.nl/project-detail/55967
[208] https://zolaelectric.com/

energy access to households in areas with unreliable or non-existent grid connection. Increased energy access contributes to productivity of households, small businesses and economic growth as lighting and charging allows work and study beyond sunset.

Improving the company's credit systems and team's knowledge resulted in better collections and contributed to a more sustainable business which will reach more users. The consultant, Frankfurt School of Finance and Management, has helped validate hypotheses, provide assurance, and sharpened the strategic thinking of ZOLA's internal staff, all of which are particularly relevant due to the high uncertainty and consolidation phase that the entire PAYGo solar industry is facing.

Sustainable Water Fund (FDW) Project: Securing eroding delta coastlines, Building with Nature in Demak District, Central Java, Indonesia

FDW supports at-scale the implementation of a 'Building with Nature' pilot, which provides coastal security and supports revitalisation of at least 6,000 ha of aquaculture ponds along a 20 km shoreline in Demak district (Central Java). This enhances the resilience of 70,000 people living along the coast.

Building with Nature is an innovative approach to integrate nature-based solutions in water and marine engineering practices. Indonesia is one of the first countries that embraced the Building with Nature approach. The project was designed to halt land loss, bring back mangroves and revitalise aquacultures along a 20 km stretch of eroding coastline in Demak District, Northern Java. The approach has been taken up by 13 other districts. Similar work is taking place in Tanzania, Kenya, Mozambique, Madagascar, Shenzhen (China).

The project introduces the Building with Nature approach to accomplish resilience along eroding delta coastlines. This innovative approach combines civil engineering with mangrove rehabilitation to build safe and adaptive coastlines, while simultaneously introducing sustainable land use. The Building with Nature approach is mainstreamed in policies, plans and budget allocations for lowland development, disaster risk reduction, climate change adaptation and water safety in Indonesia. The Building with Nature approach is one of a kind to integrally manage water resources protecting delta coastlines and river basins in a sustainable way. Multi-level and multi stakeholder engagement at both government, private and community levels created a profound understanding of the importance to protecting the livelihoods of many coastal inhabitants.

By designing and learning by doing with a multi-disciplinary team, the project has been able to blend technical, scientific, social and local knowledge and site specific system understanding, create innovative solutions and build trust. Engagement of community members has been essential in the design process, implementation of measures, and adaptive management. The community attitude has changed from passively accepting regular floods and low productivity to embracing hopeful, creative and collaborative methods. The engagement models 'Biorights' and 'Coastal Field Schools' can be considered success factors that can be replicated and adapted to site specific needs in other projects. The role of the Indonesian Ministries (MMAF and PUPR), being partners in the project, along with that of Demak district and Central Java Province has been crucial throughout, to align with their field programmes and to create an enabling policy environment.

Mainstreaming of knowledge and lessons is conducted through Training for Trainer programmes taken up by 8 universities and government institutes, reaching over 2500 students. In addition, the project developed a series of technical guidelines, scientific papers and was included as case study in publications worldwide.

Some example of transferred technologies include the construction and monitoring of permeable dams with community-based maintenance, repair and ownership transformation, and the introduction of planting techniques to rehabilitate mangrove forests and sustainable aquaculture management regimes

In terms of adaptation, this project is expected to positively impact the protection of up to 30 million vulnerable communities in Indonesia against coastal hazards induced by climate change and unsustainable land-use. Further, the revival of ecosystems should ensure the sustenance of vital natural resources and provide a basis for livelihood adaptation in the wake of climate change. As for mitigation, by reducing greenhouse gas emissions from high-carbon mangrove soils resulting from unsustainable coastal zone management, an avoided emission of up to several 100s tC/ha is expected.

*The Clean Cooking Finance Masterclasses (*Ethiopia, Kenya, Malawi, Nigeria, Rwanda, Sierra Leone, Somalia and Uganda)

The aim of this project was to build the capacity of early stage clean cooking companies around the fundamentals of the capital raising journey from pitching to closing a deal. The Masterclasses was jointly organised by the multi-donor programmes Energising

Development[209], supported by the Netherlands, Germany, Norway and Switzerland, and GET.invest[210], supported by the European Union, Germany, Sweden, the Netherlands, and Austria, in partnership with the Clean Cooking Alliance[211].

The Masterclasses created an interactive and cross-learning space for participants to actively share their experiences in fundraising and learn from the expertise of seasoned financial advisors that themselves founded and ran clean cooking companies. In addition, the Masterclasses invited leading clean cooking companies to share their successes and challenges with the participants, providing a first-hand learning experience inspired by peer fellows from the sector.

The main element of change that was observed is the "mindset shift" where participants appreciated that raising capital is a holistic process and not a "one-off event". Participants learned how the process of capital raising evolves across all business development stages from early ventures to growth and later scale stages. Most of the participants indicated that they would implement many of the learnings inspired through the discussions, including to source external advisory when needed, develop or improve their 'data room', improve their pitch-decks and 'set up systems and strategies' – among others.

All participants continue to benefit from EnDev ongoing capacity building, specifically Business Development Support activities. Others applied for GET.invest financial advisory services and one company was successfully accepted for support. Companies may grow to become eligible for the CCA Industry Catalyst support.

Water Efficiency in Sustainable Cotton Production System (India)

The project stimulates increased water efficiency and good agricultural practices (GAP), both regenerative and organic, in the production of sustainable cotton. This supports farmers increasing their profits as well as making them more resilient towards the negative impacts stemming from climate change (including prolonged droughts). Additionally, the project introduces a socio-hydrological model. This model aims to aid farmers to predict effects of introducing water efficiency interventions on their incomes. Moreover, this model helps the farmers to visualise the effects of the present decisions regarding farm management on future income in the sustainable cotton market – taking into account climate variability. Importantly, the introduction of technologies and

[209] www.endev.info
[210] www.get-invest.eu
[211] www.cca.org

techniques to harvest, conserve and re-use rain water will reduce the overexploitation of groundwater resource by providing supplemental sources of irrigation. It is envisioned this will make farmers more resilient to the expected risks of climate change in years to come.

The project is a Public Private Partnership (PPP) based consortium involving corporate partners, technical university and government institutions who collaboratively bring expertise in agriculture, cotton value chain, water resources and smallholder farming. All the project activities are combined in an interdisciplinary approach – from interventions such as introducing farm machinery, water structures to introduction of a socio-hydrological model, better agricultural practices to uplift the knowledge and confidence of farmers and their financial management training. It also includes supporting farmers to access micro credit for small scale water efficiency measures.

Local governance structures in the form of Water User Groups (WUG) have been established in several villages. These groups consist of the farmers who work proactively in the management of the common water sources and raising awareness issues on water saving within their community. These groups have been in continuous touch with the project team and are building their capacities to further actively participate in local level water management, which will contribute to their sustainability after the project.

Some examples of transferred technology include the construction of farm ponds, the provision of cotton trash shredders and certified low-cost waste decomposer pouches, the installation of drip irrigation systems, automated weather stations, pest monitors, soil moisture sensors, and the introduction of modular Bio-digesters.

The adoption of regenerative practices and organic cultivation in cotton production by the farmers contributes to carbon sequestration in the soil. An estimated 32,000 tonnes of CO_2-eq per year has been sequestered through the adopted better practices (regenerative and organic) by the farmers, promoted through the FDW programme.

Geodata for Agriculture and Water (G4AW) (Global programme)

The aim of this programme is to improve food security in developing countries by using satellite information to reach small-scale food producers. The G4AW Facility fills a niche in the current range of instruments by stimulating public-private partnerships using (digital) technologies in the nexus of food security, water productivity and climate change adaptation. The program was in 2021 evaluated to have significant potential in

addressing climate adaption in that information services such as smartphone weather apps become increasingly important and could, if successful, improve the position of small-holder farmers and improve financial resilience among food producers, insurance companies and the like. The Netherlands has invested EUR 68 million in this programme.

Safe Drinking Water for Ethiopia

The Safe Drinking Water for Ethiopia project aims at ensuring 250,000 people (50,000 households) in rural areas of Amhara will have access to safe drinking water at the point of use by the end of the project. This access to save drinking water will significantly improve their health situation through reducing the incidence of waterborne diseases. Through the project, knowledge is transferred of water related diseases and adequate household water treatment and storage systems.

A public-private partnership (PPP) has been brokered to achieve this. The partnership focuses on enhancing knowledge and awareness on waterborne diseases and household water treatment solutions; increasing availability of affordable treatment and storage solutions; and increasing access to credit for rural households to purchase the filter.

The project contributes to the reduction of greenhouse gas emissions through the concept of suppressed demand. Through the introduction of the water filters, the demand for fuel-wood is suppressed and hence CO_2 emissions are reduced. As most firewood is produced from local vegetation, the project also has a positive impact on reducing deforestation and contributes to mitigating climatic change.

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 climate system, impact and policy support, and implementation studies. These activities are characterised by:

- intensive participation in international and European programmes, with the Dutch Research Council (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW) coordinating Dutch contributions to the international research arena;
- clustering into a large national research network: the National Water and Climate Knowledge and Innovation Programme (NKWK).

The Ministry of Infrastructure and Water Management is the leading department on adaptation to climate change and supports research into climate-proofing the Netherlands and into water and infrastructure. The Ministry of Economic Affairs and Climate Policy focuses on 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 as land use.

With regard to systematic observation, the Netherlands actively participates in the various fields of climate-related monitoring, both at the national level and in European and global programmes. An integrated national programme for the implementation of the Dutch contribution to the Global Climate Observing System (GCOS) has not yet been established. A well-defined structure is lacking, as neither funding nor resources are available. Moreover, there is no national focal point for GCOS.

Cooperation on scientific and technical research/data exchange

Cooperation is assured through national and international clustering. The national research programmes actively seek private-sector participation and facilitate the dialogue between stakeholders from the 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 Dutch research community participates in a few European Joint Programming Initiatives (JPIs) for climate: Climate, FACCE (agriculture), Oceans and Water. These

initiatives aim to align various fields of climate research activities in the different countries. They have been supportive in framing the content of Horizon 2020 and Horizon Europe, the new European research programme from 2021 onwards. The JPIs 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 at the European level and the Global Earth Observation System of Systems (GEOSS) at the global level. We also see international cooperation at the individual project level, e.g. regarding the development 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 and offline publications. These results can often be obtained free of charge or at low cost.

8.2 (B) Research

8.2.1 Cooperation on European research

Many of the leading Dutch institutions participate in research projects under the EU's Horizon 2020 and Horizon Europe Research and Innovation programmes and the Copernicus Climate Change Service (C3S). Horizon Europe is organised along three pillars: excellent science, global challenges and European industrial competitiveness, and innovative Europe. 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 and Horizon Europe programmes to which the Netherlands contributes are Development of Climate Services, Climate Modelling, Seasonal/Decadal Prediction, Process Studies and Satellite Services. These projects include Integrated Projects, Network Activities, Infrastructure Programmes and Transnational Access Programmes. C3S combines 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 includes 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, derived climate indices), a near-real-time climate monitoring facility, multi-model seasonal forecasts and climate projections on

global and regional scales. This wealth of climate information is the basis for generating a wide variety of climate indicators aimed at supporting European adaptation and mitigation policies in a number of sectors.

The EU's Integrated non-CO_2 Greenhouse gas Observing System (InGOS)[212], coordinated by ECN and involving 34 partners from 15 countries, was finalised in 2016. This programme integrated Europe's capacity to monitor non-CO_2 greenhouse gases. The infrastructure project worked on standardising the measurements, upgrading the existing observation sites into supersites, building capacity in new Member States and preparing for the integration of the network with other networks already in place or being set up (e.g. the Integrated Carbon Observation System, ICOS[213]).

8.2.2 Cooperation beyond the European domain

The Netherlands' research on climate change is well embedded in, acknowledged by and co-managed within the World Climate Research Programme (WCRP). The Royal Netherlands Meteorological Institute (KNMI) participates in the WCRP through its membership of the World Meteorological Organisation (WMO).

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 is mainly carried out by KNMI and by Utrecht University and research for Working Groups II and III by Wageningen University and Research (WUR) and the Netherlands Environmental Assessment Agency (PBL). Eighteen Dutch scientists contribute as lead authors or co-authors to the sixth IPCC assessment report and special reports in the sixth assessment cycle. The sixth IPCC 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 methodology report. The Netherlands also hosts a number of international programmes that are specifically aimed at technology transfer and international cooperation (see chapter 7). In 2022, KNMI initiated a three-year programme ('KNMI-global'), co-funded by the Ministry of Infrastructure and Water Management, to bridge existing capacity gaps in the field of meteorological and hydrological data, research and services in support of climate change adaptation worldwide.

[212] http://www.ingos-infrastructure.eu/
[213] https://www.icos-cp.eu/

The Netherlands is involved in the Belmont Forum[214], a high-level group of the 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, NWO also joined the Belmont Forum. It is currently participating in the group of program coordinators dealing with climate predictability and inter-regional linkages, while WUR is in the group dealing with food security and land use change. Additionally, NWO is one of the thematic programme offices for the group dealing with transformations to sustainability, with NWO as coordinator of the New Opportunities for Research Funding Agency Cooperation in Europe's European Research Area Network (NORFACE ERA-NET).

The COP23 in Bonn saw the launch of the Global Center on Adaptation (GCA)[215]. The GCA 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). The GCA 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. Together with the African Union, African Development Bank, International Monetary Fund, Africa Adaptation Initiative and the Climate Vulnerable Forum, the GCA is convening the Africa Adaptation Summit (the Netherlands, September 2022) to lay the foundation for an adaptation breakthrough for Africa at COP27.

The Global Facility for Disaster Reduction and Recovery (GFDRR)[216] is a global partnership that helps developing countries gain a better understanding of and reduce their vulnerability to natural hazards and climate change. The 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, the GFDRR provides knowledge, funding and technical assistance. In partnership with France, the World Bank, the WMO and the United Nations Office for Disaster Risk Reduction (UNDRR), the GFDRR has launched the Climate Risk and Early Warning Systems (CREWS)[217] initiative to finance weather stations, radar facilities and early warning systems in poor and vulnerable countries where weather data are unreliable or lacking. The Netherlands is participating in CREWS with climate analysis and

[214] http://www.belmontforum.org/about/
[215] https://gca.org/
[216] https://www.gfdrr.org/en
[217] https://www.crews-initiative.org/en

data for western Africa and Indonesia (in the context of the Joint Cooperation Programme with Indonesia), following the well-established European Climate and Data project (ECA&D)[218]. Similar projects are currently being implemented/planned in seven additional regions in Africa, the Pacific and the Caribbean. These projects are meant to build capacity and to disclose meteorological data for climate research in the afore mentioned regions.

ECA&D works with the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) to provide scientific and technical input concerning atmospheric climate observations. The ECA&D data sets of GCOS ECVs support the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the IPCC.

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 programmes set up by NWO;
- research programmes supported by various ministries;
- knowledge networks and programmes.

Below we describe the programmes in more detail.

Beyond the programmes described below, the Netherlands is an active participant in the Joint Programming Initiative for Food, Agriculture and Climate Change (FACCE-JPI)[219], an 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, FACCE-JPI led to an ERA-NET on climate-smart agriculture in 2013. The 2020 Strategic Research Agenda (SRA) is an update of the 2016 SRA and takes into account FACCE-JPI's past work and achievements and input from the members of FACCE-JPI as represented in the Governing Board. Member States' national priorities that need to be highlighted were specified and integrated into the text, along with the JPI's past and ongoing work with other European and international initiatives. It also takes into account the context of Horizon Europe with its new mission areas and partnerships.

[218] https://www.ecad.eu/
[219] https://www.faccejpi.net/en/faccejpi.htm

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[220]. 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 consultation with the private sector 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 contributes €275 million to the top sectors each year[221], of which more than €100 million 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 through a competition system 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[222].

Research integrated into the national Knowledge for Climate programme 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 NWO, the Knowledge for Climate Foundation, energy research programmes and several larger and smaller institutes that conduct research in the field of sustainability and the Earth.
The NWO-funded Open Programme 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

[220] https://www.nwo.nl/en/about-nwo/strategy/objectives+2011-2014/collaboration+in+themes/water+and+climate
[221] https://www.nwo.nl/en/policies/top+sectors
[222] https://www.nwo.nl/en/researchprogrammes/netherlands-polar-programme

to promote innovative scientific research of a high quality across the entire breadth of earth and life sciences. 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[223].

