# Environmental accounts of the Netherlands 2011

## Explanation of symbols

| | |
|---|---|
| . | data not available |
| * | provisional figure |
| x | publication prohibited (confidential figure) |
| – | nil or less than half of unit concerned |
| – | (between two figures) inclusive |
| 0 (0,0) | less than half of unit concerned |
| blank | not applicable |
| 2011–2012 | 2011 to 2012 inclusief |
| 2011/2012 | average of 2011 up to and including 2012 |
| 2011/'12 | crop year, financial year, school year etc. beginning in 2011 and ending in 2012 |
| 2009/'10 -2011/'12 | crop year, financial year, etc, 2009/'10 to 2011/'12 inclusive |

Due to rounding, some totals may not correspond wit the sum of the separate figures.

## Colofon

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# Foreword

In February 2012, the System of Environmental and Economic Accounting Central Framework (SEEA) was adopted as an international statistical standard by the United Nations Statistical Commission, the apex entity of the global statistical system. This forms a major milestone in the provision of economic-environmental information to support the needs of government, industry and the general public. As an international standard, the SEEA has the same status as the System of National Accounts (SNA), from which key economic indicators as GDP are derived. SEEA provides an internationally agreed set of recommendations expressed in terms of concepts, definitions, classifications, accounting rules and standard tables which will help to obtain international comparability of environmental-economic accounts and related statistics.

The *Environmental Accounts of the Netherlands* 2011 by Statistics Netherlands (CBS) presents a broad quantitative overview of the most important recent developments in the relationship between the environment and the economy. It covers developments in energy, water, materials, greenhouse gas emissions and air pollution, as well as policy instruments and economic opportunities. Environmental accounts can be used to provide indicators for policy frameworks such as sustainable development and green growth. This edition contains a chapter devoted to the status of green growth in the Netherlands using the OECD indicator set as its point of departure.

Four articles provide more in-depth analyses of specific topics. The first article explores how useful the economy-wide material flow accounts module is for tackling issues about the resources required for the Dutch economy, resource productivity, and import dependencies. A new methodology developed by Eurostat  was applied to the Dutch situation to go "beyond" the current indicators for material use. The second article describes a feasibility study about compiling water quality accounts. Taking the Water Framework Directive as its point of departure, provisional estimates were obtained on the status of various types of Dutch surface waters, expressed in surface area. It also presents an analysis of the Dutch population (by province) by quality of the water resources in the neighbourhood where they reside. The third article provides a full physical water balance for the Netherlands, both national and on a river basin scale. For the first time a complete water balance is published that describes exchanges of fresh water with the atmosphere, namely precipitation and evapotranspiration with high accuracy and with complete coverage of the exchange of water with other territories with inflow from upstream territories and outflow to downstream territories or the sea. Moreover exchange of water with other territories via import and export and the flows between the inland water system and the economy are assessed. New data sources, such as data from remote sensing, helped to improve estimates for the water balance items. The fourth article presents the provisional results of an assessment of government expenditure on mitigation and adaptation to climate change. It concludes that the expenditure on climate change related issues has increased from 2.5 billion euro in 2007 to almost 3.3 billion euro in 2010, which constitutes 1.1 percent of total government expenditure.

The Director General of Statistics Netherlands

*G. van der Veen*

Heerlen/The Hague, November 2012

# Summary


**Strong decrease in energy use and greenhouse emissions in 2011**

In 2011, the net use of energy by Dutch economic activities was 6 percent lower than the energy use in 2010. While over that same period the economy grew by 1.0 percent, which implies that there was absolute decoupling between energy use and economic growth. As a result, during the same period also the total greenhouse gas emissions decreased by 5.6 percent. This sharp decrease in energy use and greenhouse gas emissions is mainly the result of a dip in natural gas consumption. This dip was the result of both a mild winter and some economic stagnation in the more emission intensive industries. Emissions and energy use decreased in most industries, particularly in the chemical industry, due to lower production levels. Demand for petrochemicals fell, particularly in the second half of 2011. On the other hand, emissions rose in the basic metal industry and the refineries, where production processes are also quite substantial. Energy companies produced less, as more electricity was imported. As a result $CO_2$ emissions fell by 9 percent. The production of natural gas from the Dutch gas fields amounted to 79 billion standard cubic metres ($Sm^3$) compared to 86 billion $Sm^3$ in 2010. Total production was 8.5 percent lower than in 2010, which is primarily due to the mild winter at the end of 2011. On 1 January 2012, the value of the reserves of natural gas amounted to 147 billion euro, which is 7 percent less than they were on 1 January 2011.

**Government expenditure for climate change mitigation and flood control increases**

The expenditure on climate change mitigation and flood control measures has increased from 2.5 billion euro in 2007 to almost 3.3 billion euro in 2010, which constitutes 1.1 percent of total government expenditure. In 2010, 1.3 billion euro was spent on climate change mitigation. Nearly three-quarter of this number was spent on subsidies for energy saving and renewable energy production. The State government is responsible for nearly 90 percent of this mitigation expenditure. In 2010, the State government spent over 726 million euro on flood control. About two thirds of this number was designated to the maintenance of dikes and coastal defense. Here it is important to note that part of the spending on flood control would have occurred also without climate change. However, at present it is not possible to make this distinction.

**Natural resource footprint of imports increases over time**

Economy-wide material flow accounts (EW-MFA) provide insight in the origin and use of natural resources. In physical terms the Netherlands is a net importer of materials. The large amounts of imports and exports show that the Netherlands is a major transit route and underline the importance of an open trading system. Dutch domestic material consumption (DMC) per capita is below the EU average. The high population density in the Netherlands limits the amount of land available for domestic extraction and leads to a lower per capita requirement of infrastructure. Over time the consumption of materials is decoupled with the value added of key industries indicating an improvement of the resource efficiency. A new methodology

developed by Eurostat was applied to the Dutch situation to go “beyond” the current indicators for material use. Accordingly footprint indicators can be calculated for the Dutch economy. The physical amount of natural resources required to produce Dutch imports is 1.6 times higher than the actual amount of imported products. Between 2000 and 2010 the Dutch natural resource footprint for imports has increased by 8 percent as more raw materials were needed for the increasing imports of products. However, the increase in resource material equivalents is low compared to the 12 percent increase in total physical imports. This indicates an increase in efficiency in the production of Dutch imports.

**Nearly two thirds of the people live in an area near surface water of bad ecological quality**

Water quality accounts provide a description of water resources in quantitative and qualitative terms for a country as a whole or at a sub-national level. They allow comparing different types of water resources (rivers, lakes, etc.) in terms such as volume and surface area. Taking the Water Framework Directive (WFD) as its starting point, provisional estimates were obtained on the status of various types of Dutch surface waters. Counting the number of water bodies that belong to different water types gives a different picture than looking at the total surface area of those water types. While the majority of WFD water bodies consists of lakes (450 out of 724), they have a joint surface area of only 18 percent. Rivers make up for only 2.7 percent of total water surface area. Also, it was analysed whether there are differences in the Dutch population (by province) in terms of the quality of the water resources within their direct neighbourhood. Nearly two thirds of the population live in areas with surface water of bad ecological quality. The provinces Zuid-Holland, Noord-Holland and Groningen have the largest share of people living near surface waters of bad ecological quality. In the provinces of Utrecht, Overijssel, Drenthe and Friesland there is a relatively large share of ‘moderate’ ecological status and very few people living near water with ‘bad’ ecological status.

**Improved water balance for the Netherlands**

A water balance describes exchanges of fresh water with the atmosphere, namely precipitation and evapotranspiration and exchange of water with other territories with inflow from upstream territories and outflow to downstream territories or the sea. Moreover, exchange of water with other territories via import and export and the flows between the inland water system and the economy are assessed. In this study an improved water balance for the Netherlands for 2009 is presented using new data sources (including remote sensing data). The water balance includes the four main flows (precipitation, evapotranspiration, actual inflow and actual outflow), but also calculated values for several indicators, namely the ‘internal flow’, the ‘total freshwater resources’, the ‘recharge into the aquifer’, and the ‘groundwater available for annual abstraction’. In addition, the water balance provides additional information on total abstractions and discharges as well as imports and exports of tap water and water contained in products. The outcomes of this balance illustrate the need to compile not only annual data but at least data per season. Annual totals do not explicitly show the precipitation deficit in the summer months and the resulting negative internal flow.

# Samenvatting

**Sterke afname energiegebruik en uitstoot broeikasgassen in 2011**

Het netto energiegebruik door Nederlandse economische activiteiten daalde in 2011 met 6 procent ten opzichte van 2010. De economie groeide (1 procent) in dezelfde periode, dat betekent dat er sprake is van absolute ontkoppeling. Door de daling van het energieverbruik is ook de totale uitstoot van broeikasgassen fors lager dan in het voorgaande jaar. De sterke daling van het energieverbruik en de uitstoot van broeikasgassen werd voornamelijk veroorzaakt door een afname van het aardgasverbruik door de zachte winter en het begin van de economische stagnatie. Uitstoot en energieverbruik daalden in de meeste bedrijfstakken van de industrie, met name in de chemische industrie als gevolg van lagere productie. De vraag naar petrochemische producten daalde, met name in de tweede helft van 2011. Anderzijds stegen de emissies in de basismetaalindustrie en de raffinaderijen, waar het productieproces ook zeer emissie-intensief is. Energiebedrijven produceerden minder, omdat meer elektriciteit werd geïmporteerd, met als gevolg dat de $CO_2$-uitstoot daalde met 9 procent. De productie van aardgas uit de Nederlandse gasvelden bedroeg 79 miljard standaard kubieke meter ($Sm^3$) in vergelijking met 86 miljard $Sm^3$ in 2010. De totale productie daalde met 8,5 procent, wat vooral te wijten is aan de zachte winter aan het einde van 2011. Op 1 januari 2012 bedroeg de waarde van de aardgasreserves 147 miljard euro, wat 7 procent minder is dan in 2011.

**Hogere overheidsuitgaven preventief klimaatbeleid**

In Nederland is er veel vraag naar gegevens over aan klimaatverandering gerelateerde uitgaven. De overheidsuitgaven gerelateerd aan klimaatverandering zijn gestegen van 2,5 miljard euro in 2007 tot bijna 3,3 miljard euro in 2010. Dat is 1,1 procent van de totale overheidsuitgaven. In 2010 werd 1,3 miljard euro besteed aan klimaatmitigatie. Bijna driekwart van de van de mitigatie uitgaven werd besteed aan subsidies voor energiebesparing en duurzame energieproductie. De rijksoverheid is verantwoordelijk voor bijna 90 procent van alle mitigatie-uitgaven. De uitgaven voor klimaatadaptatie zijn moeilijker te bepalen. In Nederland hebben uitgaven voor klimaatadaptatie voornamelijk betrekking op waterveiligheid. In 2010 heeft de rijksoverheid meer dan 726 miljoen euro besteed aan waterveiligheid. Ongeveer tweederde werd besteed aan het onderhoud van dijken en kustverdediging. Het is belangrijk om op te merken dat de resultaten voor waterveiligheid zoals gerapporteerd in deze studie niet volledig kunnen worden aangemerkt als ‘klimaatadaptatie gerelateerd’ omdat een groot deel van deze uitgaven kan worden beschouwd als ‘business as usual’. Verder onderzoek is nodig om te bepalen of het mogelijk is om dit onderscheid wel te maken.