Furthermore, there are some internationally oriented programmes for which the first calls for proposals were recently launched. Urbanising Deltas of the World[224] aims to contribute to global water safety, water and food security and sustainable economic development in river deltas worldwide. Increasing pressure and climate change in these areas demand more effective and efficient responses. A second international programme, funded by the UK Department for International Development (DFID), is aimed at conflict and cooperation in the management of climate change[225] and has 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 support research for policymaking purposes, including studies inspired by questions from the ministries, in consultation with other organisations where appropriate:

- Up to 2017, infrastructure and environment studies were clustered within a scientific assessment and policy analysis programme on climate change issues. As of 2017, these topics are integrated into the regular work of PBL and the National Institute for Public Health and the Environment (RIVM).
- WUR uses knowledge basis (KB) research to provide the basis for answers to questions that will be relevant to the Ministry of Economic Affairs and other stakeholders in three to five years. The knowledge base programme 'Sustainable development of the blue green space' is a broad programme involving many parties. Thematically, KB research focuses on developing expertise to support medium-term governmental policies in the green-blue domain with regard to aspects of:
  a) mitigation, including increasing societal pressure to achieve a transition to climate-neutral agriculture and food production, production and use of biofuels, efforts to maximise net effects on emissions and knowledge in the area of emissions and absorption of greenhouse gases from land use. These aspects include the analysis of relevant biophysical processes, management and improvement of monitoring techniques;

[223] http://www.nwo.nl/en/funding/our-funding-instruments/nwo/free-competition/alw/open-programme.html
[224] https://www.nwo.nl/onderzoeksprogrammas/urbanising-deltas-world-udw-0
[225] https://www.nwo.nl/sites/nwo/files/documents/CCMCC_Adaptation%20brief_web.pdf

b) the 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 dealing with the risks of new diseases and pests in both agriculture and nature;
c) the 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 BR2, R&D related to the energy transition is to a large extent implemented through the top-sector approach, as mentioned previously. One of the top sectors is the top sector Energy (TSE)[226]: 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 and stimulates a dialogue between the national government and parties in society and promotes connection. TSE platforms allow the private sector, trendsetting companies, knowledge institutes and creative NGOs to work together on central energy-related themes. Each platform, with a non-governmental chairperson, plays a stimulating role in order to get R&D and the market moving and to find new ways to realise sustainable initiatives. Altogether, seven themes were initially defined for R&D to focus on in order to realise a sustainable energy supply. Some were later combined or redirected. The themes were chosen because they offer the Netherlands considerable economic opportunities and are feasible for this country. A platform was set up for each theme: offshore 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 the human capital agenda.

Knowledge networks and programmes

The Delta Programme[227] was initiated in 2010 to address the issue of keeping the Netherlands attractive to both live and work in for future generations. In 2014, the Dutch government approved five decisions on water safety, the availability of fresh water, spatial adaptation, the IJsselmeer (lake used for fresh water storage) and the Rhine-Meuse delta (division of water across the rivers). Questions in the 2015 Knowledge Agenda were included in the knowledge development programmes of the Ministry of Infrastructure and Water management, the Foundation for Applied Water Research (STOWA), KNMI, Deltares and universities. In addition, the articulated knowledge

[226] https://topsectorenergie.nl/en
[227] http://www.rijksoverheid.nl/onderwerpen/deltaprogramma

questions informed the new knowledge and innovation agenda. NWO incorporated the research questions into the Urban Deltas of the World and New Deltas initiatives. In 2017, a task force was established for the Delta Programme. The aim of this task force is to highlight new insights in the field of natural sciences and socio-economic development that may be important for adapting the strategy of the Delta Programme Committee.

The National Climate Adaptation Strategy (NAS) is aimed at making the Netherlands more climate-resilient. The NAS is the result of a participative process involving public-sector authorities at the regional and local levels, water management authorities, knowledge institutes, private-sector companies and civil-society organisations. The programme is complementary to the Delta Programme and considers seven sectors: energy systems, ICT networks, transport and infrastructure, health, agrifood, fishery and nature. The NAS includes the combined inputs of experts in a wide range of disciplines and from workshops with stakeholders. The NAS is now working towards implementation.

The National Water and Climate Knowledge and Innovation Programme (NKWK) is a national programme as part of which government authorities, knowledge institutes and the private sector 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 parties together, which leads to surprising and promising connections. However, the NKWK has no financial resources and the 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.

In 2019, the Ministry of Infrastructure and Water Management and the Delta Programme launched the national knowledge programme on rising sea levels. Rising sea levels are an important issue for the Netherlands and there are indications that the rate of change may be faster than previously expected. As part of the programme, ministries, knowledge institutes, the private sector and civil-society organisations work together to establish new insights in the rate of change with regard to rising sea levels and its consequences for coastal defence, freshwater supplies and spatial adaptation.

8.3 (C) Systematic observations

The Netherlands actively participates in the various fields of climate-related monitoring, both nationally and in European and global programmes. These include atmospheric climate observation systems, such as those measuring atmospheric constituents; ocean climate observation systems; and terrestrial climate observation systems. Below, we summarise the ground-based observations, oceanic 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 the Cabauw Experimental Site for Atmospheric Research (CESAR)[228].

CESAR-Ruisdael
The CESAR-Ruisdael observatory is located in the western part of the Netherlands (51.971° N, 4.927° E) in a polder 0.7 metres 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) the monitoring of long-term tendencies in atmospheric changes; b) studies of atmospheric and land surface processes for climate modelling; c) the validation of space-borne observations; d) the development and implementation of new measurement techniques; and e) the training of young scientists at the postdoc, PhD and Master's level.

Three universities and five major research institutes (KNMI, TU Delft, WUR, TNO, ECN, ESA, UU and RIVM) work together in the CESAR project. It is the focal point of experimental atmospheric research in the Netherlands and is internationally connected through EU-funded research and transnational access programmes.

[228] https://ruisdael-observatory.nl/

CESAR-Ruisdael is one of the selected certified stations for the GCOS Reference Upper-Air Network, GRUAN[229].Through GRUAN, CESAR 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 characterise the properties of the atmospheric column and their changes fully. 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).

Through ICOS[230], CESAR contributes to a European effort to understand and predict the global carbon cycle. The aims of ICOS are to a) provide the long-term observations required to understand the present state; b) predict the future behaviour of the global carbon cycle and greenhouse gas emissions; and c) to monitor and assess the effectiveness of carbon sequestration and/or greenhouse gas emission reduction activities on global atmospheric composition levels, including the attribution of sources and sinks by region and sector.

Through the Aerosol, Clouds and Trace gases Research InfraStructure (ACTRIS)[231], CESAR participates in an integrated project for measuring policy-relevant parameters. ACTRIS is a European project aimed 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 the long-distance transport of pollutants.

BSRN

The Baseline Surface Radiation Network (BSRN) is a project of the Data and Assessment Panel of the Global Energy and Water Exchanges (GEWEX) project under the umbrella of the WCRP. As such, it is aimed at detecting important changes in the Earth's radiation field at the Earth's surface that may be related to climate changes. The data are of primary importance to supporting the validation and confirmation of satellite and computer model estimates of these quantities. The Netherlands contributes to this network with several radiation measurements.

[229] https://www.gruan.org/
[230] https://www.icos-cp.eu/
[231] http://www.actris.eu/

Paramaribo

The Paramaribo observatory[232] was established in 1999, with a grant from NWO, as a joint initiative of KNMI and the Meteorological Service of Surinam (MDS). It is home to 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 make 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 WMO[233].

A special particulate matter measurement programme, run by RIVM[234], is in place to monitor the regional variations in aerosol concentration.

8.3.2 Oceanic observations (Argo)

The Dutch systematic oceanic observation efforts are bundled in the Argo[235] programme. Argo is a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2,000 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 of collection. The Netherlands supports seven floats.

8.3.3 Satellite-based observations

Satellite records are comprehensive enough these days that systematic long-term records can be obtained. Under the auspices of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Netherlands participates in a number of Satellite Application Facilities (SAFs[236]) 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

[232] https://www.knmi.nl/research/satellite-observations/projects/paramaribo-atmospheric-observatory
[233] https://community.wmo.int/regional-basic-synoptic-network-rbsn-and-regional-basic-climatological-network-rbcn
[234] http://www.rivm.nl/bibliotheek/rapporten/680704018.html
[235] https://www.aoml.noaa.gov/phod/argo/
[236] https://www.eumetsat.int/about-us/satellite-application-facilities-safs

Monitoring SAF, The Ocean, Sea and Ice SAF, the Ozone and Atmospheric Chemistry SAF and the Numerical Weather Prediction SAF.

The Netherlands also participates enthusiastically in the European Space Agency (ESA)'s Climate Change Initiative (CCI)[237]. The initiative is ESA's response to the need for climate-quality satellite data. Its aim is to realise 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 databases required by 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 from ESA but from all sources, thanks to 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 CCI will bring together European expertise covering the full range of scientific, technical and developmental specialisations available within the European earth observation community and will establish lasting and transparent access to its results for global climate scientific and operational communities. The Dutch contributions to the CCI are through the themes Aerosol, Cloud and Ozone (all through KNMI), Greenhouse Gases (the Netherlands Institute for Space Research, SRON) and Land Cover (WUR).

Since 1995, KNMI is involved with supplying and reprocessing atmospheric composition data using the satellite instruments GOME/SCHIAMACHY/GOME2/OMI[238].

Furthermore, the Netherlands had the lead in developing a new satellite system, TROPOspheric Monitoring Instrument (TROPOMI)[239], on board of the Copernicus Sentinel-5 Precursor satellite that has been probing the atmospheric composition with unsurpassed resolution and accuracy since October 2017. Due to the global coverage of satellite measurements the derived datasets for weather and climate research benefit the Global South as well as North.

[237] http://www.esa-cci.org/
[238] http://www.temis.nl/
[239] 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 government activities in the Netherlands to promote 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. 'Education' is, in the Netherlands, acknowledged as both 'formal learning' as well as 'non-formal, informal and transformative learning and social innovation'.

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[240] contains a dossier on climate change, which explains the causes and nature of climate change and 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 government information on environmental and climate issues is found on the websites referred to in the footnote above, in Dutch as well as in English. The Netherlands has a national ESD programme especially for formal education, which among other SDG topics also addresses climate change education.

[240] 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
https://iedereendoetwat.nl

Under that national programme, 'DuurzaamDoor'[241], many networks of schools are also connected in the 'Learning for tomorrow'[242] partnership.

General policy of the Dutch government

There is a high-level mandate for education, training and public awareness.
In summary, the general policy to promote education, training and public awareness is aimed at:

- integrating sustainability in the curricula of all levels of education, as far as appropriate under Article 23 of our constitution: 'Freedom of Education' (see Section 9.2);
- fostering the network of initiatives, organisations and educational institutions that work on education for sustainable development (see Section 9.2 as well);
- funding organisations that 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.

Job market and education

Throughout the Netherlands, the energy transition has led to activities to increase sustainability. It is no longer a question of whether the energy transition will create jobs, but of how we can find people to do those jobs in view of the shortage of technically skilled professionals. Senior secondary vocational education institutions (especially those that provide technical and vocational education and training, TVET), universities of applied sciences and research universities in particular are being encouraged to make an active contribution, among other things by developing specific projects and degree programmes about the climate and energy transition.

Furthermore, the government has announced a Green and Digital Jobs Action Plan (Actieplan Groene en Digitale Banen) as part of its Climate and Energy policy programme. The objective of this plan is to help reduce the current labour shortages in technical sectors and ICT. In the coming months, the government will investigate opportunities for additional policymaking and work on the specific implementation of the Green and Digital Jobs Action Plan. The plan will emphasise the successful initiatives of

[241] https://www.duurzaamdoor.nl/education-sustainable-development-netherlands
[242] https://lerenvoormorgen.org/en/

employers and educational institutions to address labour shortages in technical sectors through innovative partnerships.

As regards the curriculum updates for primary and secondary education, sustainability will be incorporated into various learning areas, including man and nature, man and society, and citizenship. In any case, the current curriculum already pays ample attention to sustainability in many subjects, such as geography, physics, biology and Nature, Life and Technology (NLT). Pursuant to the Van Raan motion, which was part of a broader investigation into the state of sustainability in education, schools and educational institutions will be required to pay even greater attention to the topic of sustainability in their teaching wherever possible. The investigation into the state of sustainability in education at senior secondary vocational education institutions and universities of applied sciences has been completed. For primary and secondary education, the investigation is expected to conclude with a report in late 2022. The follow-up will incorporate feedback from public consultations.

Senior secondary vocational education institutions set aside time to discuss the circular economy and sustainability. The latter is covered in the exit qualifications for citizenship education at senior secondary vocational education level. In addition, students can choose electives about the circular economy, sustainability and the climate and energy transition. Some of these are generic, a few are sector-specific. In higher education, the curriculum content is a matter for the individual institutions. A network called Het Groene Brein (The green brain) has been working to put sustainability on the agenda at universities of applied sciences and research universities. Our focus will remain on the continued easing of the transition between education and the job market.

Participation

Climate policy has an impact on all of our daily lives. It is therefore crucial that citizens are involved in the development of transition policies, plans and projects in appropriate and innovative ways. Making the Netherlands more sustainable is already very much a topic of conversation, thanks to the ongoing national public information campaign and the efforts of the regions. In the Netherlands, participation and public consultation are enshrined in the law in various ways, for example in the obligation to make energy transition plans available for public inspection. When it comes to putting participation into practice, many local and regional authorities go beyond these minimum requirements by using public consultation evenings, citizens' assemblies or questionnaires to gauge public opinion as input for their plans and projects. Programmes like DuurzaamDoor support

trajectories like this one as well by providing access to toolkits, methodologies and research, specifically in the context of integral policy considerations (regional transition workshops) and the involvement of local residents, housing associations and local and regional authorities (link: https://www.duurzaamdoor.nl/thema/energie).

In the future, the government would like to explore further whether innovative types of participation (including online participation) can contribute to the energy transition conversation. It has expressed this wish in a government's opinion on civic participation with regard to the energy transition, which aims to put the participation process on a more solid footing. The concept of a national citizens' assembly ('climate citizens' assembly') also has the Netherlands' special attention, all the more so because various countries worldwide have already gained experience with such a forum. The government expects to elaborate proposals for this in the near future, together with Parliament.

9.2 Primary, secondary and higher education

We are in the middle of a transition to a sustainable, environmentally aware society with a circular, nature-inclusive and climate-responsible economy. Major societal transformations such as these are a joint effort that require a joint approach. Because transitions require the involvement of society as a whole, it follows that the education sector and young people need to be involved as well. In this particular transition, they have a key role to play.

This extends beyond mere 'formal education' to integrated ways of working, multi-stakeholder engagement and new forms of governance. International developments in education, such as ESD for 2030 (UNESCO), Strategy for ESD (UNECE) and more recent EU initiatives (Framework for ESD, GreenComp and the climate change education platform), will have an impact on national networks and programmes regarding sustainability and learning.

There is a growing sense of urgency around the importance of sustainability – specifically in education – and young people are making their voices heard by taking to the streets (nationally as well as internationally) to call for climate action. The Netherlands is committed to the Paris Agreement and to achieving the Sustainable Development Goals (SDGs) by 2030. One of those goals, SDG 4.7, is about 'education for sustainable development and global citizenship education'. The Netherlands has a responsibility to facilitate this at the national level as well.

The essence of this is reflected in the national ESD programme DuurzaamDoor mentioned earlier – more specifically in the ensuing Leren voor Morgen network. In addition, there are several ad hoc projects and initiatives, mainly at the instigation of NGOs. A more long-term incorporation of this goal into Dutch curricula will need to take into account the freedom of education, which means that individual schools and teachers bear the brunt of the responsibility. As a consequence, the Dutch strategy is mainly based on the organisation of networks (including education networks) on the subject of sustainability, the development of education projects, teacher training and the sharing of best practices. The idea is to inspire, rather than compel. At the same time, we find ourselves at a crossroads when it comes to heeding the call of pupils, young people and teachers to facilitate sustainability in education. A Whole School Approach[243] is a suitable forum for this, and the Netherlands is seeking to implement one. Both education professionals and the government have a responsibility to facilitate and support this initiative. An interdepartmental task force is looking at ways to facilitate this further.