**Voetafdruk invoer natuurlijke hulpbronnen neemt toe**

De economiebrede materiaalstroomrekeningen (EW-MFA) geven inzicht in de herkomst en het gebruik van natuurlijke hulpbronnen. In fysieke termen is Nederland een netto-importeur van materialen. Uit de grote hoeveelheden import- en exportproducten blijkt nog eens dat

Nederland in Europa een belangrijk distributieknooppunt is. Het Nederlands binnenlands materiaalverbruik per hoofd van de bevolking ligt onder het EU-gemiddelde. Dit heeft te maken met de hoge bevolkingsdichtheid in Nederland, waardoor de hoeveelheid land die beschikbaar is voor binnenlandse winning beperkt is. De consumptie van materialen is ontkoppeld met de toegevoegde waarde van de bedrijfstakken die daar het meest gebruik van maken, wat wijst op een verbetering van de grondstoffenefficiëntie. Een nieuwe methodologie ontwikkeld door Eurostat is toegepast op de Nederlandse situatie waardoor betere indicatoren voor materiaalgebruik zijn bepaald. Onder andere zijn zogenaamde 'footprint indicatoren' voor materiaalgebruik berekend voor de Nederlandse economie. De fysieke hoeveelheid natuurlijke hulpbronnen die nodig zijn om de Nederlandse import te produceren is 1,6 keer hoger dan de werkelijke hoeveelheid ingevoerde producten. Tussen 2000 en 2010 is de Nederlandse importvoetafdruk voor natuurlijke hulpbronnen toegenomen met 8 procent. Echter, deze toename is laag in vergelijking met de 12 procent stijging van de totale fysieke invoer. Dit duidt op een toename van de efficiëntie in de productie van de Nederlandse importproducten.

### Bijna tweederde van de mensen woont in de buurt van water met een slechte ecologische kwaliteit

Waterkwaliteitrekeningen beschrijven de watervoorraden in kwantitatieve en kwalitatieve termen voor een land als geheel of op een subnationaal niveau, op een zodanige wijze dat de verschillende soorten waterlichamen (rivieren, meren, enz.) kunnen worden vergeleken. Door de Kaderrichtlijn Water (KRW) als uitgangspunt te nemen, kunnen voorlopige schattingen worden verkregen over de status van de verschillende soorten Nederlandse oppervlaktewateren, uitgedrukt in oppervlakte. Tellen van het aantal waterlichamen van een watertype geeft een enigszins ander beeld dan het sommeren naar oppervlak. Terwijl de meerderheid van KRW waterlichamen bestaat uit meren (450 uit 724), hebben ze een gezamenlijke oppervlakte van slechts 18 procent. Rivieren vormen slechts 2,7 procent van het totale wateroppervlak. Ook is een analyse uitgevoerd waarin is gekeken naar de Nederlandse bevolking en de kwaliteit van de oppervlaktewater waar zij bij in de buurt wonen. Bijna tweederde van de mensen woont in de buurt van oppervlaktewater met een slechte ecologische kwaliteit. De provincies Zuid-Holland, Noord-Holland en Groningen hebben het grootste deel inwoners in de buurt van oppervlaktewater met een slechte ecologische kwaliteit. In de provincies Utrecht, Overijssel, Drenthe en Friesland wonen relatief veel mensen in de buurt van water met een 'matige' ecologische toestand en zeer weinig mensen in de buurt van water met een 'slechte' ecologische toestand.

### Een verbeterde waterbalans voor Nederland

Een waterbalans beschrijft de stromen van water met de atmosfeer (neerslag en evapotranspiratie) en de uitwisseling van water met ander gebieden, zoals de instroom van rivieren van stroomopwaartse gebieden en uitstroom naar zee. Daarnaast worden wateruitwisselingen via import en exportproducten en de stromen tussen de binnenwateren en de economie in kaart gebracht. In deze studie wordt een verbeterde waterbalans voor Nederland voor 2009 gepresenteerd met behulp van nieuwe gegevensbronnen (onder andere remote sensing-gegevens). De waterbalans omvat de vier belangrijkste stromen (neerslag, verdamping, feitelijke instroom en feitelijke uitstroom), maar ook berekende waarden voor verschillende indicatoren; de 'interne flow', de totale zoetwatervoorraden, de aanvulling van het grondwater, en de hoeveelheid grondwater beschikbaar voor de jaarlijkse winning. De uitkomsten van dit onderzoek illustreren de noodzaak om niet alleen de jaarlijkse gegevens samen te stellen, maar ook gegevens per seizoen. Jaartotalen tonen niet expliciet het neerslagtekort in de zomermaanden.

**Environmental accounts, key figures**[1)]

| | Unit | 1990 | 1995 | 2000 | 2005 | 2009 | 2010* | 2011* |
|---|---|---|---|---|---|---|---|---|
| **Economy** | | | | | | | | |
| Domestic product (gross, market prices, price level 2005) | *million euro* | 352,065 | 394,332 | 480,825 | 513,407 | 541,000 | 549,814 | 555,271 |
| Final consumption expenditure households (price level 2005) | *million euro* | 176,890 | 193,074 | 239,268 | 250,343 | 251,867 | 252,720 | 250,145 |
| Investments in fixed assets (gross, price level 2005) [2)] | *million euro* | 67,050 | 73,446 | 100,979 | 97,016 | 101,148 | 93,906 | 99,303 |
| Population | *x 1000* | 14,893 | 15,424 | 15,864 | 16,306 | 16,486 | 16,575 | 16,575 |
| Labour input of employed persons | *x 1000 fte* | 5,536 | 5,774 | 6,534 | 6,478 | 6,759 | 6,718 | 6,752 |
| **Environmentally adjusted aggregates** | | | | | | | | |
| Adjusted national income for depletion of mineral resreves (net) | % | 1.2 | 0.9 | 0.7 | 1.0 | 1.9 | 2.1 | 1.8 |
| **Energy** | | | | | | | | |
| Net domestic energy use | *petajoules* | 2,940 | 3,229 | 3,391 | 3,633 | 3,499 | 3,713 | 3,498 |
| Energy intensity | *GJ / euro* | 8.4 | 8.2 | 7.1 | 7.1 | 6.5 | 6.8 | 6 |
| Extraction natural gas | *billion* $Sm^3$ | 72 | 78 | 68 | 73 | 74 | 86 | 79 |
| Mineral reserves gas [3)] | *billion* $Sm^3$ | 2,113 | 1,952 | 1,777 | 1,510 | 1,390 | 1,304 | 1,230 |
| Valuation mineral reserves gas [3)] | *million euro* | 69,236 | 60,742 | 64,444 | 99,846 | 162,639 | 158,532 | 146,767 |
| **Water** | | | | | | | | |
| Groundwater extraction | *million* $m^3$ | . | . | . | 1,013 | 1,026 | 1,014 | . |
| Tapwater use | *million* $m^3$ | 1,166 | 1,171 | 1,127 | 1,086 | 1,093 | 1,090 | 1,080 |
| Tapwater use intensity | *litre / euro* | 3.3 | 3.0 | 2.3 | 2.1 | 2.0 | 2.0 | 1.9 |
| Heavy metals to water [4)] | *1000 eq.* | 146 | 110 | 82 | 51 | 43 | 41 | . |
| Nutrients to water [4)] | *1000 eq.* | 26,811 | 14,800 | 10,756 | 7,977 | 6,310 | 6,292 | . |
| **Materials** | | | | | | | | |
| Material consumption biomass | *million kg* | . | . | 50,358 | 48,552 | 48,913 | 50,576 | . |
| Material consumpton metals | *million kg* | . | . | 7,681 | 6,299 | 5,857 | 6,214 | . |
| Solid waste production | *million kg* | 52,450 | 53,983 | 64,013 | 61,610 | 59,924 | 59,024 | . |
| Landfilled waste | *million kg* | 14,982 | 9,209 | 4,907 | 2,137 | 1,816 | 1,527 | . |
| **Greenhouse gas emissions and air pollution** | | | | | | | | |
| Greenhouse gas emissions and air pollution | *million* $CO_2$*-eq.* | 230,217 | 246,264 | 241,599 | 241,348 | 232,454 | 243,660 | 230,080 |
| Greenhousegas emission intensity | $CO_2$ *eq / 1000 euro* | 654 | 625 | 502 | 470 | 430 | 443 | 414 |
| Acidifying emissions | *billion ac-eq.* | 45 | 33 | 29 | 26 | 22 | 21 | 21 |
| Fine dust emissions | *million kg* | 78 | 61 | 51 | 45 | 39 | 38 | 37 |
| **Policy instruments and economic opportunities** | | | | | | | | |
| Environmental taxes and fees | *million euro* | 5,824 | 9,249 | 13,973 | 17,270 | 19,285 | 19,871 | 19,601 |
| Share Environmental taxes and fees in total taxes | *%* | 9.4 | 13.1 | 14.1 | 13.9 | 14.0 | 13.9 | 14.0 |
| Environmental costs | *million euro* | 3,864 | 6,601 | 9,116 | 10,105 | 10,572 | . | . |
| Labour input environmental goods and services sector | *x 1000 fte* | . | 82 | 97 | 109 | 117 | 117 | . |
| Value added environmental goods and services sector (basic prices) | *million euro* | . | 5,750 | 7,983 | 9,744 | 11,968 | 12,738 | . |

1) Intensities in this table are based upon use/ emissions of both households and industries.
2) Excluding non-profit institutions.
3) Balance as of 31st of December.
4) Net approach.

# Recent environmental economic developments

# Introduction

# 1

# Introduction

## 1.1

**Environmental accounting**
- SEEA building blocks
- Environmental statistics and environmental accounts

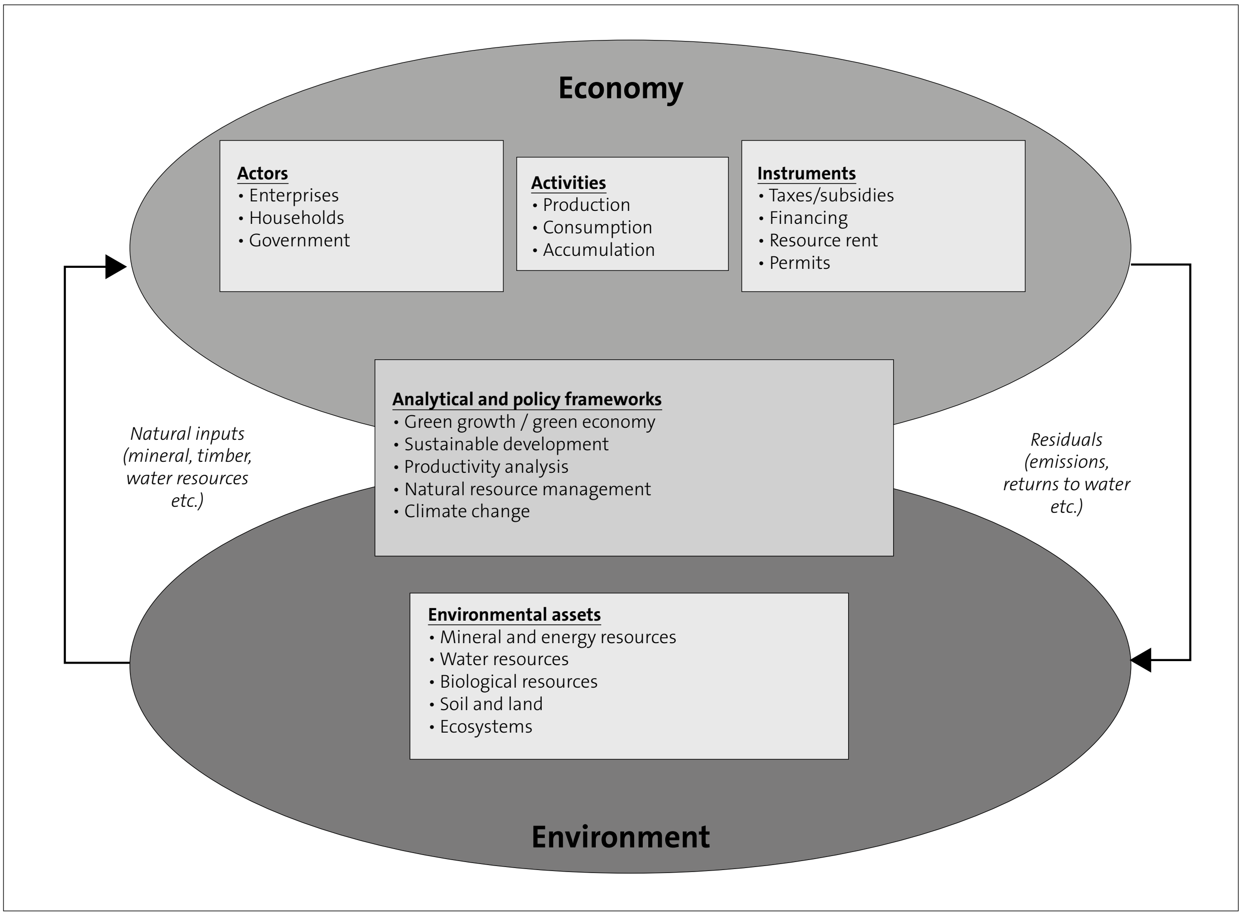
## 1.2

**The Dutch environmental accounts**
- This publication

# 1.1 Environmental accounting

The System of Environmental-Economic Accounting (SEEA) is an international statistical system that brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy and the impact of the economy on the environment (UN et al., 2012; referred to as SEEA 2012). Environmental accounts are "satellite accounts" to the System of National Accounts (SNA; UN et al, 2009; referred to as 2008 SNA). Satellite accounts are extensions to the national accounts that allow for conceptual variations in order to facilitate the analysis of the wider impact of economic change. Environmental accounts use similar concepts (such as residence) and classifications (e.g. for economic activities and products) to those employed in the SNA but at the same time enlarge the asset boundary to include also non-SNA assets, such as ecosystems, in recognition of the services they provide that often lie outside the market mechanism. They also introduce additional classifications (e.g. for residuals) and definitions (e.g. environmental subsidies).

**1.1.1 The SEEA conceptual framework**



By using common concepts, definitions and classifications, the SEEA provides a transparent information system for strategic planning and policy analysis which can be used to identify more sustainable paths of development. Because the environmental accounts are integrated with concepts from the national accounts, developments in the field of the environment and macro-economic developments can be directly compared. Key indicators can be derived from the environmental accounts that provide insight into sustainability with respect to the development of the environment and the economy. The integrated nature of the system makes it possible to quantify and analyse the underlying causes of changes in environmental indicators. The SEEA supports sustainable development and green economy policies and can be used to inform research and economic-environmental policies such as climate change mitigation, resource efficiency, natural resource management, evaluation of policy instruments and the development of the environmental goods and service sector.

The SEEA Central Framework was adopted as an international statistical standard by the United Nations Statistical Commission in February 2012. As an international standard, it has the same status as the System of National Accounts (SNA), from which key economic indicators as GDP are derived. SEEA provides an internationally agreed set of recommendations expressed in terms of concepts, definitions, classifications, accounting rules and standard tables which will help to obtain international comparability of environmental-economic accounts and related statistics.

## SEEA building blocks

The SEEA comprises three categories of accounts:

1. *Physical flow accounts*

Physical flow accounts show the origin and destination of materials in the economy and/or the environment, in a similar way to the supply and use tables of the national accounts. They take into account three types of material flows: natural inputs, products and residuals. Natural resources, such as crude oil, iron ore or wood, are the required inputs for economic production processes and thus flow from the environment to the economy. Products are materials that are produced or purchased within the economy; for example, energy products, food products and chemical products. Residual flows are materials that flow from the economy to the environment. These include emissions to air (carbon dioxide, sulphur oxides, fine dust), emissions to water (heavy metals, nutrients), emissions to soil (nutrients, etc.) and the production of waste and wastewater. Physical flow accounts make it possible to monitor the pressures the national economy exerts on the environment, in terms of both inputs of natural resources and outputs of residuals.

2. *Asset accounts*

Asset accounts describe the natural resources that are important for the economy. They show the opening and closing stocks and the changes that occur within the accounting period. These assets are accounted for in both physical and monetary terms. Examples are the asset accounts for natural gas and crude oil (subsoil accounts) or renewable resources, such as fish and timber stocks. Asset accounts make it possible to assess whether these natural assets are being depleted or degraded, or are being used in a sustainable way.

*3. Environmental activity accounts*
In these accounts, all sorts of economic transactions with an environmental aspect are identified separately from within the national accounts. Examples are environmental taxes, environmental subsidies and the emission trading system. They also include accounts for environmental protection and resource management expenditure that provide for the identification and measurement of society's response to environmental concerns. In addition, the environmental goods and services sector consists of a separate grouping of all economic activities with the intent of relieving pressure on the environment. With the aid of these economic accounts we can monitor the effectiveness and costs of environmental and climate policies as well as determine how important the environmental sector has become in terms of employment and output.

**Environmental statistics and environmental accounts**

There are several differences between Environment statistics and environmental accounts. Environmental statistics are usually directly based on the source statistics, i.e. surveys or registers. There is, often with good reason, no full consistency between one statistics and another. SEEA on the other hand provides an integrated set of a accounts in which there is full consistency between one account and another in terms of concepts, definitions and classifications. An important difference is that environmental accounts follow the residence concept that underlies the SNA. An institutional unit is said to be resident within the economic territory of a country if it maintains a centre of predominant economic interest in that territory (2008 SNA). GDP is an aggregate measure of production by all resident units. However, some of this production may occur abroad and as a result GDP differs from the sum of all production that takes place within the geographic boundaries of the national economy. Likewise, the environmental accounts record, for instance, air emissions as a result of activities of residents which differ from the emissions occurring on Dutch territory normally recorded in environment statistics. One of the tasks of the environmental accounts is to integrate source statistics based on territory principles, such as energy statistics, into residence-based accounts. At the same time bridging tables are compiled that link environment statistics to the environmental accounts.

## 1.2 The Dutch environmental accounts

Statistics Netherlands has a long history in environmental accounting (de Haan, 2004; Schenau et al., 2010). The bureau first presented an illustrative NAMEA (National accounting matrix including environmental accounts) in 1991. The original design contained a complete system of national flow accounts, including a full set of income distribution and use accounts, accumulation accounts and changes in balance sheet accounts. Statistics Netherlands has gradually extended the Dutch system of environmental accounts. In the past years accounts were developed for air emissions, water emissions, waste, energy and water, material flows, the environmental goods and service sector, and emission permits.

The Dutch environmental accounts are compiled following the general concepts, definitions and classifications as described in SEEA 2012 and the 2008 SNA. More specific information on the methodology can be found on Statistics Netherlands' website (www.cbs.nl). For some subjects specific methodological reports are available. The data of the Dutch environmental accounts are published in StatLine, the electronic database of Statistics Netherlands (http://statline.cbs.nl/StatWeb/dome/?LA=NL).

**This publication**

*The environmental accounts of the Netherlands 2011* consists of two parts. Part one provides a general overview of the most recent developments in the area of environment and economy by presenting all accounts for which Statistics Netherlands currently produces data. These are clustered in the following chapters:

*Green growth*
- What is green growth?
- Measuring green growth
- State of green growth in the Netherlands

*Energy*
- Energy consumption
- Oil and natural gas reserves

*Water*
- Water use
- Emissions to water

*Solid waste*
- Solid waste

*Greenhouse gas emissions and air pollution*
- Greenhouse gas emissions according to different frameworks
- Greenhouse gas emissions from production
- Greenhouse gas emissions from household activities
- $CO_2$ emissions on a quarterly basis
- Air pollution

*Policy instruments and economic opportunities*
- Environmental taxes and fees
- Environmental subsidies and transfers
- $CO_2$ emission permits
- Environmental protection expenditure
- Economic opportunities of the environmental goods and services sector

Part two presents four studies that provide more in-depth analyses for specific subjects. In chapter 8 it is investigated to what extent the module of the economy wide material flow accounts can be used to tackle policy issues related to resources needed for the Dutch economy, resource productivity, and import dependencies. A new methodology developed by Eurostat was applied to the Dutch situation to go "beyond" the current indicators for material use. Chapter 9 provides a full physical water balance for the Netherlands, both national and on a river basin scale. New data sources, such as data from remote sensing, helped to improve estimates for water balance items: precipitation, actual evapotranspiration, and the actual external inflow by rivers and outflow to the sea. Chapter 10 presents the provisional results of an assessment done by Statistics Netherlands to determine mitigation and adaptation expenditures of the government related to climate change. It concludes that the expenditure on climate change related issues has increased from 2.5 billion euro in 2007 to almost 3.3 billion euro in 2010, which constitutes 1.1 percent of total government expenditure. Chapter 11 examines the methodology for compiling water quality accounts. Taking the Water Framework Directive (WFD) as its point of departure, provisional estimates were obtained on the status of various types of Dutch surface waters, expressed in surface area. It also presents an analysis of the Dutch population (by province) by quality of the water resources in the neighbourhood where they reside.

# Green growth

# 2

# Green growth

## 2.1

**What is green growth?**
- OECD framework conceptual framework for green growth
- Environmental accounting and green growths

## 2.2

**Measuring green growth**
- Indicator selection and data sources
- Scoring of the indicators

## 2.3

**The state of green growth in the Netherlands**
- Environmental and resource efficiency
- Natural asset base
- Environmental quality of life
- Policy responses and economic opportunities

# 2.1 What is green growth?

The performance of an economy is usually measured in terms of changes in its gross domestic product (GDP). Economic growth, i.e. the increase of GDP, offers benefits such as welfare, but it also has some negative side effects. In this respect, there are multiple reasons to look at the nexus of the environment and economy. Non-renewable resources such as fossil fuels and some metals are becoming scarce, and renewable stocks, such as fish, are vulnerable to over-exploitation. In turn, these developments can hamper future growth. In addition, there is substantial scientific evidence that the quality of our environment is degrading to a critical level. For instance, global boundaries such as the concentration of greenhouse gases in the atmosphere, water extraction and biodiversity losses have exceeded their tipping points (Rockström et al. 2009; IPCC 2007). There is international consensus that more action is required (e.g. OECD, 2008; UNEP, 2009; UN, 2012).

As a result of these concerns, the notion of 'greening the economy' is receiving more attention from policy and decision makers. Green economy was one of the central themes on the Rio+20 Earth Summit in June 2012. According to the declaration of Rio+20, "a green economy in the context of sustainable development and poverty eradication is considered as one of the important tools available for obtaining sustainable development" (UN 2012, par. 56). Consequently, a sound measurement framework is required to guide and evaluate policy decisions and to evaluate current policies with respect to greening growth.

The concept of "greening the economy" is still relatively new. Recently, there have been two important initiatives that focus on the economic and ecological aspects of sustainability, namely the green growth strategy of the OECD and the green economy of UNEP. Although both initiatives broadly encompass the same topics, there are some conceptual differences. According to the definition formulated by the OECD (OECD, 2011a), green growth is about *"fostering economic growth and development while ensuring that the quality and quantity of natural assets can continue to provide the environmental services on which our well-being relies. It is also about fostering investment, competition and innovation which will underpin sustained growth and give rise to new economic opportunities"*. UNEP defines a green economy as one that results in *"improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities"* (UNEP, 2011). Statistics Netherlands has chosen to apply the OECD framework to measure green growth as this currently provides the most elaborate measurement framework.