9.2.1 Review of primary and secondary education curricula

In the past years, teachers and school leaders have worked with other experts in nine development teams to elaborate proposals for a review of the curricula for primary education and the first stage of secondary education. These proposals were announced in 2019. They include a plea for greater attention to the themes of sustainability and climate in education. The Dutch national curriculum is defined in terms of learning objectives and learning content at various levels. They are based on the Common European Framework of Reference for the teaching of foreign languages (international level); learning standards and exit qualifications (national level) for the various types of education; and school subjects (school level). The learning standards and exit qualifications are statutory guidelines that determine the learning objectives and content of each subject, subject cluster or learning area. Within this framework, the learning standards indicate what pupils should know and be able to do at the end of primary education and the first stage of secondary education. The exit qualifications apply to the second stage of secondary education.

In 2021, an academic curriculum committee advised the Minister of Education, Culture and Science to use the proposals from the education sector as building blocks in order to update the learning standards (primary education and first stage of secondary education) and exit qualifications (second stage of secondary education). The committee annotated the proposals with critical commentary.

[243] https://wholeschoolapproach.lerenvoormorgen.org/en/

In late 2021, the Minister instructed the Netherlands Institute for Curriculum Development (SLO), the national centre of expertise for curriculum development, to work with the education sector to convert the advice of the curriculum committee into new, specific learning standards. In the coming period, the SLO will elaborate these for the primary education subjects of Dutch, calculus/mathematics, citizenship and digital literacy. For secondary education, it will elaborate new learning standards for the natural sciences and citizenship subjects. It will also conduct a review of the first stage of pre-vocational secondary education with a view to easing the transition towards the exit qualification structures of senior secondary vocational education. For the citizenship subject in particular, the learning standards will be adjusted and expanded to include the necessary knowledge and basic skills in the areas of climate, ecology and sustainability. In early 2023, a review will take place to determine whether the process is still on track. This may be followed by an instruction to update the learning standards for other learning areas as well. Naturally, teachers, school leaders, pupils and key education sector stakeholders will be closely involved.

Moreover, senior secondary vocational education institutions (TVET) are facing heavy pressure from the business sector to train more pupils for sustainability-related professions, particularly in the technical and energy sectors, but also to enable the transition to sustainable construction, sustainable agriculture and sustainable transportation. In adopting the exit qualification structure for vocational education, the SLO will look at ways to meet the need for sustainability qualifications.

9.2.2 Sustainable Schools task force and National Whole School Approach Conference 2022

In 2021, the Ministries of Agriculture, Nature and Food Quality (LNV), Economic Affairs and Climate Policy (EZK), the Interior and Kingdom Relations (BZK) and Infrastructure and Water Management (IenW) took the initiative to set up an interdepartmental Sustainable Schools task force. The focus of the task force is on cooperation in areas where the themes of young people, sustainability and education intersect, which makes it a unique partnership. The Ministry of Education, Culture & Science (OCW) joined the task force in the summer of 2021. From that moment on, its members have been jointly investigating ways to embed sustainability in education for the longer term. The needs of pupils, young people and education professionals are key in this regard, which is why the education sector is also involved in the task force. The task force is a framework which aims to work in an integrated fashion and through interdisciplinary cooperation between

all actors in and outside of schools to facilitate the desired support for pupils and teachers in order to achieve sustainability in education in the broadest sense.

As a working method, the task force has adopted the Whole School Approach (WSA). The WSA offers schools and educational institutions a framework to give systemic shape to addressing sustainability challenges in the context of education, combining the school's vision on education, business operations, curriculum (the content of its education), expertise and environs. WSA is a tool that is used globally to embed the Sustainable Development Goals in education.

Source: https://wholeschoolapproach.lerenvoormorgen.nl

The international WSA conference in March 2022, held in partnership with UNECE's ESD network[244], was immediately followed by a national conference attended by representatives of OCW, LNV and IenW, education professionals and young people. At the Dutch national conference, delegates shared lessons learned at the international conference and the ministries and education professionals held presentations to map out the current situation in the Netherlands. The conference also saw the presentation of studies into administrative support for sustainable schools[245] (conducted by the Dutch Environmental Education Foundation, SME) and into support in the education sector for sustainability in education (conducted by Oberon). The Sustainable Schools task force will use the outcomes of these national and international studies as building blocks for future steps.

The conference delegates expressed the need for coherence and cooperation and discussed which steps they should take now in order to meet the 2030 targets. They also talked about the importance of an unambiguous

[245] Draagvlak Duurzame School (Support for sustainable schools)
[245] Draagvlak Duurzame School (Support for sustainable schools)

overarching strategy and a support structure tailored to the individual stakeholders (in the education sector, per region). This is incumbent on cooperation between the various ministries. There is a need for an overarching approach by the central government, local and regional authorities, sector councils, educational umbrella organisations, etc. The conference concluded with a joint statement expressing the desire to work with each other on sustainability in education. In that regard, the conference marked the starting point of closer cooperation in order to make sustainability in education a reality.[246]

9.2.3 Sustainability Day

For some years now, the Netherlands has celebrated Sustainability Day on 10 October. This always involves an education programme organised jointly by the networks promoting sustainability in education. A recurring event is the reading marathon in primary education[247], based on an annually changing theme that is discussed in more than 1,000 schools on the day. To this end, a special educational booklet is published each year. Two years ago, the theme of the project was 'new energy'.[248] Other educational institutions mark Sustainability Day with guest lectures or other events.

9.2.4 Groene Peper (Green pepper)

This is a four-day festival for students and teaching staff, first organised in 2020, that evolved from the already existing National Day for Sustainability in Higher Education. The National Day was an initiative of SURF, the Netherlands Enterprise Agency and Sustainable Higher Education (DHO), a student movement that has been arguing since the 1990s (!) for a 'green' curriculum and business operations. Students for Tomorrow joined the programme committee in 2015. Since 2020, the National Day has been a multi-day event under the name of Groene Peper.[249] A recurring highlight of the festival is the award of the SustainaBul, a prize for the most sustainable higher education institution as determined by the annual sustainability ranking compiled by Students for Tomorrow since 2012. Prizes are also awarded for the best 'green' graduation projects. The festival is hosted by a different university of applied sciences or research university each year. The central government provides financial support to the festival through the Netherlands Enterprise Agency. At the event, another award is presented for the most

[246] https://sme.nl/images/documenten/WSA-verslag-NL-def_lo.pdf
[247] https://duurzamepabo.nl/
[248] https://duurzamepabo.nl/de-kracht-van-nieuwe-energie/
[249] https://groenepeper.com

sustainable member of teaching staff in primary, secondary or senior secondary vocational education.

9.3 Public information campaigns

Iedereen Doet Wat (Everyone chips in)

This campaign is an initiative of the Ministry of Economic Affairs and Climate Policy (EZK) in partnership with the Ministries of the Interior and Kingdom Relations (BZK), Infrastructure and Water Management (IenW) and Agriculture, Nature and Food Quality (LNV). The objective of the campaign is to help citizens make their environs more sustainable.

In 2019, the central government launched a multi-year climate campaign to provide information about and guidelines for sustainability measures that citizens could take themselves. The websites Iedereendoetwat.nl[250] and verbeterjehuis.nl[251] contain information about the steps that consumers can take to live more sustainable lives. As the current campaign no longer meets the central government's communication objectives, a new campaign will be developed in 2022. It is expected that this will be ready for launch in the first quarter of 2023.

Zet Ook de Knop Om (Turn it down)

In 2022, the government will strongly urge businesses and households to conserve as much energy as possible, even in the summer. Like the rest of Europe, the Netherlands will be increasing the pace of its efforts to reduce its energy consumption and switch to more sustainable energy sources. For example, it will speed up the insulation of homes, the supply of more green gas and hydrogen and the construction of wind turbines in the North Sea. One of the measures that the central government is taking is the *Zet Ook de Knop Om* campaign. With this campaign, the government wants to prompt local and regional authorities, businesses and households to consume less energy. The aim is to make consumers more aware of their energy consumption, give them insights into the advantages of energy conservation, show how to conserve energy and list the energy-conserving measures that they can take. The centrepiece of the campaign is a series of tips that let consumers conserve a considerable amount of energy straight away and are

[250] https://iedereendoetwat.nl
[251] https://verbeterjehuis.nl

easy to stick to in the long term. The average household should be able to reduce its gas consumption by around 36%.

The success of the campaign will be measured by monitoring household behaviour before and after the campaign. The campaign is supported by a number of organisations[252] that are working actively to reduce gas consumption in homes and offices.

9.4 Events

National Climate Week

Many people are already on the right track and are conserving energy, but much more needs to be done in order to meet the agreed-upon CO_2 targets. To inspire even more citizens and organisations to become active for a better climate, we will be organising the National Climate Week[253] from 31 October until 6 November 2022. This will be the second edition, following the inaugural Climate Week in 2021. This campaign is an initiative of the Ministry of Economic Affairs and Climate Policy. The aim of the National Climate Week is to show, together, what we can achieve as a country and how we can make the Netherlands greener. Businesses, organisations and institutions can sign up as a climate supporter. Climate supporters have the task of demonstrating that climate-conscious enterprise is possible. As promoters of a climate-neutral Netherlands, they will take centre stage. Dutch citizens can also sign up as their municipality's climate mayor. These are individuals who inspire their local area, club, association or colleagues. They actively promote a sustainable Netherlands and set the right example for those around them.

The first edition of the National Climate Week[254] took place last year. During this first edition, we charted the course that we will continue to follow this year. The 2021 edition saw the registration of 142 climate mayors: citizens who have made strides in the area of sustainability and are able and willing to serve as an example to others. In addition, there were 68 climate supporters: businesses and organisations that want to share the narrative of their sustainability efforts. Finally, there were lots of events – both locally and nationally, internally and externally – to get people involved in the movement. As far as the organisers were concerned, this inaugural edition (although still somewhat marred

[252] *Zet ook de knop om* – supporting organisations
[253] www.nkw2022.nl
[254] https://www.iedereendoetwat.nl/nkw/afsluiting-nationale-klimaatweek-2021

by coronavirus measures) was a success and laid down a marker for subsequent editions. A great start to the sustainability drive!

9.5 Training programmes

Young Climate Ambassadors of the Future[255]

In 2020, we launched the Young Climate Ambassadors of the Future programme. As part of this programme, eight young people from various groups and with diverse backgrounds attend a one-year training course designed to inspire and provide them with a toolkit to become climate ambassadors. Content-specific monthly sessions alternate with work on personal projects. This way, the young people are encouraged to develop their own ideas and to inform and motivate the people around them to think along and take action. During the content-specific sessions, which deal with such topics as communication, youth participation and climate diplomacy, they receive assistance from experiential and subject matter experts. Upon conclusion of the programme, there will be eight new climate storytellers and ambassadors, who will each use their newly acquired skills and their own network to advocate for climate action and support the existing youth network.

A key feature of the Young Climate Ambassadors of the Future programme is that the eight participants should be able to stand on their own two feet after the year has gone by. It is possible to organise a return session with a group of young people who completed the first edition successfully. This will safeguard continued engagement and enable the exchange of experiences and knowledge with the new group.

Objectives:

1. To inform, inspire and prompt young people outside of the climate bubble to take action.
2. To enable these young people to inform, inspire and prompt people within their own bubble to take action to contribute to the climate transition.

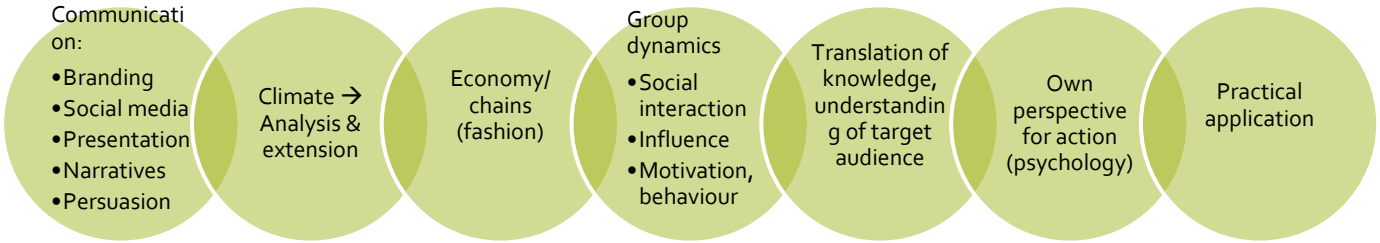
Outcome: motivated young people who are able to make a personal contribution to addressing climate change in their own way and through their autonomously developed project.

[255] Klimaatambassadeurs van de toekomst | Iedereen doet wat

Working method:
A training course consisting of around 10 sessions, during which the young people become acquainted with the most important tools they need to work as a climate ambassador. The young people are encouraged to use these tools in practice and in their own projects straight away. An additional objective is that they learn from each other by doing. Some of the sessions could be organised by the young people themselves, using the network to be created for the programme. The prospective climate ambassadors will also play a role in various existing climate activities organised by the government, such as the National Climate Week.

Annual plan:
The programme consists of various sessions, supervised by an alternating roster of the Climate Envoy and various policy officers, external speakers, experts and mentors. It is important to find the right balance between providing information and offering scope for the specific elaboration and implementation of the participants' personal projects. The programme below is a first draft and subject to change. Much will depend on the role of the Climate Envoy, the programme manager/moderator and the participants themselves.

Climate ambassador learning objectives:



- Each of the climate ambassadors must find, elaborate and present a personal project.

The climate ambassadors must have expanded their networks and (optionally) joined one of the existing youth movements.

9.6 Access to information: resource and information centres

Communication with consumers and citizens is key to achieving the necessary transition to a climate-neutral society across a broad front. Milieu Centraal (the Central

Environment Foundation)[256] plays a vital role in this communication. This is an independent knowledge centre for information about the climate and the environment. The centre is funded by IenW, BZK and EZK.

Conflicting information about potential solutions, technologies, costs, savings, comfort and other issues leads to confusion among consumers. This is an obstacle to the energy transition. Milieu Centraal was founded to counteract misinformation on the sustainability drive and more sustainable behaviour. As the knowledge centre for a sustainable lifestyle, it offers the ultimate practical guide with tips and advice for each step along the way: from energy conservation tips to the purchase of solar panels. It also serves as a repository of independent information to provide background to the debate in society on the seriousness of climate change, potential solutions and the use of renewable energy sources. Consumers are well aware of the existence of Milieu Centraal when it comes to finding information about energy and sustainability. The information provided by Milieu Centraal is reliable, matter-of-fact, factual and practical. All of its tips and advice are based on academic research. Its own researchers maintain an extensive knowledge database around the clock. Consultation rounds among businesses, sectors, civil-society organisations and knowledge institutions lead to diversity and support. An academic advisory council is at the heart of the foundation's quality assurance process. Its members are all affiliated with a research institute or university. Finally, the information provided by Milieu Centraal is based on validated knowledge about consumer behaviour: what motivates or prevents them from taking steps towards sustainability?

9.7 Climate Agreement Progress Committee/Climate Agreement platform

The Climate Act (Klimaatwet) provided the legal framework that defines the current governance. In 2019, the further detailing and implementation of the agreements to achieve the target of the governance of the Climate Agreement, was entrusted to the participating parties, including central government, as much as possible. This means that the parties themselves bear primary responsibility for effective implementation of the agreements reached and are jointly responsible for implementing their part of the Climate Agreement. Sector-specific implementation committees are set up under the supervision of the relevant ministers, either built on existing structures or integrated in the new coalitions that rose during the Climate Agreement discussions.

[256] Milieu Centraal – Practical guide to sustainability | Milieu Centraal

Based on the coordinating role, the Minister of Economic Affairs and Climate Policy set up an overarching progress committee. This fulfils the commitment set out in the Coalition Agreement to ensure that the Climate Agreement creates a platform to maintain a constant dialogue and to respond to new technological developments. In its response to the Climate and Energy Outlook of 1 November 2019, the government is giving substance to the governance of the Climate Agreement.

In addition to the Sector-specific implementation committees, there is a Voortgangsoverleg van het Klimaatakkoord (VGO, Progress meeting of the Climate Agreement), and it has the following two tasks:

1. coherence (connection, coordination, harmonisation and knowledge sharing) around the most important implementation processes that affect several sectors.
2. functioning as a platform to permanently connect the community of the Climate Agreement and to organise a platform for dialogue.

Under the responsibility of the chair of the VGO, the VGO-secretariat is facilitated and supported by employees of the SER-secretariat.

In the new Coalition Agreement in 2022, the cabinet decided to strengthen the governance around climate policy and establish it for the long term. There is now a Minister for Climate and Energy in charge of the goals in the Climate Act. The Minister has the coordinating role and the sector-ministers are responsible for achieving the goals set for their sector. The central government is now also fulfilling its role in ensuring that the goals set in the Climate Agreement are carried out. Due to these changes, the chair of the VGO advised the Minister of Climate and Energy to replace the VGO with a platform for social dialogue and reflection and have the Overlegorgaan voor de Fysieke Leefomgeving (OFL, Consultative Body for the Physical Living and Environment) support the new chairmen and platform.

The mandate of the new chairman is that he/she can organise discussions with different social parties about climate policy. There will be no reoccurring meetings with reoccurring parties, which is currently the case with the VGO. The chairmen, in consultation with the Minister for Climate and Energy, can choose whom to speak to and when in order to gain insight from society and speed up processes. This way, the chairman can speak to many different parties, such as the chairmen of the sector-specific implementation committees, NGO’s and citizens (including young people). The chairman may, on the basis of the reflections from society, give (un)solicited advice to the Minister for Climate and Energy.

The mandate of the chairman is broadly formulated so that they have sufficient space to organise climate consultations flexibly and effectively. They can build on experiences and products of the current VGO such as the webinars and the annual climate day[257].

9.8 International cooperation and implementation of education and training

The previous sections also describe activities and efforts taken to implement the amended Doha work programme, integrated in the Dutch communication approach on climate change.

A new work programme on Article 6 of the UNFCCC was agreed in Glasgow in November 2021, for which a new action plan will need to be agreed in Sharm el Sheikh in November 2022.

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[258] 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 were available in 2017.
There is also information on scholarships, 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, for example:
    - Evaluating and managing sustainable development impact at Wageningen UR;

[257] https://www.klimaatakkoord.nl
[258] https://www.studyinholland.nl/

    - Strategic Environmental Assessment and Environmental Impact Assessment at University of Twente;
- the Netherlands Fellowship Programmes (NFP), which on 1 July 2017 entered a new phase as a novel five-year programme under the name Kennisontwikkelings-programma (Knowledge 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, and manages 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.

Its website[259] presents an overview of programmes and students in international studies. Nuffic also manages Netherlands Education Support Offices (NESOs) in a number of countries such as Brazil, China, India, Indonesia, Mexico, Russia, South Africa, South Korea, Thailand, Turkey and Vietnam.

To support Education for Sustainable Development in a broader way than Climate alone, the Netherlands is also active in other forums for international cooperation on ESD.

- UNESCO 'ESD for 2030' as follow up of the Global Action Plan on ESD was confirmed on the Berlin 2021 conference on ESD. Under this international plan, there is also attention for ESD in policy, in teacher training, in curricula, but Member states are also stimulated in further educational arenas to put effort into educational activities
- UNECE "Strategy for ESD" as an ongoing international cooperation on ESD in the pan-European Region since 2004. The Ministries of Environment, Education and

[259] https://www.nuffic.nl/

the National Focal Point in the Ministry of Agriculture, Nature and Food security are active in this arena.

- In 2021, the European Union launched, under the umbrella of The Green Deal, educational activities as a Framework for ESD, a document about competences Green Comp, and a network under the theme of climate change education.
-

Coordinating input from these international forums runs through the National Focal Point (min LNV) through the National ESD programme DuurzaamDoor, through the network 'Leren voor Morgen' and/or through individual NGOs, schools or networks. The Netherlands also contributes to international capacity building and sharing of good practices. An example is:

Whole School Approach conference 2022

In March 2022, OCW International, LNV and IenW commissioned the United Nations Economic Commission for Europe (UNECE) to organise a Whole School Approach conference in Lunteren.

Figure 2: Healthy policies for enabling a Whole School Approach, adapted from Wals & Mathie (2022)

This hybrid conference was attended by various UNECE member countries, which presented best practices regarding the WSA focused on meeting each other, exchanging stories and gaining inspiration. The presentations alternated with workshops and field trips to schools that have embedded sustainability into their education and discussions of 'the way forward'. The conference also saw the presentation of the study conducted by Prof. Arjen Wals and Rosalie Mathie, 'Whole School Approaches to Sustainaibility: Exemplary Practices from around the world[260]'. They gathered and analysed examples of WSA practices from Japan, the Netherlands, South Africa, the USA, Cyprus, India, Norway, Hong Kong, China and Finland. In Figure 2, Wals and Mathie present a policy environment in the shape of a wider circle in which the WSA is embedded, highlighting some of the key points that the examples reveal. The study shows the different methodology and power of the WSA.

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 for 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 60 youth organisations, on whose behalf it advocates for more ambitious climate action. Some of their landmark campaigns include klimaatkandidaat (climate candidate), the Dutch Youth Climate Summit and the Dutch Youth Climate Agenda[261]
  During the Climate Festival in 2019, Sigrid Kaag, Minister of Foreign Affairs, launched our *We Are Tomorrow Global Partnership*[262]. This team was launched to join the national climate debate, as well as highlight the importance of facilitating international discussions with youth organisations and building opportunities to strengthen one another. The *Global Partnership* aims to help youth organisations, especially in the Global South, to shape their own sustainable visions for 2050. As

[260] Whole School Approaches to Sustainaibility: Exemplary Practices from around the world
[261] https://jongeklimaatbeweging.nl/
[262] https://wearetmrw.nl

an example, we use the Young Climate Agenda 3.0, which was created in 2022 with the help of 70 youth organisations from the Netherlands. In addition to shaping a sustainable vision for the future, *Global Partnership* encourages youth organisations from partner countries to influence local decisionmakers towards the COP26 in Glasgow. In this way, youth organisations can contribute to increasing climate action in their own countries. The current partner countries include the following: Uganda, Bangladesh, Chile, Egypt, Mexico, Nigeria, South Africa, India, Qatar and the Netherlands.

- NJR[263] (Dutch National Youth Council), an umbrella organisation of youth organisations. It supports a team of eight youth representatives, of which two are youth representatives on sustainable development to the UNFCCC who work together with a "young and sustainable" working group. Together with the working group, these youth representatives give guest lectures on sustainability around the country and organise events to spread awareness. The youth representatives also advocate for more ambitious climate action through continuous contact with various ministries. NJR has a facilitating role in making sure the youth representatives can do their work of both reaching youth and policy makers alike.

- Youth for Climate NL[264] is a Dutch foundation, set up in 2021, with the primary focus of calling the attention of Dutch politicians and young people to climate change. We try to move towards a cleaner and more sustainable world for future generations by engaging politicians and the business sector in conversation. This effort involves thousands of young people aged between 12 and 20 who are keen to make their voices heard when it comes to the climate. This is how we represent the generation that will be making the difference. We have drawn up a *policy plan* that clearly illustrates our points of view.

- Umbrella Organisation for Climate and Energy (*Klimaat en Energie Koepel*, KEK)[265]. KEK's mission is to connect young professionals and enable them to help achieve a liveable world for future generations. In early March 2019, a large group of KEK ambassadors gathered for a brainstorming session on the key principles for young professionals who want to speed up the climate and energy transition in order to keep the world liveable for future generations.

[263] NJR (The Dutch National Youth Council) - NJR
[264] https://youthforclimate.nl
[265] https://klimaatenergiekoepel.nl

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[266]. 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 discussions about the ACE Glasgow work programme, the ACE action plan and the yearly ACE dialogues. At UNFCCC conferences, the youth representatives also play an important role in building the capacity 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.

The youth delegates also contribute to enhanced youth participation and inclusion of youth through other activities while on the ground at COP. For example, during COP26, the Dutch youth delegates were involved in the organisation of four official side events. In cooperation with other youth present at COP, they also organised a youth gathering for young people to become included in certain youth movements. While at COP, the youth representatives also had an online meeting with interested youth in the Netherlands, connecting them and the negotiation team with the aim of raising awareness of the work done on the ground.

Youth delegates at times are also able to play a facilitating role for other youth. In this, they aim to include more youth at the table during COP. This resulted in the inclusion of an extra youth delegate, representing the Dutch Caribbean, who was able to participate in a side event during the SB56 negotiations in Bonn.

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 ACE National Focal Point has been under the Ministry of Economic Affairs and Climate Policy since 2019.

[266] https://www.njr.nl/en/cases/jongerenvertegenwoordigers-en

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 workshop of the UNFCCC secretariat organised in May 2019. 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.

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Klimaatambassadeurs van de toekomst | Iedereen doet wat

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Whole School Approaches to Sustainaibility: Exemplary Practices from around the world

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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
GW	Giga Watt
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 kilometre
mld	1,000 million
mln	million
Mt	Mega ton (= 1,000,000 metric ton = 1 Tg)
MW	Mega Watt
Nm^3	Normal cubic metre (volume of gas at 105 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= Mt-eq)
$	US Dollar
USD	US Dollar
€	Euro
EUR	Euro

Abbreviatons

A	
AACJ	African Activists for Climate Justice
AAU	Assigned Amount Unit
ABPP	African Biogas Partnership Program
ACE	Action for Climate Empowerment
ACTRIS	Aerosol, Clouds and Trace gases Research InfraStructure
ADB	Asian Development Bank
ADVZ	Zambezi Valley Agency
AEA	Annual Emission Allocation
AEF	Access to Energy Fund
AER	Annual Environmental Reports
ANWB	Algemene Nederlandse Wielrijders Bond
AOPC	Atmospheric Observation Panel for Climate
ASAP	Adaptation for Smallholder Agricultural Programme
ATA	Agricultural Transformation Agency
AR2	2nd IPCC Assessment Report
AR4	4th IPCC Assessment Report
ARK	National Programme for Spatial Adaptation to Climate Change
B	
BEMS	Emission Requirements Combustion Installation Decree
BLOW	Intergovernmental Wind Energy Agreement
BOVAG	Bond Van Automobielhandelaren en Garagehouders
BPM	Belasting personenauto's en motorrijwielen (Taks on Passenger Cars and Motor vehicles)
BR	Biennial Report

BSRN	Baseline Surface Radiation Network
BZK	Ministry of Interior and Kingdom Relations
C	
CASCAPE	Capacity-Building for Scaling-up evidence-based best Practices in Ehiopia
CAF	Corporación Andina de Fomento (Development Bank of Latin America)
CAFI	Central African Forest Initiative
CBS	Netherlands Statistics (Centraal Bureau voor de Statistiek)
CCI	Climate Change Initiative
CCPM	Common and Coordinated Policies and Measures (of EU)
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CEM	Clean Energy Ministerial
CER	Certified Emission Reductions Unit
CERF	Climate Energy Response Facility
CESAR	Cabauw Experimental Site for Atmospheric Research
CGIAR	Consultative Group on International Agricultural Research
CHP	Combined Heat and Power
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
CNK	Climate Buffer Coalition
COP	Conference of Parties
CP	Conference of Parties
CPI	Consumer Price Index
CREWS	Climate Risk and Early Warning Systems
CRF	Common Reporting Format
CTF	Common Tabular Format
C3S	Copernicus Climate Change Service
D	
DAC	Development Assistance Committee
DEI	Demonstratie Regeling Energie Innovatie

DES	Data Exchange Standards
DFCD	Dutch Fund for Climate and Development
DFID	UK Department for International Development
DHO	Sustainable Higher Education
DP	Delta Programme
DRR	Disaster Risk Reduction

E

E-AER	Electronic annual environmental reports
EC	European Commission/European Community
ECA&D	European Climate and Data project
ECN	Netherlands Energy Research Centre (Energie Centrum Nederland)
ECV	Essential Climate Variable
EED	Energy Efficiency Directive
EHG	Energy efficiency and renewable energy horticulture
EIA	Energie Investerings Aftrek (Energy Investment Allowance)
EML	Erkende Maatregelen Lijst (Recognised Lists of Measures)
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
ETF	Energy Transition Facility
ETFF	Energy Transition Financing Facility
ETS	Emission Trading Scheme
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EZK	Ministry of Economic Affairs and Climate Policy (Ministerie van Economische Zaken en Klimaat)

F

FACCE-JPI	Joint Programming Initiative for Food, Agriculture and Climate Change
FAO	Food and Agriculture Organisation of the United Nations
FEH	Fund for improving the energy efficiency of rental housing
FDW	Fonds Duurzaam Water (Sustainable Water Fund)
F-gases	Fluorinated greenhouse gases (HFCs, PFCs, SF6)
FIBANI	Professional Education in the Niger Basin
FIPAG	Fundo de Investimento e Património do Abastecimento de Água
FLEGT	Forest Law Enforcement, Governance and Trade
FMO	Dutch development bank

G

GAFSP	Global Agriculture and Food Security Program
GAGGA	Global Alliance for Green and Gender Action
GCA	Global Center on Adaptation
GCF	Green Climate Fund
GCIC	Ghana Climate Innovation Centre
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEOSS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Exchanges
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Green House Gas
GIRE	Integrated Water Resource Management Programme in the Niger Basin
GRUAN	GCOS Reference Upper-Air Network
GUAN	GCOS Upper Air Network
GWP	Global Warming Potential

H

HER	Hernieuwbare Energie Regeling
HNR	Het Nieuwe Rijden (Ecodriving)
HNT	Het Nieuwe Telen (The Next Generation Cultivation)

I

IATI	International Aid Transparency Initiative
IAE	International Energy Agency

ICAO	International Civil Aviation Organisation
ICOS	Integrated Carbon Observation System
IDB	Inter-American Development Bank
IDH	Initiative for Sustainable Landscapes of the Sustainable Trade Initiative
IED	EU Industrial Emissions Directive
IenW	Ministry of Infrastructure and Water Management
IFC	International Finance Corporation
IGG	Inclusive Green Growth Department, Ministry of Foreign Affairs of the Netherlands
IKIA	Integrated Knowledge & Innovation Agenda
IMO	International Maritime Organisation
InGOS	Integrated non-CO_2 Greenhouse gas Observing System
IPCC	Intergovernmental Panel on Climate Change
IPO	Association of Provinces of the Netherlands
ISDE	Investment Subsidy Renewable Energy
ISSD	Integrated Seed Sector Development
ITL	Independent Transition Log
IVDM	Institute for Sustainable Mobility
I&W	

J

JCP	Joint Cooperation Partnership
JI	Joint Implementation
JPI	Joint Programming Initiative

K

KB	Knowledge Basis
KEK	Umbrella Organisation for Climate and Energy (Klimaat en Energie Koepel)
KEV	Climate and Energy Outlook (Klimaat en Energie Verkenning)
KNAW	Royal Netherlands Academy of Arts and Sciences
KOP	Knowledge development programme (Kennisontwikkelings-programma)
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	
MDS	Meteorological Service of Surinam
MEI	Market Introduction Energy Innovations
MEL	Theory of Change and Monitoring, Evaluation and Learning
MEP	Environmentally Friendly Electricity Production Programme
MEWAT	Taskforce on Waste
MIA	Milieu Investeringsaftrek
MIEK	Multi-Year Energy and Climate Infrastructure Programme
MIT	Medium Sized Enterprise in Topsectors
MMR	Monitoring Mechanism Regulation
MS	Member State (s)
N	
NAS	National Climate Adaptation Strategy
NDC	National Determined Communications
NEa	Nederlands Emissie Autoriteit
NECP	National Energy and Climate Plan
NEF	National Energy Savings Revolving Fund
NESO	Netherlands Education Support Offices
NEV	Nationale Energie Verkenning (National Energy Outlook)
NFP	Netherlands Fellowship Programmes
NGO	Non-Governmental Organisation
NIA	Netherlands Investment Agency
NIE	National Inventory Entity (Single National Entity under Kyoto Protocol)
NIR	National Inventory Report
NJR	Dutch National Youth Council
NKWK	National Water and Climate Knowledge and Innovation Programme