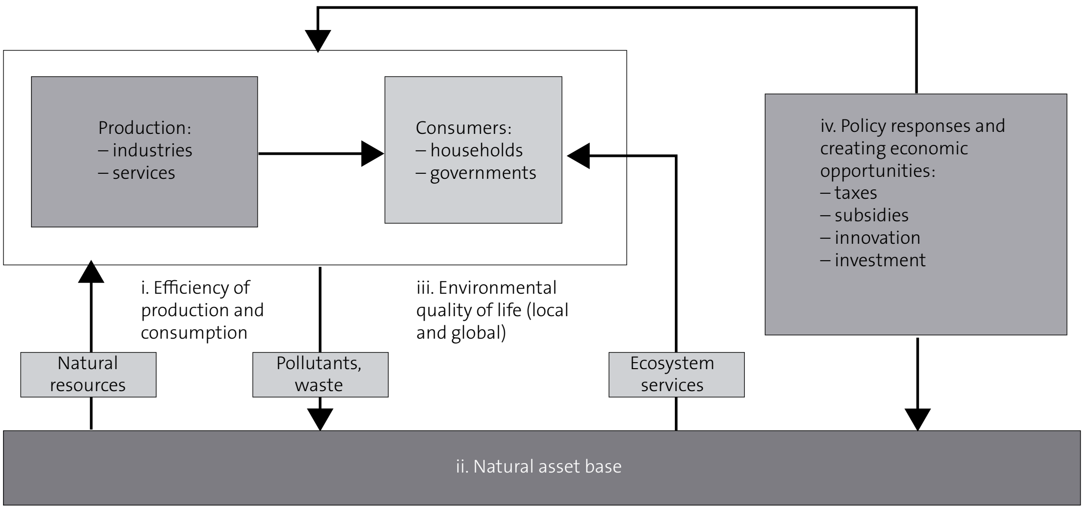
**OECD framework conceptual framework for green growth**

According to the OECD measurement framework for green growth, the indicators are broken down into four themes (OECD, 2011b):

1. Environmental and resource productivity of the economy
2. The natural asset base
3. The environmental quality of life
4. Policy responses and economic opportunities

5. Figure 2.1.1 shows how these groups of indicators interrelate. Economic production requires natural resources from the environment, such as energy, water, biomass, ores and other resources. The environment is also used as a sink to absorb emissions and waste. Therefore, environmental efficiency (for instance greenhouse gas emissions / economic growth) and its development are central measures of green growth. Due to globalizing supply chains, 'footprint' type indicators are essential to capture the worldwide environmental pressure resulting from national consumption requirements.

**2.1.1 Conceptual scheme of green growth indicators (OECD, 2011b)**




Source: Statistics Netherlands.

Furthermore, it is important to monitor whether an increasing environmental pressure does not turn into irreversible environmental damage. This is measured in the natural asset base, preferably in terms of quantity and quality of the stocks. The natural asset base is monitored by evaluating the stocks of the natural resources that are directly used for economic activities, including renewable assets, like timber, and non-renewable assets such as fossil energy reserves. Ecosystem related indicators are included as well. Due to the complexity of measuring the services that eco-systems provide to the economy, only indirect parameters are measured, such as land use changes and changes in biodiversity. The link between the environment and the population's quality of life is captured in the third set of indicators, and deals primarily on local environmental issues such as population exposure to pollution.

The shift to green growth requires different policy responses depending on the specific country's circumstances. In general, governments can choose between several policy instruments such as taxes, subsidies and regulations. The transition towards green growth also creates new opportunities for economic activities that may generate new jobs and stimulate economic growth. These last two aspects are measured by indicators for policy responses and economic opportunities.

### Environmental accounting and green growth

The System of Environmental-Economic Accounting (SEEA) provides a consistent and comprehensive measurement framework for green growth, as it integrates economic and environmental statistics. Both UNEP and the OECD advocate that environmental accounting is used as the underlying framework for deriving indicators. The OECD explicitly advocates that measurement efforts should, where possible, be directly obtained from the SEEA framework (OECD, 2011). A large number of the indicators from the OECD green growth monitoring framework can be directly obtained from the accounts of the SEEA central framework. Indicators for environmental efficiency and resource use can be derived from the physical flow accounts. Combining physical information with monetary indicators from the SNA provides information on the degree of decoupling between environmental pressure and economic growth. The asset accounts provide the basis for indicators related to the natural asset base. Environmental activity accounts offer useful information on the application and efficiency of various policy instruments, such as environmental taxes and subsidies. Finally, data from the environmental goods and service sector (EGSS) provides indicators for evaluation of economic opportunities that may be initiated by green growth.

# 2.2 Measuring green growth

Green growth is high on the political agenda. The Dutch government wants to make society more sustainable and simultaneously strengthen the economy. Greening the economy is not considered as a threat but as an opportunity for entrepreneurs to create new jobs and stimulate growth. By implementing sustainable solutions, Dutch companies may increase human well-being as well as strengthen their competitive position. In order to monitor and evaluate its policies, the Dutch government has asked Statistics Netherlands to develop monitoring frameworks for sustainability and green growth. Statistics Netherlands in cooperation with the national assessment agencies has published the sustainability monitor (Statistics Netherlands, 2011a). It has also published its first green growth report in May 2011 (Statistics Netherlands, 2011b).

### Indicator selection and data sources

The point of departure for the Dutch green growth indicator framework is the list developed by the OECD (OECD, 2011). In 2012 a revised set of 35 indicators was selected (see Table 2.2.1), based on the following criteria:

*A) Relevance for the Dutch situation*. Not all indicators from the OECD list are relevant for the situation in the Netherlands. For instance, the OECD indicator access to sewage treatment and sanitation is irrelevant for the Netherlands, as all households have access to these amenities. So, the indicator was omitted. Other indicators, not included in the OECD list, are introduced because of their relevance for the Netherlands, for example indicators on water quality.

*B) Coverage*. All themes of green growth must be covered sufficiently by indicators. Several new indicators were sought for the third theme of environmental quality of life.
*C) Interpretability*. Indicators should be clearly interpretable in relation to green growth.
*D) Data quality*. Indicators should meet general quality standards, namely analytical soundness and measurability.
*E) Consistency with other indicator sets*. Where possible, consistency with indicators of the Dutch Sustainability Monitor should be achieved.

Data for the Dutch green growth indicators originate from several different sources. Many indicators are derived from the Dutch environmental accounts. In section 2.3 where we present and discuss the Dutch set of green growth indicators, we will refer to more detailed information that are presented in the other chapters of this publication. Other indicators come from a variety of statistics, including environmental statistics, energy statistics, and innovation and technology statistics. A few indicators are obtained from sources outside Statistics Netherlands.

### Scoring of the indicators

A key aspect of measuring green growth is assessing the indicators. The scores are based on the evaluation of trends in greening growth. For example, when the share of renewable energy rises or the waste recycling percentage increases this is scored as "positive". If the trend is stable, such as a stable exposure to air pollution, the indicator is assessed as "neutral". If the trend deteriorates, such as a decline in biodiversity or decrease in energy reserves, the indicator is assessed as "negative".

It is important to emphasise that these scores do not convey the 'speed' of greening economic growth. For example, there is a growing share of renewables in energy production, but this 'positive' score does not express how fast the transition towards renewable energy production is taking place. In addition, the scores of the indicators also do not convey whether this is sufficient to prevent irreversible damage to the environment. For example, although nutrient and heavy metal emissions to the environment are steadily decreasing this may be insufficient to prevent damage to ecosystems and loss of biodiversity. The scores also do not convey if targets are met. In the first Dutch publication on green growth (Statistics Netherlands 2011b), the indicators were also evaluated with respect to policy goals, providing more insight into greening growth. The trend may look good but the targets are not reached. It also shows areas where policy targets could potentially be formulated.

The scores for environmental efficiency indicators are based on the relation between environmental pressure and economic growth. When economic growth exceeds the increase of the environmental indicator in a given period, it is called decoupling. Decoupling can be absolute or relative. Absolute decoupling occurs when the environmentally relevant variable is stable or decreasing and accordingly, the indicator has been assigned a positive score. Decoupling is said to be relative when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable. Relative decoupling is assigned a neutral score. No decoupling is scored as negative.

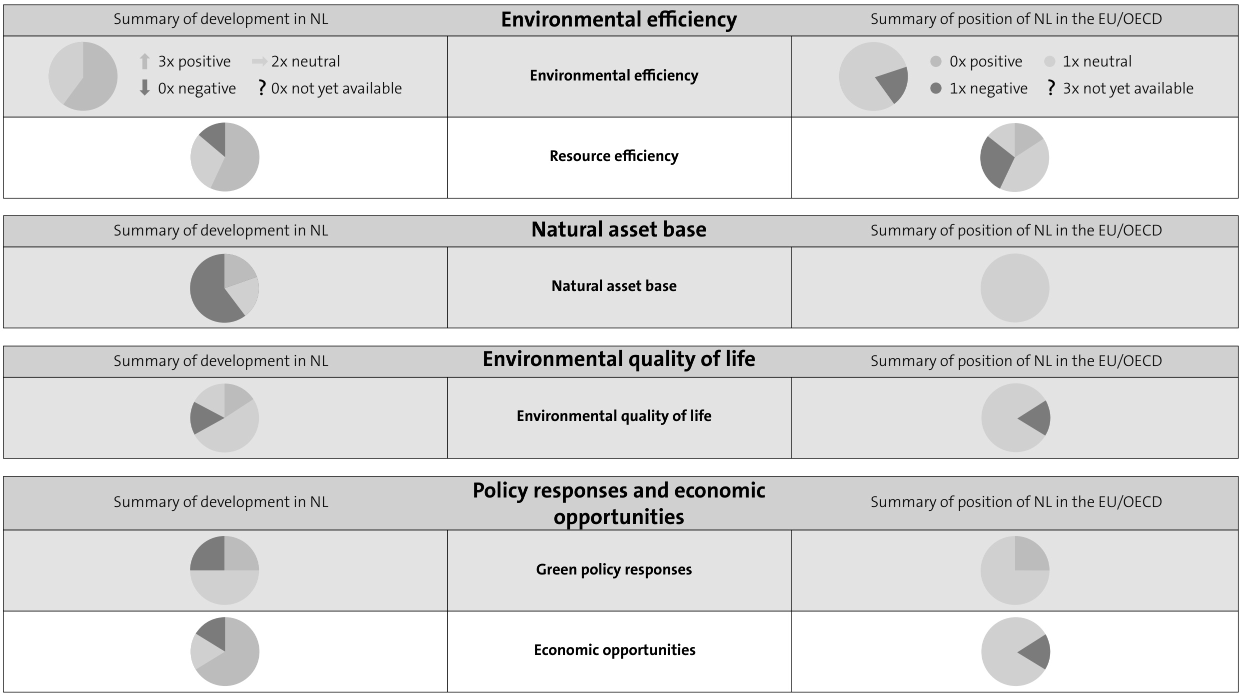
**Infographic for green growth**

Statistics Netherlands has developed an interactive infographic in 2012 to inform policymakers and the general public on the status of green growth in the Netherlands.[1)] This infographic is an interactive tool which enables users to find detailed information on green growth.

The infographic consists of two parts. In the left column of the infographic there are four dashboards that each represent one of the four themes of green growth. Consecutively, each dashboard contains a number of theme related indicators, represented by pie charts. The colours in the pie charts illustrate the trends of the indicators with regard to 'greening growth'.

1) See http://www.cbs.nl/en-GB/menu/themas/dossiers/duurzaamheid/cijfers/extra/2012-groene-groei-visualisatie.htm

### 2.2.1 Infographic for green growth




By clicking on the themes the user can show the graphs of individual indicators for that theme, view the actual data of the indicators and read some background information such as their interpretation and relation to green growth. For some indicators more information on industry level is available, which can also be shown by clicking. In the right column the indicators are compared with different OECD countries (international benchmarking). Here, the Netherlands can be compared to the other countries on the various aspects of green growth. Indicators are scored grey when no data is (yet) available.

# 2.3 The state of green growth in the Netherlands

### Environmental and resource efficiency

Overall, the Dutch economy exerts less direct pressure on the environment than in 2000. All environmental efficiency indicators for emissions and waste show absolute decoupling with economic growth. Greenhouse gas emissions caused by production activities have been reduced since 2000 (see 6.1 and 6.2). The levels of other harmful emissions to air, such as fine dust and smog forming substances are also steadily decreasing (see 6.5). Since 2000, nutrient surpluses by agriculture are down, while the value added by agriculture is up (absolute decoupling). Cutting nutrient emissions to the soil has a positive influence on the quality of soil, ground and surface water, which in turn has a positive influence on biodiversity. Despite the improvement, the Netherlands still has one of the highest nutrient surpluses of the OECD countries. Heavy metal emissions to water have fallen significantly thereby reducing the emission intensity (see 4.2). The volume of waste generated also decreased (see 5.1).

On the whole, indicators for resource use show that fewer resources are required to generate an equal amount of output. Energy use for economic production is still rising, but less than the GDP growth rate (see 3.1). The percentage of renewable energy production is increasing steadily, but it is still low compared to fossil energy carriers. The total amount of groundwater used has decreased since 2000 (see 4.1). Although water is not scarce in the Netherlands, fresh groundwater stocks are under pressure by competing uses, particularly during the summer months. There is less domestic use of inorganic minerals and metals, while the value added of the main industrial users is higher (absolute decoupling) (see chapter 8). Only the use of biomass and organic products is still increasing. One of the major challenges in the transition to green growth is to ensure that materials are used efficiently. The percentage of reused waste is steadily rising (see 5.1).

### Natural asset base

Although environmental efficiency is gaining ground, it does not mean that the economic growth is not causing irreversible damage to the environment. This is measured by indicators for the natural asset base. The group of indicators for the natural asset base shows a rather negative picture. The natural asset base is measured for both renewable and non-renewable stocks and indicators on eco-systems. The Dutch natural gas reserves, the most economically relevant non-renewable resource, are rapidly being depleted (see 3.2). A declining total stock is perceived as an indicator of unsustainable performance, as the stocks are likely to run out in a couple of decades given the current extraction rates and the absence of significant discoveries and revaluations.

Indicators for ecosystems show that land is still converted into built-up land. The conversion of nature, forests or agricultural land can been seen as a broad proxy for the pressure on the ecosystems and biodiversity. The same environmental pressure is also seen in the decrease of the European Farmland Bird Index. This is probably caused by intensive use of cultivated land, changes in crop choices and the increase of scale in agriculture. Renewable assets, such as stocks of standing timber (forests), are increasing. In economic terms, however, forestry is relatively small in the Netherlands. The main benefits derived from forests are recreation and biodiversity. The quality of marine ecosystems is measured in terms of the quality of fish stocks in the North Sea. This is indicated by the share of six important fish species for consumption, which are above the precaution limits for reproduction. It was found that the fish stocks are recovering probably because of the EU catch limits, but two species are still below the precaution limits for reproduction.

**Environmental quality of life**

Indicators for the environmental quality of life show a rather mixed picture of green growth. This theme involves the direct impact of air, water and soil emissions on the quality of life and perception. The human exposure to environmental pollution and environmental risks has an impact on public awareness of environmental concerns, well-being and related health costs. Water quality is an important environmental issue in the Netherlands as very few water bodies comply with the ecological quality standards defined by the European Water Framework Directive. The air quality is measured by urban exposure to particulates (PM10). The exposure is stabilizing. The quality of the soil is measured by the nitrate concentrations in groundwater. The nitrate concentrations are decreasing. On average, the target of 50 mg nitrate / l has almost been reached. Indicators for perception of environmental concerns are stable.

**Policy responses and economic opportunities**

There are several policy instruments that can be used to stimulate green growth. Environmental taxes and subsidies provide key policy instruments that can create incentives to reduce environmental externalities. The share of environmental taxes in total tax revenues has been constant for several years (see 7.1). The average burden of taxes on energy use is up. A shift in taxation from labour to energy consumption may foster initiatives to improve energy efficiency. The share of environmental subsidies in total government expenditures has been constant since 2005 (see 7.2). Environmental expenditure as a share of GDP has decreased in recent years (see 7.4). The development of total environmental expenditure is an indicator of the financial resources that a country/ economy has committed for the protection of the environment.

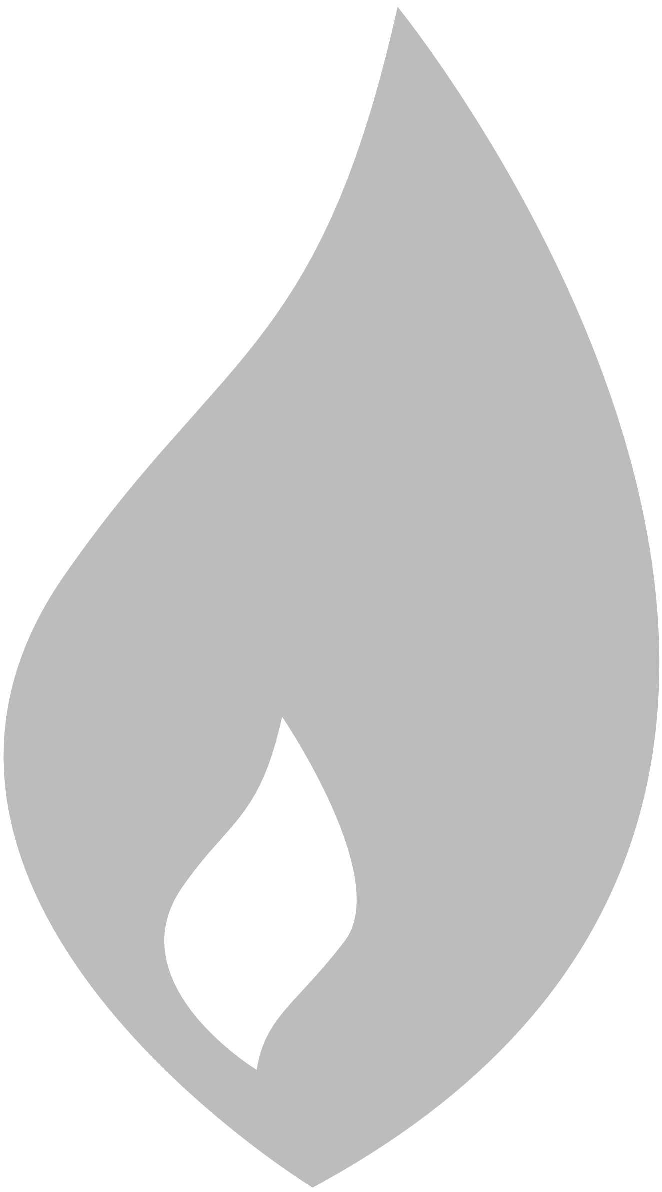
Another way to grow green is by innovation and creating economic opportunities. Several indicators show that there are more economic opportunities that arise from greening the economy. The share, but also the absolute number of green patent applications has grown since 2000, indicating an upward trend in the inventiveness and knowledge-intensification of the country in the field of green technologies. The share of environmental investments has increased till 2007, but have since gone down (see 7.4). Cleaner technologies make production processes more environmentally benign. In addition, the production of environmental technologies by specialised producers may contribute to economic growth. There share of employment in the environmental goods and services sector (EGSS) in total employment is up, whereas its share in value added in GDP started to increase since 2005 (see 7.5). With its contribution to innovation and job creation, the environmental goods and services sector is an important driver of a green economy.

### 2.3.1 Scores of green growth indicators

| Theme | Indicator | Time series | Trend |
|---|---|---|---|
| **Environmental efficiency** | Production based GHG | 2000–2011 | + |
| | Consumption-based GHG emissions | 1996–2009 | ± |
| | Emissions heavy metal to water | 2000–2010 | + |
| | Nutrient surpluses agriculture | 2000–2010 | + |
| | Waste | 2000–2009 | + |
| | Net energy use | 2000–2011 | ± |
| | Renewable energy | 2000–2011 | + |
| | Groundwater use | 2000–2010 | + |
| | Domestic metal consumption | 2000–2010 | + |
| | Domestic mineral consumption | 2000–2010 | + |
| | Domestic biomass consumption | 2000–2010 | ± |
| | Waste recycling | 2000–2010 | + |
| **Natural asset base** | Stocks of standing timber | 2000–2010 | + |
| | Stocks of fish | 2000–2011 | ± |
| | Energy reserves | 2000–2011 | – |
| | Farm bird index | 2000–2009 | – |
| | Land conversion into built-up land | 1996–2008 | – |
| **Environmental quality of life** | Urban exposure to particulates | 2000–2008 | ± |
| | Chemical quality surfacewater | 2009 | |
| | Ecological quality surfacewater | 2009 | – |
| | Nitrate concentration in groundwater | 2000–2009 | + |
| | Level of concern | 2000–2002 | ± |
| | Willingness to pay | 2000–2003 | ± |
| **Policy responses and economic opportunities** | Share of green taxes | 2000–2011 | ± |
| | Implicit tax rate for energy | 2000–2011 | + |
| | Environmental transfers / subsidies | 2005–2010 | ± |
| | Environmental expenditure | 2000–2009 | – |
| | Green patents | 2000–2008 | + |
| | Government outlays for green R&D | 2000–2010 | – |
| | Environmental investments | 2000–2009 | ± |
| | Employment renewable energysector | 2008–2010 | + |
| | Employment (EGSS) | 2000–2010 | + |
| | Value added EGSS | 2000–2010 | ± |

# Energy

# 3



# Energy

## 3.1

**Energy consumption**

- Sharp decrease in energy use in 2011
- Increase in net energy use since 2000
- Energy intensity decreased in 2011
- Less energy dependency
- Rising energy costs

## 3.2

**Oil and natural gas reserves**

- Diminishing production of natural gas
- Oil production increasing slightly
- Value of gas reserves down by 7 percent
- Natural gas revenues continue to be important
- Depletion of oil and gas reserves reduces net national income by 1.8 percent

# 3.1 Energy consumption

Energy is essential to all economic activities as input for production processes and as a consumer commodity. As global demand for energy increases and non-renewable energy resources like crude oil and natural gas become scarce, energy prices increase to a point where they may hamper future economic developments. The impact of economic developments on the environment is largely determined by the consumption of energy. Energy use is often directly linked to the emission of the greenhouse gas $CO_2$ and many other environmental pollutants. Improving energy efficiency and decoupling energy consumption from economic growth are major goals for green growth. The energy accounts provide an overview of energy production and consumption by different industries and by households. The data are fully consistent with the concepts of the national accounts. The energy accounts can be used to determine how energy use by economic activities changes over time, which industries are most energy intensive, how efficiently energy is used in production processes and how dependent the economy is on energy imports[1)].