NORFACE ERA-NET	New Opportunities for Research Funding Agency Cooperation in Europe's European Research Area Network
NOVI	National Strategy on Spatial Planning and the Environment
NPCE	National Program for the Circular Economy
NPDA	National Partnership for Sustainable Earth Research
NVWA	Netherlands Food and Consumer Product Safety Authority
NWO	Dutch Research Council

O

OCW	Ministry of Education, Culture & Science
ODA	Official Development Assistance
ODE	Sustainable energy surcharge
OECD	Organisation for Economic Co-operation and Development
OFL	Overlegorgaan voor de Fysieke Leefomgeving (Consultative Body for the Physical Living Environment)
OOF	Other Official Flows

P

PACE	Platform for Accelerating the Circular Economy
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
PIDI	Sustainable Industry Infrastructure Programme
PMR	Partnership for Market Readiness
POV	Power of Voices
PPP	Public-private partnerships
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

SAF	Satellite Application Facility
SAFAL	Sustainable Agriculture, Food Security and Linkages in Bangladesh
SCER	Steering Committee ER
SCE	Cooperative Energy Production Subsidy Scheme
SCF	Strategic Climate Fund
SDE+	Stimulation of Sustainable Energy Production (Stimulering Duurzame Energieproductie)
SDE++	Stimulation of Sustainable Energy Production and Climate Transition
SDG	Sustainable Development Goals
SEEH	Subsidy for Energy Savings at Home
SER	Sociaal economische Raad (Social Economic Counsel)
SGEI	Services of General Economic Interest
SIDS	Small Island Developing States
SLO	Netherlands Institute for Curriculum Development
SLR	Sea level rise
SME	Small and Medium-sized Enterprises *OR* Dutch Environmental Education Foundation
SRA	Strategic Research Agenda
SREP	Scaling up Renewable Energy Program
SSMISP	Small-Scale and Micro Irrigation Support Project
STEP	Subsidy scheme for improving energy efficiency in social housing
STOWA	Foundation for Applied Water Research
SWF	Sustainable Water Fund

T	
TCP	Technology Collaboration Programmes
TERT	Technical Expert Review Team
TFA	Tropical Forest Alliance
TNO	Netherlands Organisation for Applied Scientific Research
TSE	Top Sector Energy
TVET	Technical and Vocational Education and Training
U	
UDW	Urbanising Deltas of the World
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
V	
VAMIL	Arbitrary Depreciation of Environmental Investments
VAT	Value Added Taxation
VCA	Amplifying Voices for Just Climate Action
VEKI	Accelerated Climate-related Investments in Industry
VGO	Progress meeting (Voortgangsoverleg)
VHR	Birds and Habitats Directives
VNG	Association of Netherlands Municipalities
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
WASAC	Water and Sanitation Corporation Rwanda
WASH	Water, Sanitation and Hygiene

WBG	World Bank Group
WBSO	Wet Bevordering Speur en Ontwikkelingswerk
WCRP	World Climate Research Programme
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)
WLO	Welvaart en Leefomgeving (Prosperity and Environment)
WMO	World Meteorological Organisation
WRI	World Resources Institute
WSA	Whole School Approach
WUR	Wageningen University and Research
W2E	Waste to Energy
Z	
ZOA	International relief and recovery organisation based in the Netherlands

ANNEX I SUMMARY TABLES ON EMISSION TRENDS

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	CO_2 equivalent (kt)							
CO_2 emissions without net CO_2 from LULUCF	161806,92	161806,92	172300,14	171082,23	176917,31	181526,73	164142,51	137849,52
CO_2 emissions with net CO_2 from LULUCF	167465,28	167465,28	177811,75	176158,01	181903,83	186349,85	168562,61	141288,88
CH_4 emissions without CH_4 from LULUCF	31834,84	31834,84	29631,27	24196,81	19774,72	19359,14	18144,89	16967,60
CH_4 emissions with CH_4 from LULUCF	31835,19	31835,19	29631,66	24197,24	19775,18	19359,60	18145,38	16968,10
N_2O emissions without N_2O from LULUCF	17478,90	17478,90	17612,64	15487,26	13862,73	8150,00	8328,33	7754,30
N_2O emissions with N_2O from LULUCF	17589,13	17589,13	17712,19	15583,49	13959,58	8252,37	8426,20	7845,70
HFCs	5606,33	5606,33	7545,61	4608,46	1374,01	2128,77	1817,30	1151,94
PFCs	2662,85	2662,85	2279,92	1902,81	365,99	313,77	104,22	67,24
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	206,70	206,70	255,66	227,64	152,83	104,83	111,67	124,58
NF_3	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE
Total (without LULUCF)	219596,54	219596,54	229625,24	217505,21	212447,59	211583,23	192648,93	163915,18
Total (with LULUCF)	225365,49	225365,49	235236,78	222677,66	217531,41	216509,20	197167,38	167446,45
Total (without LULUCF, with indirect)	220513,73	220513,73	230277,18	218036,77	212885,82	212041,44	193100,65	164334,50
Total (with LULUCF, with indirect)	226282,68	226282,68	235888,72	223209,22	217969,64	216967,41	197619,10	167865,77

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	CO_2 equivalent (kt)							
1. Energy	158560,85	158560,85	169195,29	166971,53	172875,62	178774,97	161199,52	134763,41
2. Industrial processes and product use	22346,70	22346,70	24290,59	20739,11	15599,58	10697,32	9785,77	8765,41
3. Agriculture	24511,96	24511,96	23621,48	20038,36	17640,20	17512,75	18219,27	17654,20
4. Land use, land-use change and forestry[5]	5768,95	5768,95	5611,55	5172,44	5083,82	4925,97	4518,45	3531,27
5. Waste	14177,03	14177,03	12517,88	9756,21	6332,19	4598,19	3444,38	2732,16
6. Other	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)[6]	225365,49	225365,49	235236,78	222677,66	217531,41	216509,20	197167,38	167446,45

Table 1 Emission trends (Summary) (Kt of CO_2 equivalents)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	(kt CO_2 eq)							
Total (net emissions)[2]	225365,49	225365,49	235236,78	222677,66	217531,41	216509,20	197167,38	167446,45
1. Energy	158560,85	158560,85	169195,29	166971,53	172875,62	178774,97	161199,52	134763,41
A. Fuel combustion (sectoral approach)	155732,52	155732,52	166713,26	165684,21	170848,69	176798,39	159512,77	133408,66
1. Energy industries	53364,11	53364,11	62725,13	64645,27	68230,55	67558,59	69628,86	47.832,85
2. Manufacturing industries and construction	34496,45	34496,45	29224,97	27980,96	27936,65	27807,55	24906,73	27.266,73
3. Transport	28016,45	28016,45	30554,29	32982,35	35421,09	34768,45	30379,89	26.328,74
4. Other sectors	39535,13	39535,13	43898,73	39815,31	39059,99	46401,80	34433,16	31.816,72
5. Other	320,37	320,37	310,14	260,33	200,42	262,01	164,13	163,62
B. Fugitive emissions from fuels	2828,34	2828,34	2482,03	1287,32	2026,93	1976,58	1686,74	1354,74
1. Solid fuels	121,39	121,39	122,01	89,55	91,67	87,99	83,16	76,54
2. Oil and natural gas and other emissions from ene	2706,94	2706,94	2360,02	1197,76	1935,26	1888,59	1603,58	1.278,21
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	22346,70	22346,70	24290,59	20739,11	15599,58	10697,32	9785,77	8765,41
A. Mineral industry	1410,72	1410,72	1628,34	1464,59	1509,86	1396,58	1454,06	1.069,62
B. Chemical industry	17076,57	17076,57	19006,32	15075,84	11449,27	6570,79	5943,56	5.860,29
C. Metal industry	3089,78	3089,78	2608,75	2129,98	669,79	414,33	62,83	158,00
D. Non-energy products from fuels and solvent use	188,11	188,11	206,06	259,30	306,39	311,61	314,49	335,00
E. Electronic industry	25,17	25,17	49,75	260,74	253,92	205,04	85,47	31,31
F. Product uses as ODS substitutes	NO	NO	247,88	1074,20	1080,79	1528,38	1668,82	1.033,15
G. Other product manufacture and use	483,86	483,86	512,98	425,48	296,10	241,51	243,01	260,91
H. Other	72,48	72,48	30,51	48,97	33,45	29,07	13,54	17,12
3. Agriculture	24511,96	24511,96	23621,48	20038,36	17640,20	17512,75	18219,27	17654,20
A. Enteric fermentation	9231,67	9231,67	8911,55	7892,00	7598,40	7967,67	8509,41	8.196,20
B. Manure management	6378,24	6378,24	5976,14	5143,89	4366,97	4447,29	4547,34	4.475,11
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	8717,38	8717,38	8632,82	6902,57	5591,81	5005,76	5027,87	4.904,69
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	183,15	183,15	98,20	97,62	74,74	59,72	68,72	31,03
H. Urea application	1,51	1,51	2,76	2,28	8,28	32,32	65,93	47,17
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
4. Land use, land-use change and forestry[2]	5768,95	5768,95	5611,55	5172,44	5083,82	4925,97	4518,45	3531,27
A. Forest land	-2442,67	-2442,67	-2598,41	-2742,66	-2382,97	-2348,53	-2304,59	-2.249,81
B. Cropland	2624,53	2624,53	2356,01	2160,87	2015,14	2059,68	1760,40	1.593,56
C. Grassland	4627,35	4627,35	4549,39	4462,55	3868,74	3623,03	3342,70	2.825,56
D. Wetlands	8,97	8,97	8,87	6,03	18,81	38,72	24,67	-46,02
E. Settlements	1025,27	1025,27	1124,29	1218,10	1371,65	1389,50	1419,88	1.105,64
F. Other land	99,33	99,33	96,53	100,28	103,65	114,13	154,76	180,88
G. Harvested wood products	-173,85	-173,85	74,86	-32,73	88,82	49,44	120,63	121,46
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	14177,03	14177,03	12517,88	9756,21	6332,19	4598,19	3444,38	2732,16
A. Solid waste disposal	13679,30	13679,30	11960,78	9225,82	5832,20	4122,45	2974,28	2.212,08
B. Biological treatment of solid waste	10,80	10,80	157,16	180,00	185,03	182,16	179,52	206,85
C. Incineration and open burning of waste	6,09	6,09	6,18	6,27	6,42	6,67	6,83	0,21
D. Waste water treatment and discharge	480,84	480,84	393,77	344,12	308,54	286,91	283,75	313,02
E. Other	NO	NO	NO	NO	NO	NO,NA	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:								
International bunkers	39940,19	39940,19	42651,04	52719,08	61845,38	55347,26	52769,18	44426,46
Aviation	4643,54	4643,54	7662,83	9962,28	11009,65	10293,74	11477,00	6.687,85
Navigation	35296,65	35296,65	34988,21	42756,80	50835,72	45053,53	41292,18	37.738,61
Multilateral operations	IE	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass	4016,95	4016,95	4669,81	6656,12	9365,93	13182,99	12414,42	18.540,71
CO_2 captured	NO,NA	NO,NA	NO	NO	NO	NO	NO,NA	NO
Long-term storage of C in waste disposal sites	NO	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
Indirect CO_2 [3]	917,19	917,19	651,94	531,56	438,23	458,20	451,72	419,32
Total CO_2 equivalent emissions without land use, land-use change and forestry	219596,54	219596,54	229625,24	217505,21	212447,59	211583,23	192648,93	163915,18
Total CO_2 equivalent emissions with land use, land-use change and forestry	225365,49	225365,49	235236,78	222677,66	217531,41	216509,20	197167,38	167446,45
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	220513,73	220513,73	230277,18	218036,77	212885,82	212041,44	193100,65	164334,50
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	226282,68	226282,68	235888,72	223209,22	217969,64	216967,41	197619,10	167865,77

Table 2 Emission Trends Greenhouse gases CO_2-eq (ktonnes of CO_2 equivalents)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	(kt)							
1. Energy	155366,74	155366,74	165594,56	164346,53	170297,07	175242,51	158287,62	132037,21
A. Fuel combustion (sectoral approach)	154481,67	154481,67	165042,34	163995,35	169135,71	174108,23	157250,30	131105,75
1. Energy industries	53146,86	53146,86	62464,98	64347,45	67845,55	67177,10	69185,62	47.438,14
2. Manufacturing industries and construction	34393,76	34393,76	29127,73	27877,80	27842,92	27707,38	24809,15	27.158,35
3. Transport	27710,52	27710,52	30158,51	32608,70	35089,24	34416,01	30044,69	26.040,23
4. Other sectors	38916,49	38916,49	42987,47	38907,14	38162,43	44550,25	33049,63	30.308,31
5. Other	314,04	314,04	303,65	254,26	195,57	257,50	161,21	160,71
B. Fugitive emissions from fuels	885,07	885,07	552,22	351,17	1161,35	1134,28	1037,32	931,46
1. Solid fuels	110,44	110,44	111,02	84,24	86,07	82,95	78,13	71,89
2. Oil and natural gas and other emissions from energy produc	774,63	774,63	441,20	266,94	1075,28	1051,33	959,20	859,57
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	6255,51	6255,51	6604,62	6635,80	6537,22	6192,19	5720,24	5734,10
A. Mineral industry	1410,72	1410,72	1628,34	1464,59	1509,86	1396,58	1454,06	1.069,62
B. Chemical industry	4132,02	4132,02	4360,91	4374,68	4119,32	4107,49	3881,30	4.180,05
C. Metal industry	452,10	452,10	378,57	487,90	567,78	347,12	56,33	131,73
D. Non-energy products from fuels and solvent use	187,96	187,96	205,90	259,06	306,14	311,31	314,19	334,68
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	0,61	0,83	0,90
H. Other	72,48	72,48	30,51	48,97	33,45	29,07	13,54	17,12
3. Agriculture	184,67	184,67	100,97	99,90	83,02	92,04	134,65	78,21
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	31,03
H. Urea application	1,51	1,51	2,76	2,28	8,28	32,32	65,93	47,17
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry[2]	5658,37	5658,37	5511,61	5075,78	4986,52	4823,12	4420,10	3439,36
A. Forest land	-2450,13	-2450,13	-2605,48	-2749,58	-2389,71	-2355,01	-2310,62	-2.255,32
B. Cropland	2559,47	2559,47	2301,15	2110,35	1965,31	2005,16	1710,89	1.548,77
C. Grassland	4621,13	4621,13	4543,96	4457,53	3863,69	3617,55	3336,42	2.818,77
D. Wetlands	6,53	6,53	6,46	3,55	16,30	36,12	22,07	-48,41
E. Settlements	1001,59	1001,59	1099,48	1191,81	1344,25	1362,03	1393,66	1.082,73
F. Other land	93,62	93,62	91,19	94,85	97,87	107,84	147,06	171,36
G. Harvested wood products	-173,85	-173,85	74,86	-32,73	88,82	49,44	120,63	121,46
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	NO,IE,NA	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	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	NO,IE,NA
D. Waste water treatment and discharge								
E. Other	NO	NO	NO	NO	NO	NA	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:								
International bunkers	39551,76	39551,76	42240,81	52214,00	61251,18	54814,96	52262,08	43914,02
Aviation	4604,36	4604,36	7598,17	9878,21	10916,75	10206,87	11380,15	6.631,41
Navigation	34947,41	34947,41	34642,64	42335,79	50334,43	44608,09	40881,93	37.282,61
Multilateral operations	IE	IE	IE	IE	IE	IE	IE	IE
CO_2 emissions from biomass	4016,95	4016,95	4669,81	6656,12	9365,93	13182,99	12414,42	18.540,71
CO_2 captured	NO,NA	NO,NA	NO	NO		NO	NO,NA	NO
Long-term storage of C in waste disposal sites	NO	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O								
Indirect CO_2 [3]	917,19	917,19	651,94	531,56	438,23	458,20	451,72	419,32
Total CO_2 equivalent emissions without land use, land-use change and forestry	161806,92	161806,92	172300,14	171082,23	176917,31	181526,73	164142,51	137849,52
Total CO_2 equivalent emissions with land use, land-use change and forestry	167465,28	167465,28	177811,75	176158,01	181903,83	186349,85	168562,61	141288,88
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	162724,11	162724,11	172952,08	171613,79	177355,54	181984,93	164594,23	138268,84
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	168382,48	168382,48	178463,69	176689,57	182342,06	186808,05	169014,33	141708,20