The methodology of the energy accounts is described in the report *The Dutch energy accounts* (Schenau, 2010). The data of the energy accounts can be found in StatLine, the online database of Statistics Netherlands.

### Sharp decrease in energy use in 2011

Net energy use by Dutch economic activities decreased by 5.8 percent with respect to 2010. This means that economic growth rose (1.0 percent) while energy use fell (absolute decoupling). Particularly the use of natural gas and naphtha decreased, while the use of motor fuels and electricity increased slightly. The main reasons for the slowdown in energy consumption are the mild winter, the lower electricity production level and the reduced production level in the petrochemical industry.

Overall, energy use in manufacturing and mining fell by 4.6 percent while value added increased by 1 percent. The development of energy use by the different industries in manufacturing shows a mixed picture. Oil consumption by the petrochemical industry – where the base material for plastic products is produced – fell by 10 percent. This was a direct response to the economic crisis that started by mid-2011. The petrochemical industry is very sensitive to economic ups and downs. Still, energy use increased in oil refineries and basic metal producers, which are both very energy intensive industries. The consumption of energy generally decreased in other manufacturing, where the strongest decrease was observed in the manufacturing of transport equipment and non-metallic mineral products.

Domestic electricity use increased by 1 percent in 2011. However, the amount of electricity generated in the Netherlands has declined over the last year. The main reason is that the

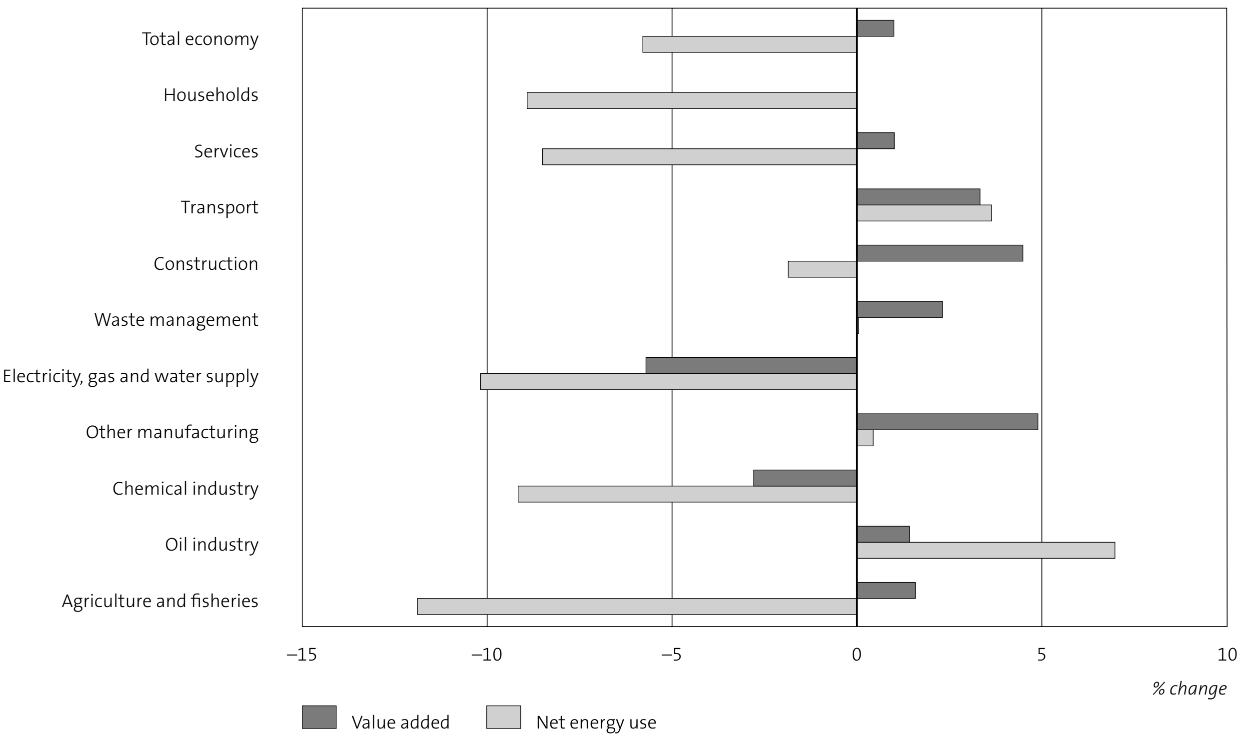
1) In this chapter energy use is equal to all net energy use, which is defined as final energy use for energetic and non- energetic purposes by residents plus transformation losses by residents.

amount of imported electricity grew substantially while exports decreased. It was cheaper to import electricity in 2011 than to generate it in the Netherlands. As a result, less natural gas and coal was required to produce electricity and heat. Power stations running on natural gas are also far more efficient than the obsolete power stations which were recently closed down.

The transport sector achieved a positive economic result in 2011, although the growth rate in the second half of the year declined. The output of inland shipping in particular rose sharply. As a result, the consumption of diesel by inland shipping increased, but relatively less than the production because water transport became more energy efficient. Dutch marine vessels did not transport more goods, so accordingly less gas oil and fuel oil was consumed. The aviation sector consumed 6 percent more kerosene. Dutch national airports saw passenger numbers increase to almost 54 million in 2011, a record high. More goods were transported by road, increasing fuel consumption by 1 percent.

The winter months of 2011 were relatively warm compared to 2010, so less natural gas was consumed to heat homes and offices. Energy use in agriculture fell by more than 10 percent while production levels remained more or less the same as in the previous year. In horticulture, less natural gas was needed to heat the greenhouses. Energy consumption also fell sharply in the services sector.

**3.1.1 Change in value added and net energy use, 2010–2011**



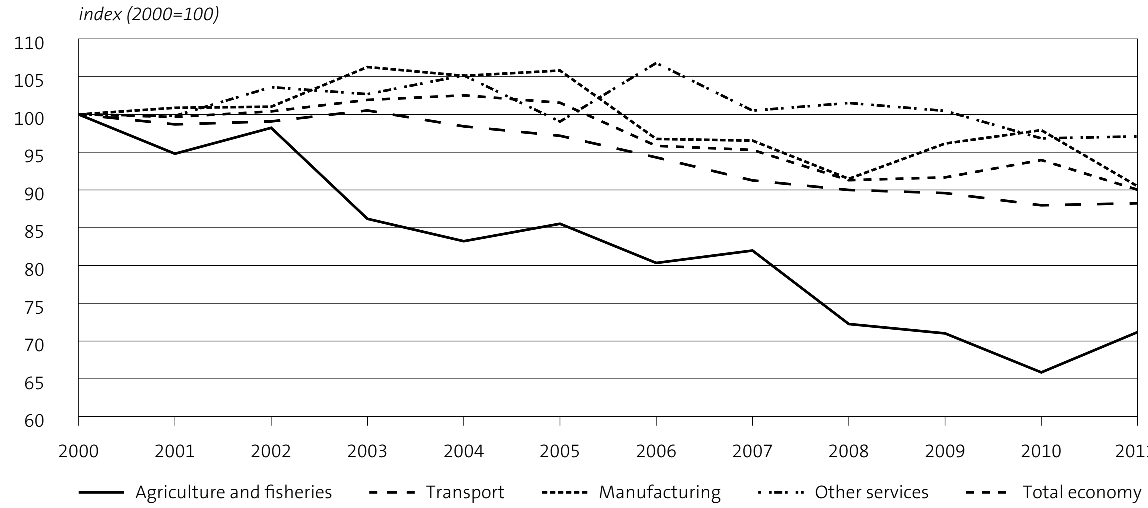
### Increase in net energy use since 2000

Net energy use of the Dutch economy has increased by 3 percent since 2000. Accordingly, there is relative decoupling between energy use and economic growth with respect to this year. Net energy use rose in aviation, the chemical sector, and refineries whereas it fell in horticulture, water transport and the manufacturing of food products. Energy use declined in fisheries, manufacture of textile and leather products, manufacture of paper and paper products, publishing and printing, manufacture of other non-metallic mineral products and manufacture of transport equipment.

### Energy intensity decreased in 2011

Energy intensity, defined as energy use per unit of value added (fixed price level), is an indicator for the energy efficiency of the economy or different industries. A decrease in energy intensity can be caused by more efficient energy use in production processes, for example by energy conservation, or by systematic changes in the economy. Variation in temperature also effects the year-on-year changes of the energy intensity, particularly for the service industries and agriculture. Figure 3.1.2 shows the energy intensities of industries adjusted for this temperature effect. The energy intensity of the Dutch economy has decreased by 10 percent since 2000. Agriculture and manufacturing in particular contributed to this improvement, as did the transport and the services sector. In 2011, the energy intensity of the economy as a whole decreased by 4 percent on the previous year. This was mainly due to the manufacturing industries.

**3.1.2 Energy intensity of industries and the economy, corrected for weather influences**




### Less energy dependency

Energy sources such as oil, coal or natural gas can be either extracted from a country's own territory or imported. If a great many resources have to be imported, a national economy will become very dependent on other countries. Energy dependency can be calculated as the share of net domestic energy consumption originating from imported energy products. In 2011 the energy dependency of the total Dutch economy was 56 percent[2)]. This means that more than half of net energy consumption originates from outside the Netherlands, while the remainder was extracted within its own borders. The Netherlands has substantial stocks of recoverable natural gas beneath the surface. Since its discovery in the 1950s and 1960s, natural gas has been extracted for the benefit of the Dutch economy. Accordingly, the Netherlands is self-supporting with respect to natural gas. For oil and coal, however, the situation is quite different. The few oil fields on the Dutch territory do not supply enough crude oil to meet the large domestic and foreign demand for Dutch oil products. Since the closure of the coal mines in the province of Limburg, all coal has been imported.

Between 1996 and 2007 the Dutch economy became increasingly dependent on imported energy sources. The share of imported energy rose from 51 percent in 1996 to 59 percent in 2007. This increasing dependency was mainly caused by the growing demand for oil products. In the 1990s the growing demand for crude oil products was compensated by the use of natural gas supplied by domestic sources for the production of electricity. The domestic demand for natural gas has been stable since 2000. As a side effect of the financial crisis, energy dependency decreased between 2008 and 2009 as the domestic demand for gas increased in relative terms, while the domestic demand for oil products decreased. 2011 saw an increase in energy dependence to 56 percent mainly because less natural gas was used for heating as a result of the mild winter.