Table 3 Emission Trends CO_2 (Kt of CO_2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	(kt)							
1. Energy	113,82	113,82	123,34	82,71	80,23	116,32	89,54	85,70
A. Fuel combustion (sectoral approach)	36,09	36,09	46,14	45,27	45,60	82,63	63,56	68,77
1. Energy industries	2,76	2,76	3,55	4,12	5,75	5,13	5,19	5,49
2. Manufacturing industries and construction	2,68	2,68	2,71	2,99	2,59	2,55	2,41	2,61
3. Transport	7,90	7,90	5,56	3,89	3,36	3,10	2,60	2,39
4. Other sectors	22,73	22,73	34,29	34,23	33,87	71,83	53,35	58,26
5. Other	0,03	0,03	0,03	0,03	0,02	0,02	0,01	0,01
B. Fugitive emissions from fuels	77,73	77,73	77,19	37,45	34,62	33,69	25,98	16,93
1. Solid fuels	0,44	0,44	0,44	0,21	0,22	0,20	0,20	0,19
2. Oil and natural gas and other emissions from energy produ	77,29	77,29	76,75	37,23	34,40	33,49	25,78	16,75
C. CO_2 transport and storage								
2. Industrial processes	12,85	12,85	12,77	13,30	14,61	13,56	13,46	14,99
A. Mineral industry								
B. Chemical industry	10,78	10,78	10,70	11,39	12,80	11,83	11,71	13,12
C. Metal industry	NO,IE	NO,IE	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE	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	0,01
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	2,06	2,06	2,06	1,90	1,80	1,72	1,73	1,85
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	586,88	586,88	557,67	490,12	450,71	467,12	491,20	475,41
A. Enteric fermentation	369,27	369,27	356,46	315,68	303,94	318,71	340,38	327,85
B. Manure management	217,61	217,61	201,21	174,44	146,77	148,41	150,82	147,57
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	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	NA
4. Land use, land-use change and forestry	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02
A. Forest land	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02
B. Cropland	NO,NE,IE	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	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	NO,NE,IE
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	559,85	559,85	491,48	381,74	245,45	177,36	131,60	102,60
A. Solid waste disposal	547,17	547,17	478,43	369,03	233,29	164,90	118,97	88,48
B. Biological treatment of solid waste	0,17	0,17	2,84	3,29	3,37	3,84	4,09	4,66
C. Incineration and open burning of waste	0,15	0,15	0,15	0,16	0,16	0,16	0,17	0,00
D. Waste water treatment and discharge	12,35	12,35	10,06	9,25	8,63	8,46	8,37	9,45
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	1273,39	1273,39	1185,25	967,87	790,99	774,37	725,80	678,70
Total CH_4 emissions with CH_4 from LULUCF	1273,41	1273,41	1185,27	967,89	791,01	774,38	725,82	678,72
Memo items:								
International bunkers	3,20	3,20	3,19	3,89	4,62	4,11	3,82	6,44
Aviation	0,03	0,03	0,05	0,07	0,08	0,07	0,08	0,05
Navigation	3,17	3,17	3,13	3,82	4,55	4,04	3,74	6,40
Multilateral operations	IE	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 (Kt CH_4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	(kt)							
1. Energy	1,17	1,17	1,74	1,87	1,92	2,10	2,26	1,96
A. Fuel combustion (sectoral approach)	1,17	1,17	1,74	1,87	1,92	2,10	2,26	1,96
1. Energy industries	0,50	0,50	0,58	0,65	0,81	0,85	1,05	0,86
2. Manufacturing industries and construction	0,12	0,12	0,10	0,10	0,10	0,12	0,13	0,14
3. Transport	0,36	0,36	0,86	0,93	0,83	0,92	0,91	0,77
4. Other sectors	0,17	0,17	0,18	0,18	0,17	0,19	0,17	0,17
5. Other	0,02	0,02	0,02	0,02	0,01	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	NO,IE,NA
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from ene	NO,IE,NA	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	24,48	24,48	24,45	23,60	22,83	5,43	5,69	4,41
A. Mineral industry								
B. Chemical industry	23,72	23,72	23,76	23,09	22,51	5,12	5,40	4,11
C. Metal industry	NO	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	NO,NA
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	0,76	0,76	0,69	0,50	0,33	0,31	0,29	0,30
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	32,40	32,40	32,14	25,79	21,11	19,27	19,48	19,10
A. Enteric fermentation								
B. Manure management	3,15	3,15	3,17	2,63	2,34	2,47	2,61	2,64
C. Rice cultivation								
D. Agricultural soils	29,25	29,25	28,97	23,16	18,76	16,80	16,87	16,46
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	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	NA
4. Land use, land-use change and forestry	0,37	0,37	0,33	0,32	0,32	0,34	0,33	0,31
A. Forest land	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
B. Cropland	0,22	0,22	0,18	0,17	0,17	0,18	0,17	0,15
C. Grassland	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
D. Wetlands	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
E. Settlements	0,08	0,08	0,08	0,09	0,09	0,09	0,09	0,08
F. Other land	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,03
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0,61	0,61	0,77	0,71	0,66	0,55	0,52	0,56
A. Solid waste disposal								
B. Biological treatment of solid waste	0,02	0,02	0,29	0,33	0,34	0,29	0,26	0,30
C. Incineration and open burning of waste	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00
D. Waste water treatment and discharge	0,58	0,58	0,48	0,38	0,31	0,25	0,25	0,26
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	58,65	58,65	59,10	51,97	46,52	27,35	27,95	26,02
Total direct N_2O emissions with N_2O from LULUCF	59,02	59,02	59,44	52,29	46,84	27,69	28,28	26,33
Memo items:								
International bunkers	1,04	1,04	1,11	1,37	1,61	1,44	1,38	1,18
Aviation	0,13	0,13	0,21	0,28	0,31	0,29	0,32	0,19
Navigation	0,91	0,91	0,90	1,09	1,30	1,16	1,06	0,99
Multilateral operations	IE	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	NO,NE
Indirect CO_2 [3]								

Table 5 Emission Trends N_2O (Kt N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1995	2000	2005	2010	2015	2020
	(kt)							
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	8269,18	8269,18	9825,54	6511,28	1740,00	2442,54	1921,52	1219,19
Emissions of HFCs - (kt CO_2 equivalent)	5606,33	5606,33	7545,61	4608,46	1374,01	2128,77	1817,30	1151,94
HFC-23	0,38	0,38	0,49	0,21	0,02	0,03	0,01	0,01
HFC-32	NO	NO	0,00	0,01	0,02	0,03	0,03	0,03
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	0,00	0,06	0,07	0,12	0,13	0,06
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO	NO	0,03	0,13	0,30	0,39	0,41	0,37
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	0,00	0,07	0,06	0,10	0,10	0,03
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	0,02	0,02	0,00	0,00	0,00	0,00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs[4] - (kt CO_2 equivalent)	NO	NO	200,97	827,97	155,69	213,09	206,64	133,54
Emissions of PFCs - (kt CO_2 equivalent)	2662,85	2662,85	2279,92	1902,81	365,99	313,77	104,22	67,24
CF_4	0,28	0,28	0,24	0,16	0,01	0,01	0,00	0,00
C_2F_6	0,05	0,05	0,04	0,04	0,00	0,00	0,00	0,00
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO	NO
c-C_3F_6	NO	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	40,97
Unspecified mix of HFCs and PFCs - (kt CO_2	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of SF_6 - (kt CO_2 equivalent)	206,70	206,70	255,66	227,64	152,83	104,83	111,67	124,58
SF_6	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,01
Emissions of NF_3 - (kt CO_2 equivalent)	NO,IE	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	NO,IE

Table 6 Emission Trends F-gases (Kt of CO_2 equivalents)

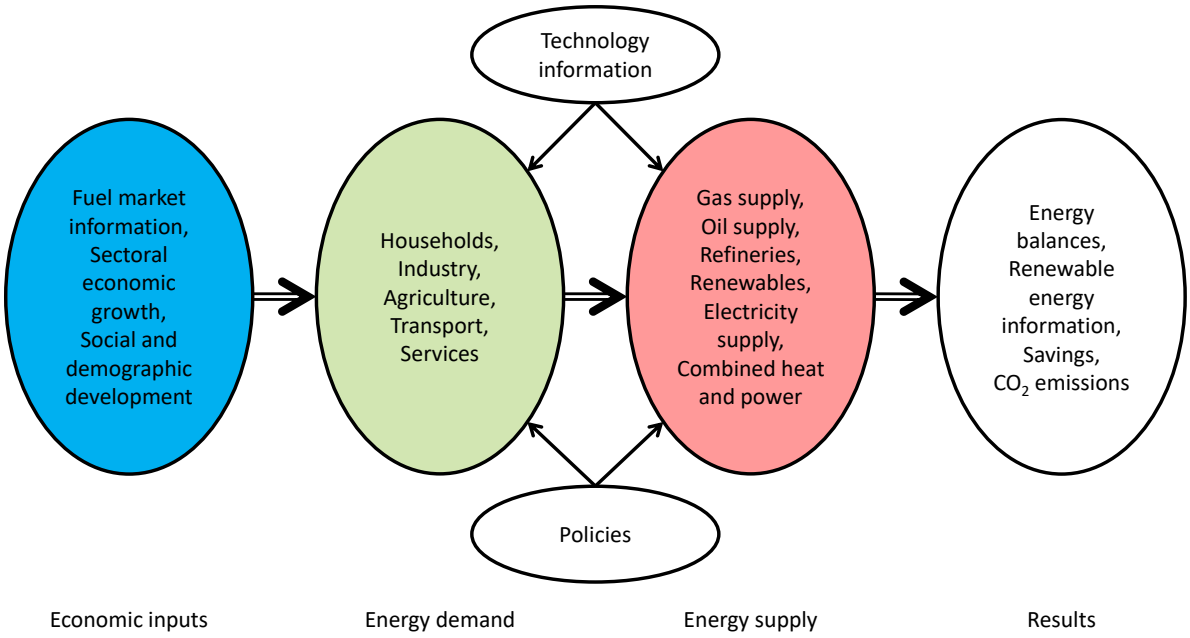
ANNEX II MODELLING SYSTEMS FOR PROJECTIONS

This annex briefly describes the modelling system for projections of greenhouse gas emissions. In the Netherlands, a combination of modelling tools is used. The National Energy Outlook Modelling System (NEOMS) is the primary modelling suite, which has been developed for over 20 years by Energy Research Centre of the Netherlands (ECN) and PBL Netherlands Environmental Assessment Agency for projections and policy evaluations. In 2018, the NEOMS was transferred to PBL.

National Energy Outlook Modelling System

NEOMS is a suite of models to simulate the various parts and sectors of the Dutch Energy System[267]. Some constituent models have been developed in spreadsheets (Excel) and Python, some are optimization models developed in AIMMS or GAMS. Although each model is unique, the general starting point is a detailed inventory of the existing portfolio of (economic) activities in all sectors like industrial production, transportation volumes etc. The models translate the activity levels in an (projected) energy demand and supply using assumptions on energy prices, policies and technologies. The models are calibrated using recent 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, behavioural change and technological development- 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 results in projections of final and primary energy consumption, greenhouse gas emissions and air pollutants. Most energy demand and supply models provide data on investment costs and costs for operation and maintenance.

[267] https://www.pbl.nl/modellen/kev-rekensysteem



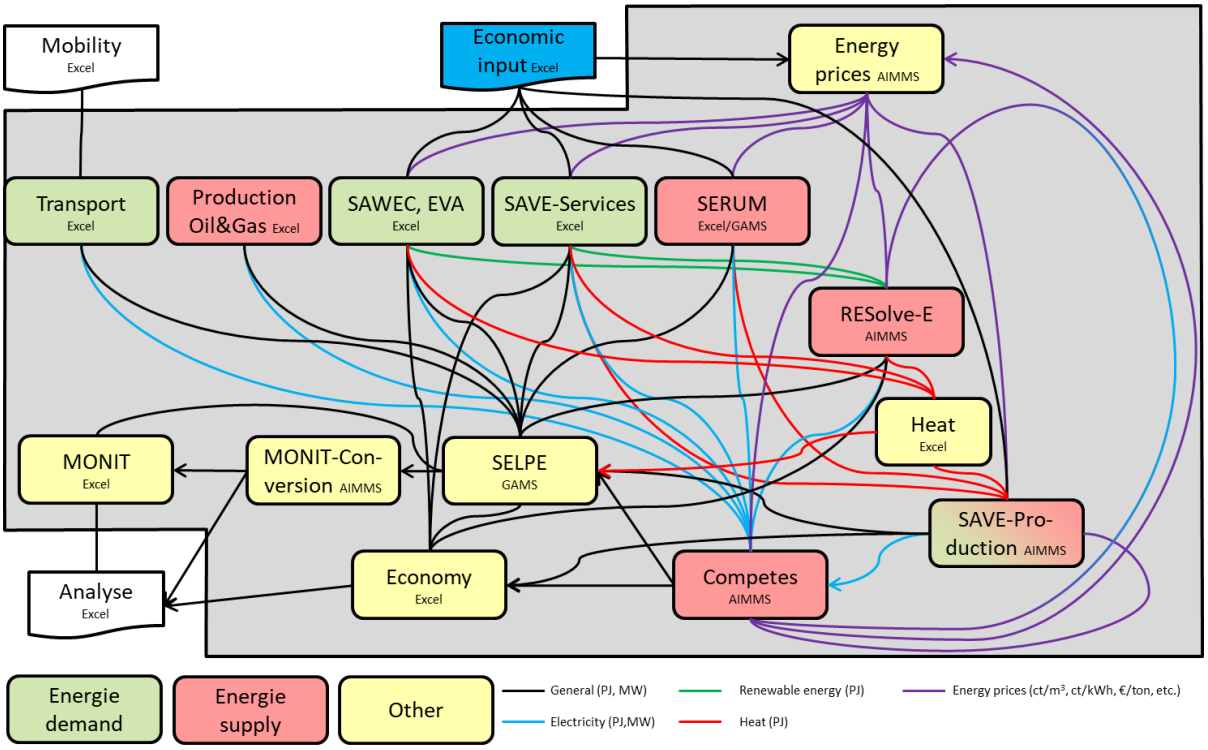
The NEOMS enables the exchange of data between 12 energy models, producing consistent and detailed results. Detailed results include energy demand, supply, emissions, technology uptake, investments, costs, prices, policy impacts. The total system includes about 22 sub-sectors with all relevant technologies 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-Productie),
  - Service sector (SAVE-Services),
  - Households (SAWEC and EVA),
  - Transport (various models).
- **Energy supply**
  - Combined heat and power (SAVE-Productie),
  - Electricity supply (Competes),
  - Refineries (SERUM),
  - Renewables (RESolve-E and SAVE-Productie),
  - Gas and oil supply.

The outputs of 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

that 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-Productie (industry, agriculture and CHP)

SAVE-Productie 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 historical 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 (mostly 'Ecodesign') changes in energy consumption.

Transport
The transport model is a tool to incorporate the results of the calculations of all kind of models specific for the transport sector used at PBL 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 decisions in investments and operations for centralised electricity production in the EU. 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 renewable energy production. 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. Many renewable energy technologies have been transferred from RESolve-E to SAVE-Productie, so RESolve-E does not cover heat production technologies anymore. Ultimately, RESolve-E will be fully incorporated by other models (e.g. SAVE-Productie, COMPETES).

Gas/oil production (gas and oil supply)
In this model, the supply of natural gas and crude oil is calculated based on the availability of natural gas in the 'Groningen' gas field, and the other onshore as well as the offshore fields for gas and oil. Exogenous assumptions are made about the volume for gas storage, gas export and oil export. If demand exceeds this production, natural gas and oil 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
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. The 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 historical data.

Non-energy models

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).

Agriculture

For the calculation of the agricultural emission projections, the National Emission Model for Agriculture (NEMA) is used (Vonk et al., 2018)[268]. NEMA models CH_4, NH_3, N_2O, NO_x, PM_{10}, $PM_{2.5}$ and CO_2 emissions from agriculture using a methodology in compliance with the IPCC and EMEP Guidelines. Usually the model runs with historical input data calculating the emissions for the National inventory report and the Informative inventory report. Input data for projections are based on the estimated effects of existing policies and expert judgement using other models, research and historical trends. Institutes involved in estimating input data are Wageningen Economic Research, Wageningen Environmental research, Wageningen Livestock Research and PBL.