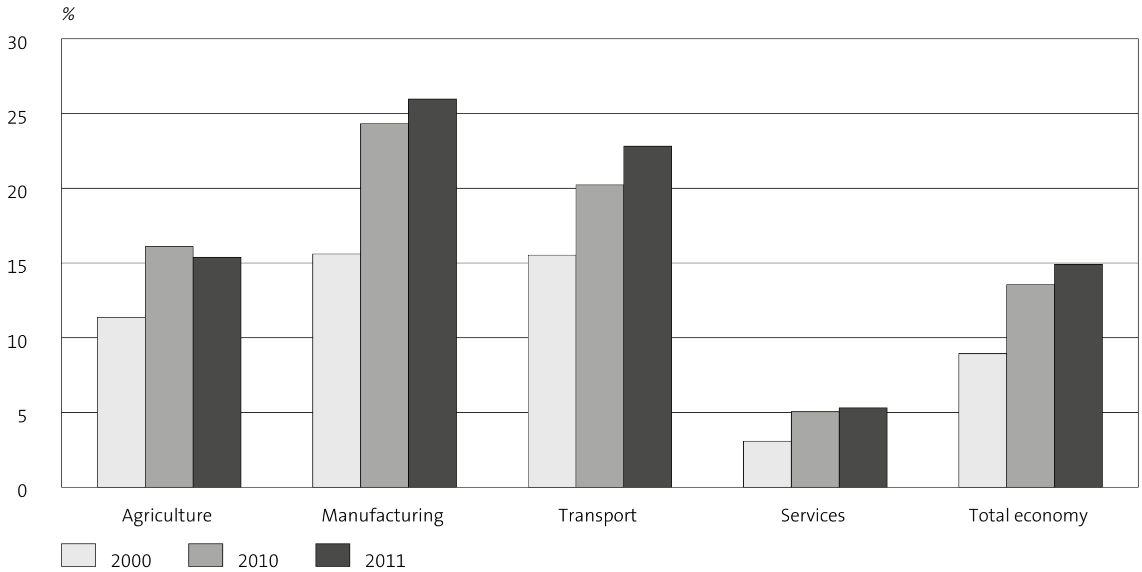
### Rising energy costs

Energy costs for companies increased from 81 billion euro in 2010 to 94 billion euro in 2011. Although energy use fell, energy prices rose sharply in 2011. Prices of crude oil, natural gas and coal were significantly higher in 2011 than in 2010. The price rise is partly caused by growing global demand for energy particularly by the emerging economies of China and India, by Japan because of the earthquake and because of the less favourable exchange rate of the euro against the dollar. Oil refineries paid over 30 percent more than in 2010, when the price of crude oil had already gone up by nearly 40 percent. Price rises continued into 2011 as a result of international insecurity, e.g. turmoil in North Africa and the Middle East. Households also had to pay more for their energy as a result of the higher energy prices. In 2011 households spent almost 11 percent of their total spending budget on energy (natural gas, electricity, motor fuels).

Energy costs have risen for companies since 2000. While they accounted for only 9 percent of the total intermediate consumption of companies in 2000, they had risen to 15 percent in 2011. Energy costs are particularly important in manufacturing, horticulture and transport.

2) In the calculation of the energy dependency it is assumed that the imported energy cannot be substituted by energy extracted from the national territory. If complete substitution is assumed, the energy dependency would be lower. For example, the Netherlands extract more natural gas than is needed for domestic use. If this surplus gas could be substituted for crude oil or oil products (which have to be imported), the energy dependency would be around 25 percent.

### 3.1.3 Share of energy costs in intermediate consumption




# 3.2 Oil and natural gas reserves

The Netherlands has significant quantities of natural gas as well as some smaller oil deposits. Since the discovery of these natural reserves in the fifties and sixties they have been exploited for the Dutch economy. The extraction of natural gas makes a significant contribution to the Dutch Treasury and to economic growth. These resources are not inexhaustible, however. Although new reserves are discovered occasionally, more than 70 percent of the initial gas reserves has already been extracted, to our current knowledge. This chapter addresses the physical and monetary aspects of oil and natural gas reserves.

The methodology for the valuation and compilation of stock accounts for the oil and natural gas reserves is described in the report “valuation of oil and gas reserves in the Netherlands 1990 -2005” (Veldhuizen et al., 2009). The physical data of the oil and natural gas reserves can be found in the annual reports ‘Oil and gas in the Netherlands’ / ‘Natural resources and geothermal energy in the Netherlands’ (1987–2010), (TNO / Ministry of Economic Affairs, 1988 – 2010; TNO/EL&I 2011–2012).

## Diminishing production of natural gas

In 2011, the production of natural gas[3)] from the Dutch gas fields amounted to 79 billion standard cubic metres ($Sm^3$)[4)] compared to 86 billion $Sm^3$ in 2010. Compared to 2010, total production was down by 8.5 percent, which is primarily due to the mild winter at the end of 2011.

### 3.2.1 Physical balance sheet of natural gas

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| | *billion $Sm^3$* | | | | | |
| Opening stock | 1,865 | 1,997 | 1,836 | 1,572 | 1,390 | 1,304 |
| Reappraisal | 248 | –45 | –59 | –62 | –86 | –74 |
| New discoveries of natural gas | 33 | 15 | 25 | 15 | 5 | 6 |
| Re-evaluation of discovered resources | 287 | 18 | –17 | –46 | –5 | –2 |
| Gross extraction (at the expense of the reserve) | –72 | –78 | –68 | –73 | –86 | –79 |
| Underground storage of natural gas[1)] | | | 1 | 0 | 2 | 2 |
| Other adjustments | 0 | 0 | 0 | 42 | –2 | –2 |
| Net closing stock | 2,113 | 1,952 | 1,777 | 1,510 | 1,304 | 1,230 |

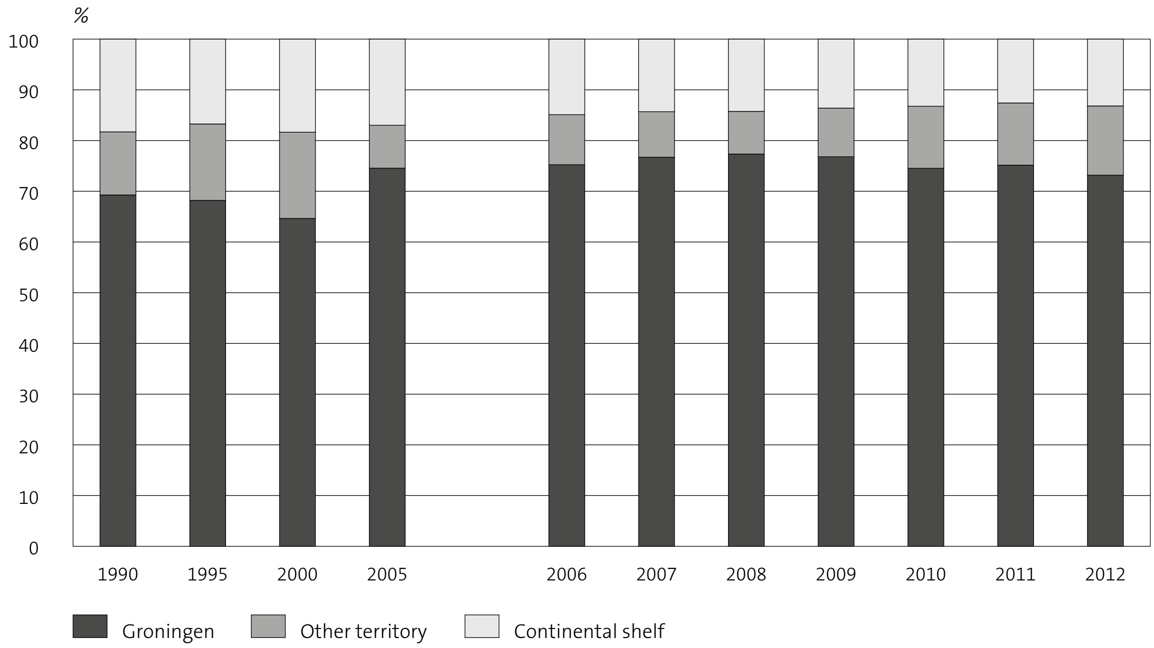
Source: TNO / Ministry of Economic Affairs (1987–2010) 'Oil and gas in the Netherlands'; TNO/EL&I (2011–2012), 'Natural resources and geothermal energy in the Netherlands'.
1) In 1997 natural gas has been injected in one of the underground storage facilities for the first time.

On 31 December 2011, the remaining expected natural gas reserves were estimated at 1,230 billion $Sm^3$. This corresponds to 41,641 petajoule. The Dutch economy used 3,498 petajoule of net energy in 2011, part of which was imported. If the net annual production remains constant at its 2011 level, Dutch natural gas will last for about 16 more years.

At the end of 2011 the Groningen field held 73 percent of the remaining expected reserves. In terms of heat equivalents – a measure that corrects for differences in quality – Groningen holds about 72 percent of the reserves. Between 1990 and the present, the share of the Groningen reserves has fluctuated between 64 and 77 percent. The share of off-shore reserves declined over time. This illustrates the small fields policy of the Netherlands, according to which small fields are exploited first via various incentives, and the Groningen field has a balance function.

3) The production equals the gross extraction at the expense of the reserve which excludes the use of natural gas from underground storage facilities as these are considered inventories that have been produced already.
4) The 'standard' cubic meter ($Sm^3$) indicates a cubic metre of natural gas or oil under standard conditions corresponding with a temperature of 15 °C and a pressure of 101,325 kPa.

**3.2.2 Distribution of natural gas reserves**




Source: TNO / Ministry of Economic Affairs (1987–2010) 'Oil and gas in the Netherlands'; TNO/EL&I (2011–2012), 'Natural resources and geothermal energy in the Netherlands'.

## Oil production increasing slightly

The production of oil increased slightly by 0.6 percent compared to 2010. This is primarily due to the Schoonebeek field which started producing again in 2011. Production had been suspended since 1996, as it was becoming more and more difficult to extract the viscous oil.[5] However, with new techniques such as low pressure steam injection in combination with horizontal wells, it is again economically feasible to produce. The expected oil reserves were estimated at 40.4 million $Sm^3$ at the end of 2011, which is a reduction of 12 percent compared to 2010. This is caused by the production of 1.27 million $Sm^3$ of oil, but more importantly, by a negative revaluation of 4.0 million $Sm^3$.

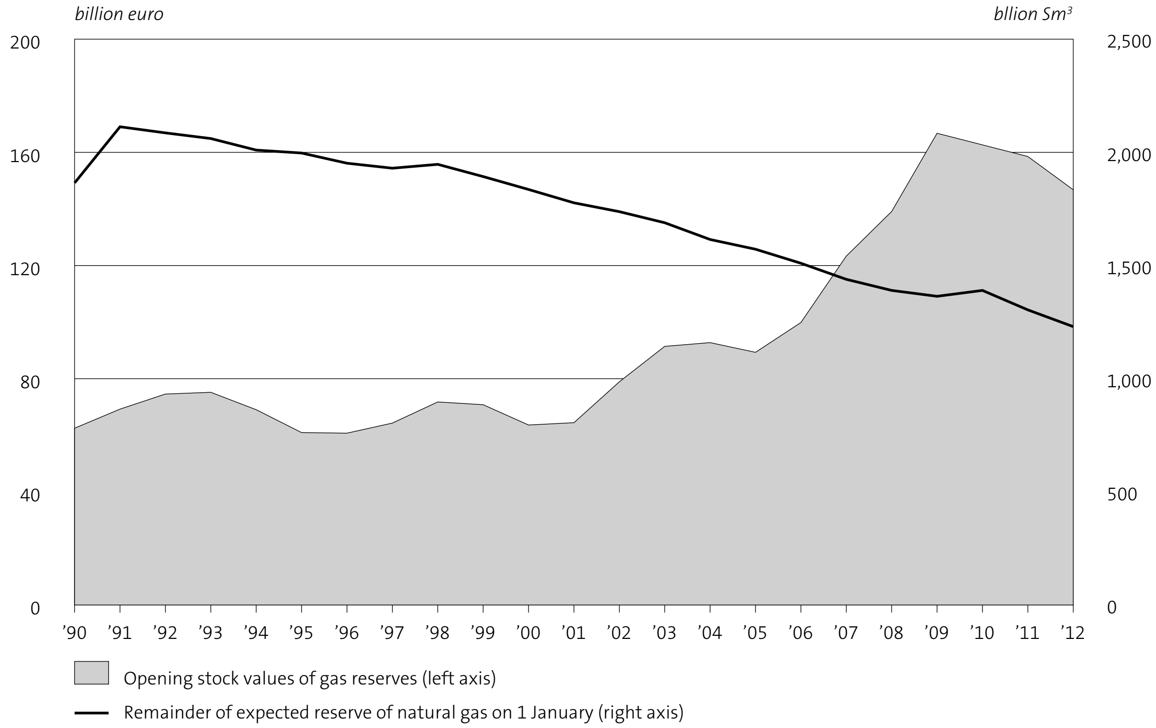
## Value of gas reserves down by 7 percent

On 1 January 2012, the value of the reserves of natural gas[6] amounted to 147 billion euro. This is 7 percent less than in 2011 when the reserves were estimated at 159 billion euro. The decrease in value is primarily caused by the decrease in the expected reserves due to extraction, and to a lesser extent to negative revaluation. Although energy prices rose by an average of 20 percent in 2011, the revaluation effect is negative as a 3 year moving average of unit resource rents

[5] http://www-static.shell.com/static/nam/downloads/pdf/biblotheek/redevelopment_schoonebeek_oil_field.pdf accessed June 2012.
[6] In the absence of market prices, the value of oil and gas reserves has been derived with the net present value methodology in which assets are valued as discounted streams of expected resource rent. More information on the various assumption used can be found in (Veldhuizen et al., 2009; Statistics Netherlands, 2007; 2009).

is used in order to smooth the effect of price volatility, and 2009 and 2010 evidenced price decreases.