LULUCF

The forestry projection is based on calculations with the EFISCEN (European Forest Information Scenario) model[269]. The projections of the other categories are expert based projections. The historical trends are used as input for these projections. A modelling tool is only applied at the LULUCF category forestry and only for carbon dioxide. Forestry inventories, updated every four years, are used for the LULUCF category forestry. The inventory supplies up-to-date forest data, as input for the modelling.

Waste

Methane from waste disposal is calculated using a spreadsheet model. The annually varying factors in this calculation are:

- the annual quantity of deposited waste;
- the carbon content;
- the amount of landfill gas extracted.

[268] https://english.rvo.nl/sites/default/files/2018/04/Vonk-et-al-2018-Methodology-report-agriculture-2018.pdf
[269] https://www.efi.int/publications-bank/manual-european-forest-information-scenario-model-efiscen-41

IPPU

CO_2 emissions from non-energy processes have been projected by a separate methodology that uses activity levels of industrial subsectors and other sectors (as they appear in the NEOMS). The activity levels for companies are expressed as added value, for transport as the transport volume and for households as the number of dwellings or inhabitants. Historical process and product use emissions are scaled using the change in activity level of these (sub)sectors. Relevant NEOMS sectors for industrial processes are Building materials, Organic chemistry, Iron and steel and Non-ferro metals. For solvent use the relevant NEOMS sectors are Transport and Organic chemistry. For liming it is Agriculture, and for indirect emissions (often oxidation of NMVOCs) Water and Waste, Construction, Organic chemistry, Households, Energy companies, Services, Agriculture, Refineries and Transport.

Nitrous oxide emissions from the industry: Nitric acid and Caprolactam production

The emissions for the future years have been calculated via a calculation sheet. The input variables, in both the production of Nitric acid and Caprolactam, in this calculation sheet are the realized emission (in CO_2-eq.) from the Dutch PRTR in 2017 (the base year) a starting point;

- the growth series(economic developments) according to the KEV:

For nitric acid, the growth series "chemical industry - fertilizer" is used and for caprolactam the series "chemical industry";

- if measures will be taken in future years:

* the introduction year(s) of the measure(s);
* the reduction percentage(s)of the measure(s).

HFC emissions from Stationary cooling

Also for this source, a calculation sheet has been used to calculate the emissions for the future years. As a result of the EU regulation on F-gases that came into force on 1 January 2015, the use of HFCs (calculated in CO_2 equivalents) should drop by 79% between 2015 and 2030. This target applies EU-wide, but has also been assumed to apply to the Netherlands. The 2022 suggested amendment to the regulation has not yet been considered in the projection. Taking the 2019 usage figure as starting point, usage figures for the years between 2019 and 2030 have been determined through modelling of the yearly stock reduction.

HFC emissions from Air conditioning Mobile

For this source the emissions for the future years have also been calculated via a calculation sheet. The European Directive 2006/40 / EC (MAC Directive (EC, 2006)) prohibits the use of refrigerants with a GWP> 150 in new cars from 2017. Taking this ban into account, the emissions for future years are calculated using an emission factor per year of construction and the size of the car park as input variables. The data on the development of the car fleet are from the KEV. The emission factors per construction year are determined using the leakage percentages from a number of surveys.

ANNEX III SUMMARY OF REPORTING OF THE SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2, OF THE KYOTO PROTOCOL IN THE NC8

Information reported under Article 7, paragraph 2	**NC8 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	4.2.15 Domestic and regional programmes and/or legislative arrangements, as well as enforcement and administrative procedures 6.3 (C) Policies and Measures
Art 10c	7.3 (B) Provision of support for technology development and 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 financial resources

ANNEX IV THE NETHERLANDS FIFTH BIENNIAL REPORT UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Content

1. SUMMARY

The majority of the information to be provided in the Fifth Biennial Report is also reported in the Eighth National Communication. This summary describes the chapters of this Fifth Biennial Report (chapters 3, 4 and 6), where information is included additional to the Eighth National Communication.

Quantified Economy-wide emission reduction target

The EU and its Member States have committed to achieving a joint quantified economy-wide greenhouse gas (GHG) emissions reduction target of 20% below the 1990 level by 2020, not including emissions/removals from Land Use, Land Use Change and Forestry (LULUCF). It is therefore a joint pledge with no separate targets for Member States under the Convention. This target is implemented internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced an approach to achieve the 20% reduction in total GHG emissions below 1990 levels by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors covered by the Effort Sharing Decision (ESD). Under the ESD, binding national targets were set for Member States.

As part of this target, Dutch companies have to fulfil their emissions reduction commitments under the EU ETS, while the emissions reduction commitments for the emissions not covered by the EU ETS are shared between the 28 Member States through individual national GHG targets. The Netherlands is committed to reducing its emissions in sectors covered by the ESD (non-ETS) by 16% compared to 2005. The quantified annual reduction targets for the Netherlands, as set by EU Decisions and expressed as AEAs in tonnes CO_2 equivalent, were 122.9 million in 2013, decreasing to 107.4 million in 2020.

Progress in achievement of quantified Economy-wide emission reduction target

The EU has substantially overachieved its reduction target under the Convention, which means that its Member States and the United Kingdom have also fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO_2-eq.

For every year in the 2013-2020 period, emissions in the non-ETS sectors were below the annual allocated emissions (see Table 4.1 and Figure 4.1). As a result, the cumulative emissions for the whole period are 797,946 tonnes CO_2-eq, and as such 123,040 tonnes CO_2-eq below the cumulative allocated emissions of 920,986 tonnes CO_2-eq.

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

Public climate finance reached €581 million in 2019 and €608 million in 2020. CTF Tables 7, 7a and 7b provide an overview of Dutch public financial support for those years. In addition, public finance from the Netherlands mobilised another €750 million in private finance for climate-relevant activities in developing countries in 2019 and €523 million in 2020. Increases in climate finance can be credited to a better integration of climate action into bilateral and multilateral development activities, the allocation of additional budget for climate-specific activities and strengthened efforts to mobilise private finance for climate-relevant activities.

Adaptation expenditure amounted to €179 million (31% of the total amount) in 2019, rising to €199 million (33% of the total amount) in 2020, while mitigation expenditure amounted to €32 million (5% of the total amount) in 2019 and increased to €81 million (13% of the total amount) in 2020. Most public climate finance supported cross-cutting activities, thanks to substantial contributions received through multilateral and other channels to support both adaptation and mitigation activities. Cross-cutting support amounted to €370 million (64% of the total amount) in 2019 and €328 million (54% of the total amount) in 2020.
As Dutch support for climate action is part of our development cooperation, we have a strong focus on poverty reduction. 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 services (WASH). Disaster risk reduction is an integral part of our programmes for integrated water resource management. Gender is an important cross-cutting issue, as climate action is most effective when it builds on the capacities and addresses the needs as well as the vulnerabilities of all, including, not least, women and girls.

2. INFORMATION ON GHG EMISSIONS AND TRENDS, GHG INVENTORY INCLUDING INFORMATION ON NATIONAL INVENTORY SYSTEM

For the relevant information, we refer to chapter 3 of the Eighth Netherlands National Communication under the UNFCCC.

3. QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

3.1 The EU target under the Convention

Under the United Nations Framework Convention on Climate Change (UNFCCC), the EU and its Member States have committed to achieving a joint quantified economy-wide greenhouse gas (GHG) emissions reduction target of 20% below the 1990 level by 2020 (the Cancun pledge). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the joint EU 2020 target together with the 27 EU Member States.

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions below 1990 levels by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors covered by the Effort Sharing Decision (ESD). Under the ESD, binding national targets were set for Member States. The achievement of EU internal compliance under the 2020 Climate and Energy Package, including the national targets under the ESD, is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

The definition of the Convention target for 2020 is documented in the revised note provided by the UNFCCC Secretariat on the 'Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention' (FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011). The EU provided additional information relating to its quantified economy-wide emissions reduction target in a submission as part of the process of clarifying the developed country parties' targets in 2012 (FCCC/AWGLCA/2012/MISC.1).

The EU's accounting rules for the target under the UNFCCC are more ambitious than the rules under the Kyoto Protocol, for example because they include outgoing flights and add an annual compliance cycle for emissions under the ESD (non-ETS) or higher Clean Development Mechanism (CDM) quality standards under the EU ETS (FCCC/TP/2013/7). Accordingly, the following assumptions and conditions apply to the EU's -20% commitment under the UNFCCC:

- The EU Convention pledge does not include emissions/removals from Land Use, Land Use Change and Forestry (LULUCF). However, this sector is estimated to be a net sink over the relevant period. EU GHG inventories 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[270].
- The target covers the gases CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and SF_6.
- The target refers to 1990 as a single base year for all covered gases and all Member States. Emissions from outgoing flights are included in the target.
- A limited number of Certified Emission Reductions (CERs), Emission Reduction Units (ERUs) and units from new market-based mechanisms may be used to achieve the target. In the ETS, the use of international credits was allowed up to specific levels set in the EU ETS Directive, amounting to over 1,500 million CER and ERU entitlements in the period up to 2020. Quality standards also apply to the use of international credits in the EU ETS, including a ban on the use of credits from LULUCF projects and certain industrial gas projects. International credits will no longer be used for EU ETS compliance in the system's fourth trading period (2021–2030). In the ESD sectors, the annual use of international credits is currently limited to up to 3% of each Member State's ESD emissions in 2005, with a limited number of Member States being permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions. From 2021 onwards, as with the EU ETS, international credits will no longer be used for compliance under the ESD.
- The Global Warming Potentials (GWPs) used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) when the target was submitted. For the implementation until 2020, GWPs from the IPCC's fourth assessment report (AR4) will be used consistently with the UNFCCC reporting guidelines for GHG inventories.

The above information is summarised in Table 3.1.

[270] The LULUCF Decision (Decision No 529/2013/EU) requires Member States to prepare and maintain annual LULUCF accounts according to the rules set out in the Kyoto Protocol. However, these accounts do not contribute to the achievement of the EU Convention pledge.

Parameters	Target
Base year	1990
Target year	2020
Emissions reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
GWP	AR4
Sectors covered	All IPCC sources and sectors, with the exception of LULUCF, as measured by the full annual inventory, including international aviation (outgoing flights)
LULUCF	Accounted under Kyoto Protocol, reported in EU inventories under the Convention. Assumed to produce no debits.
Use of international credits (Joint Implementation and CDM)	Possible, subject to quantitative and qualitative limits

Table 3.1 Key facts of the Convention target of the EU-28

3.2 The EU target compliance architecture

3.2.1 The 2020 Climate and Energy Package

In 2009, the EU established internal rules under its 2020 Climate and Energy Package[271] that underpin the EU implementation of the target under the Convention. The package introduced a clear approach to achieving the 20% reduction of total GHG emissions below 1990 levels, equivalent to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between the ETS and ESD sectors. The 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 through individual national GHG targets.

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

Under the EU ETS Directive as revised for the system's current trading period from 2013 to 2020 (Directive 2009/29/EC), a single ETS cap covers the EU Member States and three participating non-EU countries (Norway, Iceland and Liechtenstein). 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 emitted by Member States for the second trading period (2008–2012).

The vast majority of emissions within the EU which fall outside the scope of the EU ETS are addressed under the ESD (Decision No 406/2009/EC). The ESD covers emissions from all sources outside the EU ETS, except for de minimis aviation emissions, international maritime emissions, and emissions and removals from LULUCF. It thus covers a diverse range of small-scale emitters in a wide range of sectors: transportation (cars, vans), buildings (particularly 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 total GHG emissions in the EU in 2013[272].

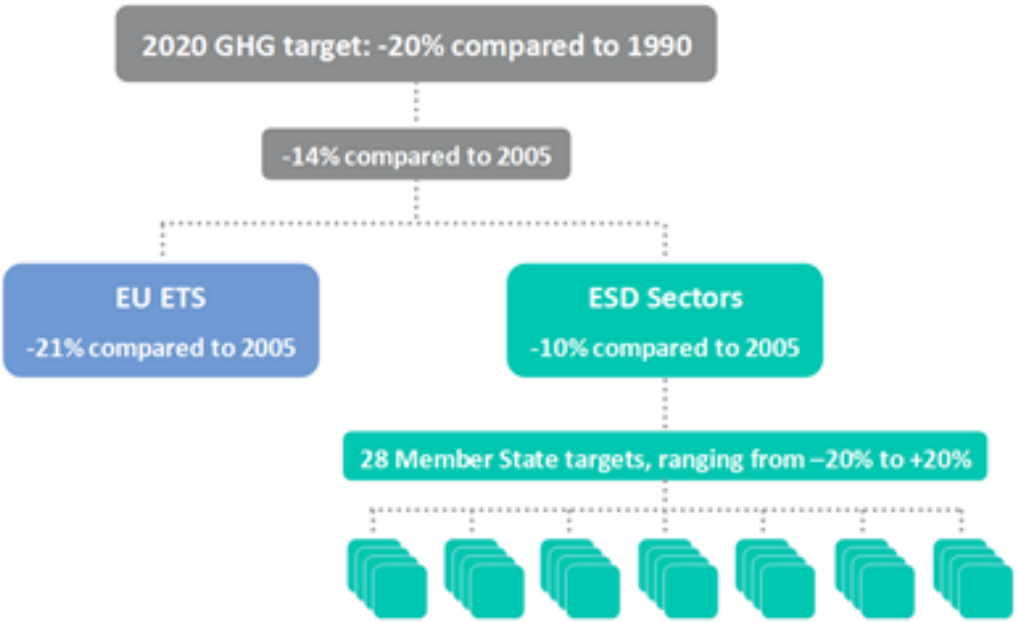


Figure 3.1 GHG targets under the 2020 Climate and Energy Package

[272] European Commission (2016). Commission Staff Working Document – accompanying the Report from the Commission to the European Parliament and the Council on evaluating the implementation of Decision No 406/2009/EC pursuant to 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

While the EU ETS target is to be achieved by the EU as a whole, the ESD target is divided into national targets to be achieved individually by each Member State (see Figure 3.1). Under the ESD, national emission targets for 2020 are set, expressed 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/EU), denominated in Annual Emission Allocations (AEAs)[273,274,275]. At the Member State level, 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. Up to certain limitations, the ESD allows Member States to make use of flexibility provisions for meeting their annual targets: carry-over of over-achievements 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 CDM).

3.2.2 Monitoring progress towards the 2020 ESD targets

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

The ESD and the Monitoring Mechanism Regulation (MMR) have introduced an annual compliance cycle, requiring a review of Member States' GHG 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 using flexibility provisions and taking

[273] 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).
[274] 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).
[275] Commission 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).

corrective action, where necessary, at the end of each relevant year. The following progress has been made on the reviews:

- A comprehensive review was completed in 2016 to establish 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.
- As of 2018, the annual review cycles continue.
- In 2022, the final review was conducted to establish the emission levels for the last compliance year 2020.

3.3 The Dutch reduction targets

As elaborated further ahead in this document, the Netherlands is committed to jointly meeting the EU economy-wide emissions reduction target under the Convention. As part of this target, Dutch companies have to fulfil their emissions reduction commitments under the EU ETS, while the emissions reduction commitments for the emissions not covered by the EU ETS are shared between the 28 Member States through individual national GHG targets.

In June 2015, the Dutch government faced judgment in the The Hague District Court in the case filed by Urgenda on the *overall national* reduction of GHG emissions in the Netherlands by 2020. The court ruled that by 2020, the Dutch government should have reduced national GHG emissions by 25% below 1990 levels. Pending the government's appeal against this decision, it was obliged to start implementing the judgment. In October 2018, the The Hague Court of Appeal ruled in the case between Urgenda and the Dutch State that GHG emissions would have to have been reduced by at least 25% below 1990 levels by the end of 2020. With this judgment, the Court of Appeal upheld the judgment of the The Hague District Court in the Urgenda case.

3.3.1 The Dutch reduction target under the ETS

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). There are no further individual caps by country. There is therefore no specific Dutch reduction target under the ETS.

For more information on the EU ETS target, we refer to the EU's Fifth Biennial Report.

3.3.2 The Dutch reduction target under the ESD (non-ETS)

The Netherlands is committed to jointly meeting the EU economy-wide emissions reduction target under the Convention. As part of this target, the Netherlands is committed to reducing its emissions in sectors covered by the ESD (non-ETS) by 16% compared to 2005. The quantified annual reduction targets for the Netherlands, as set by EU Decisions[276] and expressed as AEAs in tonnes CO_2 equivalent, are 122.9 million in 2013, decreasing to 107.4 million in 2020 (according to AR4 GWPs).

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 GHG emissions relevant to Article 3 of Decision No 406/2009/EC exceeded 1% for most Member States. In light of this outcome, all Member States' AEAs 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.

Year	AEAs (tonnes CO_2-eq.)	Year	AEAs (tonnes 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 3.2 AEAs assigned to the Netherlands using GWPs according to AR4, 2013–2020, in tonnes CO_2-eq.

[276] 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 Commission Decision (EU) 2017/1471 of 10 August 2017 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2017:209:TOC.

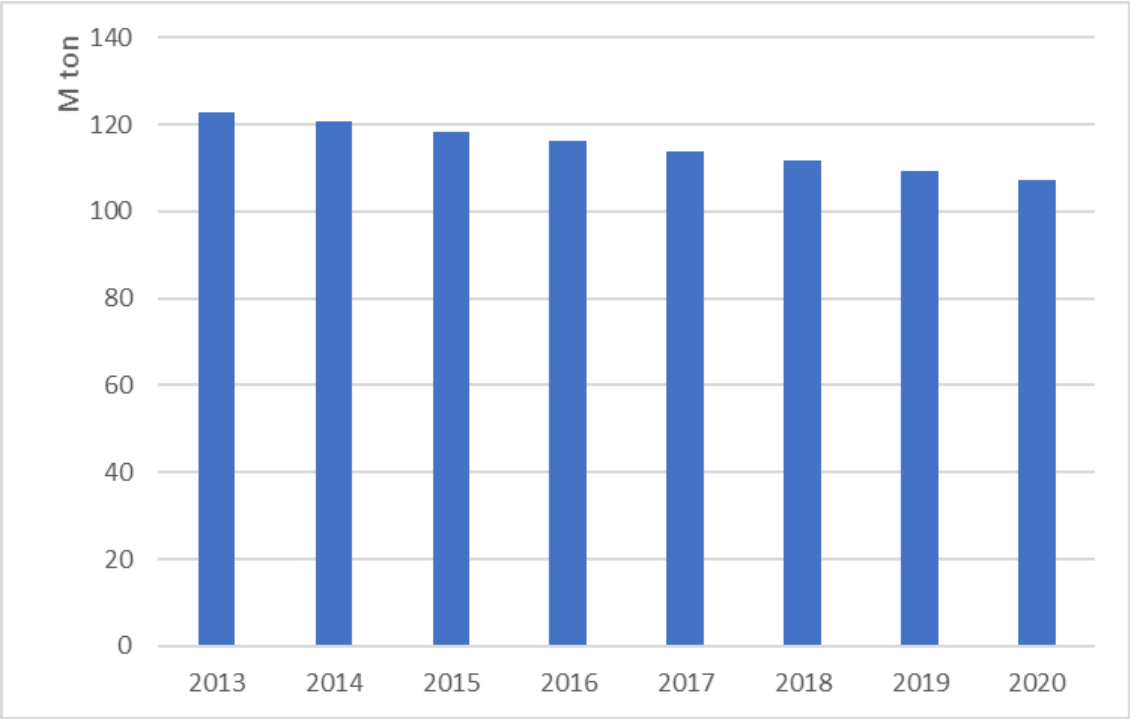


Figure 3.2 AEAs assigned to the Netherlands using GWPs according to AR4, 2013–2020, in Mt CO_2-eq

4. PROGRESS IN THE ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS AND RELEVANT INFORMATION

4.1 Introduction

This chapter describes the progress in and the achievement of the quantified economy-wide emission reduction targets in the Netherlands for the period of 2013 to 2020. While concentrating on the reduction of greenhouse gas emissions of sectors not included under the EU Emission Trading System (non-ETS or ESD emissions), this chapter also provides information on the reduction of emissions by companies in the Netherlands participating in the EU-ETS.

For a description of current policies and measures implemented since 1990 that have had (or are expected to have) a significant impact on greenhouse gas (GHG) emissions in the Netherlands, we refer to the information provided in chapter 4 of the Eighth National Communication. The estimated impacts of the main policy and measure packages on the reduction of GHG emissions are also summarised in CTF Table 3 within the CTF application.

The EU has substantially overachieved its reduction target under the Convention, which in turn means that its Member States and the United Kingdom have also fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, total GHG emissions, excluding LULUCF and including international aviation, decreased by 34%, or 1.94 billion tons of CO_2-eq, in the EU-27 + UK in 2020 compared to the base year 1990.

4.2 Progress in and the achievement of the quantified economy-wide emission reduction targets in the non-ETS (or ESD) sectors

As elaborated in chapter 3 of this Biennial report, more specifically section 3.3, the quantified annual reduction targets for the Netherlands up to 2020 are set by EU Decisions. These amounted to 122.9 Mt CO_2-eq in 2013 for the non-ETS sectors, decreasing to 107.4 Mt in 2020. This target results in a cumulative amount of 921.0 Mt for the 2013–2020 period. The non-ETS (ESD) emissions in the period 2013–2020 were 797.9 Mt CO_2-eq (see Table 4.1).

For every year in the 2013-2020 period, emissions in the non-ETS sectors were below the annual allocated emissions (see Table 4.1 and Figure 4.1). As a result, the cumulative emissions for the whole period are 797,946 tonnes CO_2-eq, and as such 123,040 tonnes CO_2-eq below the cumulative allocated emissions of 920,986 tonnes CO_2-eq.

In several years (2013, 2014, 2019, 2020) the winters were mild, resulting in less energy use for space heating and consequently in lower emissions. The years 2015 and 2016 saw colder winters. Additionally, the fluctuation of industrial activities, transport movements and changes in the number of animals in agriculture influenced emissions over the years. In 2020, the combination of a mild winter and the COVID-19 pandemic resulted in a decrease of emissions in industry, especially in the transport sector due to fewer transport movements.

Year	**Accounted Non-ETS emissions (tonnes CO_2-eq.)**	**Annual emission allocations (tonnes CO_2-eq.)**
2013	108,253,385	122,948,129
2014	97,887,338	120,675,928
2015	101,119,720	118,403,725
2016	101,333,437	116,131,523
2017	102,326,628	114,050,540
2018	99,731,984	111,821,315
2019	97,096,843	109,592,091
2020	90,196,821	107,362,866
cumulative	797,946.156	920,986,117

Table 4.1 Non-ETS emissions and annual emission allocations (in tonnes CO_2-eq)

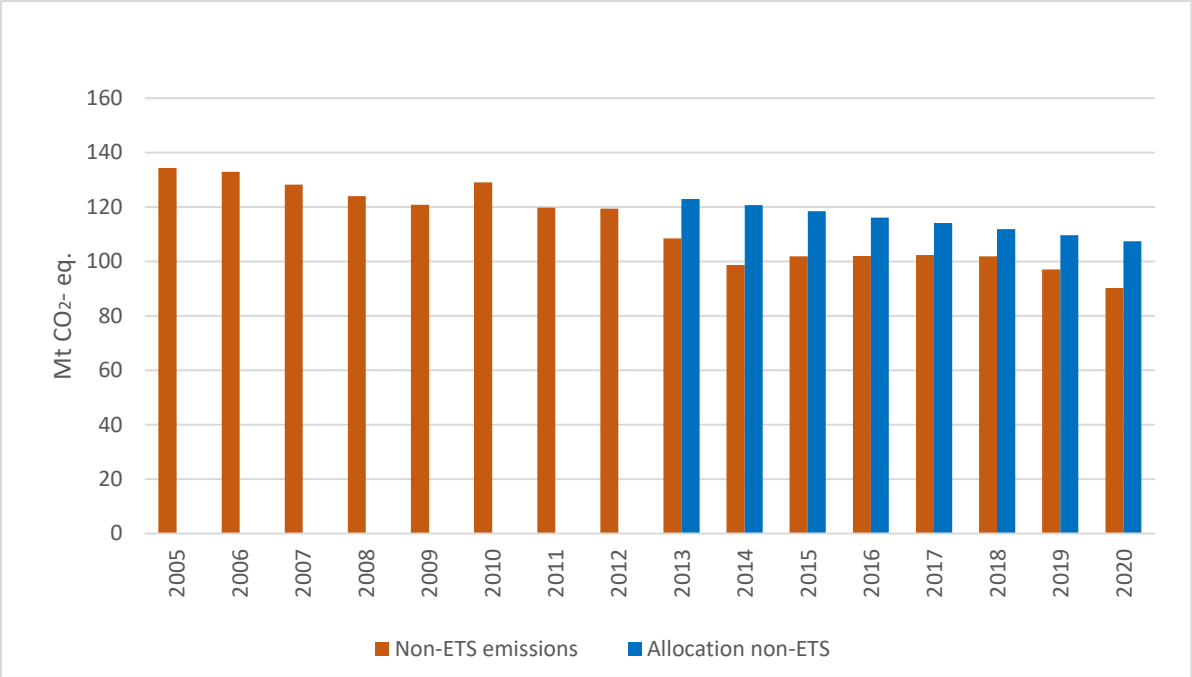


Figure 4.1 Greenhouse gas emissions for non-ETS sectors in 2005–2020 and annual emission allocations for 2013–2020, in Mt CO_2-eq

4.3 Emissions by Dutch companies participating in European Emission Trading System (ETS)

As elaborated in chapter 3 of the Biennial report, the EU ETS target is to be achieved by the EU as a whole. Nevertheless, national policies and measures also impact the emissions of companies that participate in the European Emission Trading System (ETS). In 2015, ETS emissions increased to 94 Mt CO_2-eq from 87 Mt CO_2-eq in 2013. After 2015, emissions gradually decreased to 74 Mt CO_2-eq in 2020 (see figure 4.2). This decrease was mainly caused by reduced emissions in the electricity production sector, from 50 Mt CO_2-eq in 2015 to 32 Mt CO2-eq in 2020, influenced by the increased production of renewable energy and reduced use of coal for electricity production. ETS emissions by industrial companies have decreased from about 44 Mt CO_2-eq in 2013 to 42 Mt CO_2-eq in 2020.

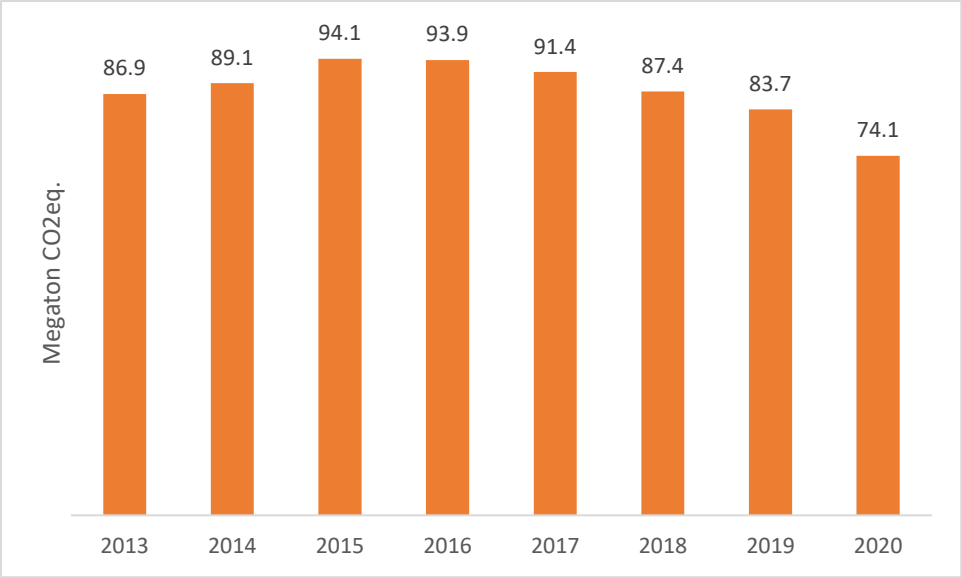


Figure 4.2 Greenhouse gas emissions by companies participating in the ETS 2013–2020, in Mt CO_2-eq

4.3 Policies and measures

Relevant information on policies and measures are reported in chapter four of the Eighth National Communication. Information on mitigation actions and their effects is included in the CTF Table 3, while additional information is provided in the other CTF tables.

5. PROJECTIONS

For the relevant information, we refer to chapter 5 of the Eighth Netherlands National Communication under the UNFCCC.

6. PROVISION OF PUBLIC FINANCIAL SUPPORT, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

6.1 Summary information on financial support

Dutch support for climate action in developing countries is an integral part of its development cooperation, financed from the Netherlands' 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 an increase in its climate finance after delivering on its Fast-Start Finance commitment in the 2010–2012 period. Public climate finance reached €581 million in 2019 and €608 million in 2020. CTF Tables 7, 7a and 7b provide an overview of Dutch public financial support for those years. In addition, public finance from the Netherlands mobilised another €750 million in private finance for climate-relevant activities in developing countries in 2019 and €523 million in 2020 (for detailed information, see National Communications 8, paragraph 7.2.8). Increases in climate finance can be credited to a better integration of climate action into bilateral and multilateral development activities, the allocation of additional budget for climate-specific activities and strengthened efforts to mobilise private finance for climate-relevant activities.

Adaptation expenditure amounted to €179 million (31% of the total amount) in 2019, rising to €199 million (33% of the total amount) in 2020, while mitigation expenditure amounted to €32 million (5% of the total amount) in 2019 and increased to €81 million (13% of the total amount) in 2020. Most public climate finance supported cross-cutting activities, thanks to substantial contributions received through multilateral and other channels to support both adaptation and mitigation activities. Cross-cutting support amounted to €370 million (64% of the total amount) in 2019 and €328 million (54% of the total amount) in 2020.

As Dutch support for climate action is part of our development cooperation, we have a strong focus on poverty reduction. 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.[277] 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 services (WASH). Disaster risk reduction is an integral part of our programmes for integrated water resource management. Gender is an important cross-cutting issue, as climate action is most effective when it builds on the capacities and addresses the needs as well as the vulnerabilities of all, including, not least, women and girls.

The results of the Dutch development cooperation, including our support for climate action, are reported to Parliament and published online.[278] Some quantitative results of Dutch climate finance reported in 2021 were:

- An additional 3.2 million people gained access to clean energy, bringing the total to 15.5 million people since 2015.
- More than 4.0 million hectares of forest were brought under improved sustainable management.
- 1.8 million people benefitted from improved water management and safe deltas.
- 9.7 million people received support in making their agricultural production systems more sustainable and resilient to climate change.

6.1.1 Meeting the needs of developing countries

See National Communications 8, paragraph 7.2.3.

6.1.2 New and additional financial support

See National Communications 8, paragraph 7.2.2.

6.1.3 Private climate finance

See National Communications 8, paragraph 7.2.8.

[277] IPCC, Climate Change 2022 Impacts, Adaptation and Vulnerability, Summary for Policymakers.
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6.2 Public financial support: contribution through multilateral channels

See National Communications, paragraph 7.2.4.

6.3 Provision of public financial support: contribution through bilateral, regional and other channels

See National Communications, paragraph 7.2.5.

6.4 Methodology used for reporting on financial support

See National Communications, paragraph 7.2.9.

6.5 Provisions of support for technology development and transfer

See National Communications 8, paragraph 7.3.

6.6 Provisions of capacity-building support

See National Communications 8, paragraph 7.4

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Chapter 3

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Chapter 6

IPCC 6th Assessment Reports about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place.
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This is a publication of the Ministry of Economic Affairs and Climate Policy (EZK)

Directorate General for Energy, Telecommunications and Competition

Address for visitors:

Bezuidenhoutseweg 73 2594 AC Den Haag

Phone number:

0031-703798911

Postal Address:

PO Box 20401

2500 EK The Hague

The Netherlands

www.rijksoverheid.nl/ezk

Preparation:

Ministry of Economic Affairs and Climate Policy (EZK)

Ministry of Infrastructure and Water Management (I&W)

Ministry of Foreign Affairs (BuZa)

Netherlands Enterprise Agency (RVO)