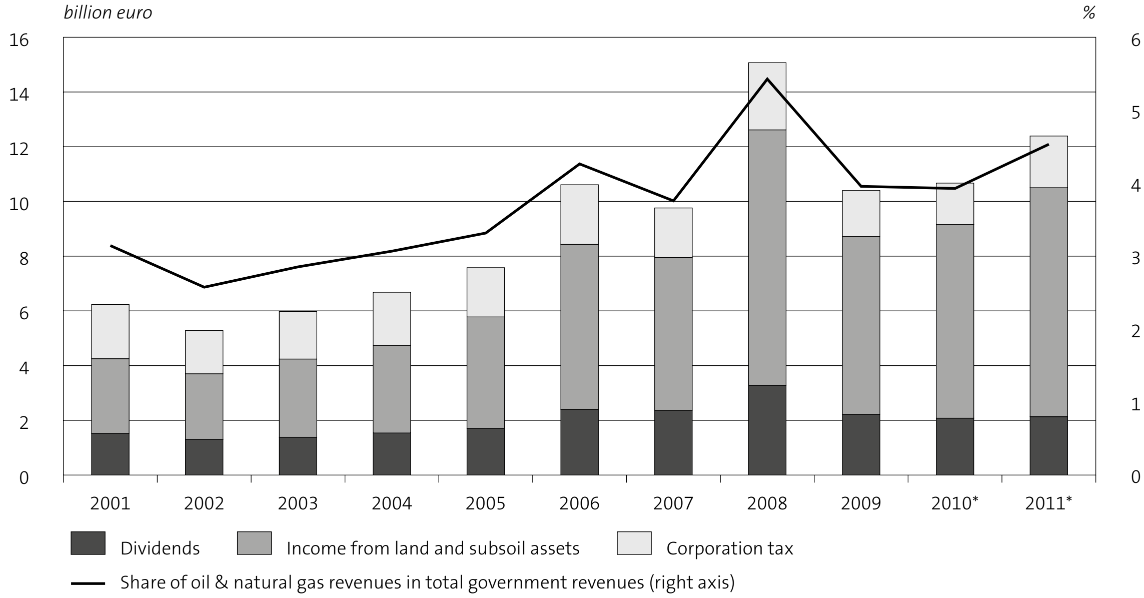
### 3.2.3 Natural gas reserves in physical and monetary units




## Natural gas revenues continue to be important

Around 80 percent of the rents earned with the extraction of oil and gas reserves are appropriated by the government through fees and royalties. The remainder flows to the oil and gas industry. In 2011 government revenues from oil and gas amounted 12.4 billion euro, a significant increase on the 10.7 billion euro in revenues for 2010. This equals a 4.5 percent contribution to the Treasury. The revenues consist of dividends, corporation tax and income from land and subsoil assets in the form of concession rights. Over the last ten years, the benefits arising from oil and gas extraction, contributed an average 3.8 percent to the total revenue of the Dutch Government, with a peak of 5.4 percent in 2008.

### 3.2.4 Oil and natural gas revenues and their share in government revenues




Source: Statistics Netherlands (2012c); Table D.13.2

## Depletion of oil and gas reserves reduces net national income by 1.8 percent

The total value generated by the exploitation of the oil and natural gas reserves is regarded as income in the national accounts. The System of National Accounts (SNA) does in fact record the depletion of natural resources in the balance sheets but not in the production or income generation accounts. From a perspective of sustainability, it is not correct to regard the complete receipts from exploitation of oil and natural gas reserves as income. The extraction hampers future opportunities for production and income. So the depletion costs should be properly offset against income, just as the depreciation of produced assets is treated via the 'consumption of fixed capital'. This would constitute equal treatment of natural and produced capital used in production.

In SEEA balancing items of the current accounts, such as net income and savings, are adjusted for depletion in addition to consumption of fixed capital. The depletion of the Dutch oil and natural gas reserves causes a downward adjustment to net national income in 2011 of 1.8 percent. This is a slight decrease compared to 2010 when the adjustment was 2.1 percent.[7)] This is primarily because there was less physical extraction in 2011 than in 2010.

[7)] The methodology for valuing depletion has been revised in light of the new recommendations of the SEEA Central Framework (UN et al., 2012).

# Water

# 4

# Water

## 4.1 Water use

- Less ground and surface water abstracted by the Dutch economy in 2010
- Household use of tap water per capita declined after 1990 peak value
- Tap water use by industries high during 1990s and stable since 2005
- Water use in livestock production determined by weather and livestock numbers
- Lower groundwater use intensity
- Regional water use
- Fresh ground water abstraction in all river basins dominated by water supply industry

## 4.2 Emissions to water

- Emissions to water decrease
- Treatment efficiency sewage industry improves
- Horticulture responsible for an increase in nutrient emissions

# 4.1 Water use

Water plays a key role in the Dutch economy. Water is abstracted from the environment and can be used as a direct input in production processes, for instance for cooling purposes. The water supply industry abstracts a large amount of fresh water to produce tap water of drinking water quality that is subsequently used by industries and households. Depending on its source, a distinction can be made between flows of surface water and groundwater. Moreover 'other kinds of water'[1] play an important role in the economy. Given the importance of water for society, there are policies in place to reduce water pollution and protect ground and surface water bodies. The water accounts provide information on water abstraction, water supply and use by different industries and households. Integrating water data with economic information makes it possible to monitor water conservation policies.

The methodology and sources used for compiling the water flow accounts are described in the reports *Dutch water flow accounts* (Graveland, 2006) and in *Water abstraction and –use at River Basin Level* (Baas and Graveland, 2011). The data of the water accounts can be found on StatLine, the electronic database of Statistics Netherlands.

### Less ground and surface water abstracted by the Dutch economy in 2010

The total abstraction of groundwater by the Dutch economy in 2010 amounted to 1,014 million $m^3$, which is a reduction of 1 percent compared to 2009. Although abstraction by agriculture increased slightly as a result of a dry spring and summer so that additional irrigation was required, this was more than offset by a reduction in use and abstraction of groundwater in the manufacturing industry. Abstraction from surface water amounted to 13.9 billion $m^3$ in 2010, down 2 percent on 2009. This is mainly explained by reduced demand from chemical manufacturing. The water supply companies also abstracted 4 percent less surface water.

### Household use of tap water per capita declined after 1990 peak value

In 2010 around 7.3 percent of the water abstracted from ground and surface water was turned into tap water supplied by the water supply industry. Total tap water use in 2010 amounted to 1.1 billion $m^3$. Households account for 72 percent of overall tap water use in the Netherlands[2]. Since 1990, the total annual amount of water used by households increased by only 0.5 percent, despite population growth. Through efficiency measures such as water saving toilets and shower heads as well as improved household appliances such as dishwashers and washing

[1] 'Other water' is water of different, superior or inferior quality compared to tap water such as unfiltered and filtered water, or distilled and demineralised water. This water is produced by water companies or other industries and delivered to other companies, particularly the chemical industry. This category of 'other water' on average compares to 6–7 percent of the total use of tap water (VEWIN, 2012). The delivery of 'other water' by the water companies is excluded from tap water.

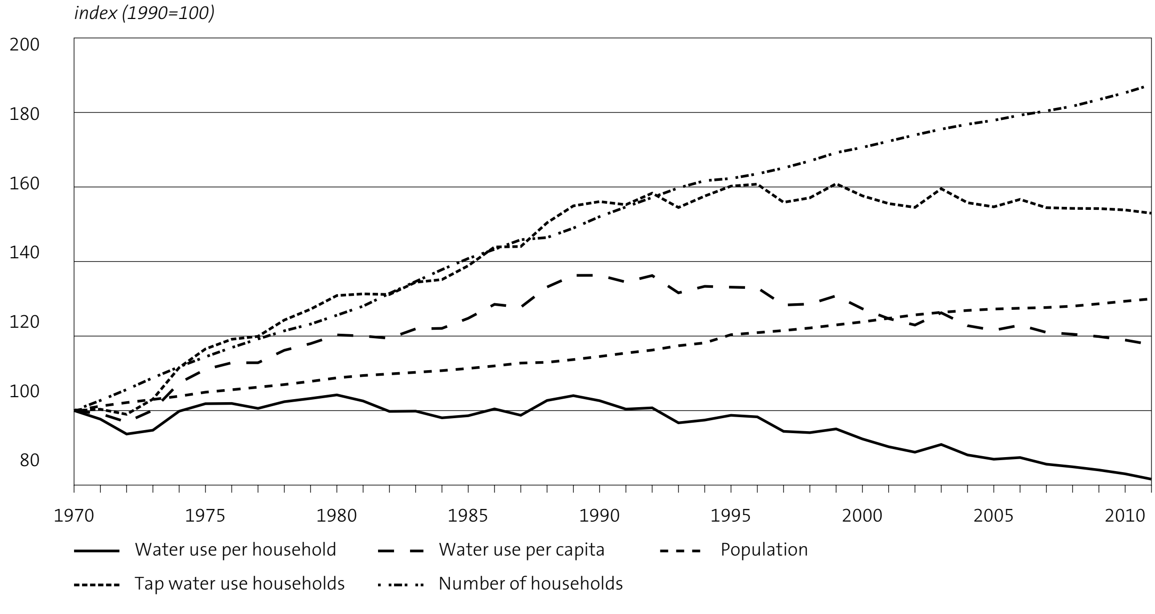
[2] Due to a break in the data in 2007, as a result of a shift from business use to residential use, the figures provided here for households and industries are adjusted for the period before 2007 and as a result differ from the VEWIN figures. For 2007 onwards figures are identical with VEWIN figure (See also Lodder, 2012; VEWIN water statistics 2007, 2010, 2012).

machines, annual household water use per capita has been reduced from 54 $m^3$ in 1990 to 47 $m^3$ in 2011. This is a 12 percent decrease in twenty one years.

Daily tap water use per capita was 109 litres in 1970, peaked in 1990 when it was close to 150 litres, and came to 129 litres in 2011, which is equal to 47 $m^3$ per year per person. The initial rise between 1970 and 1990 was the result of growing service levels and modern household appliances such as automatic washing machines that used significant amounts of water. The peak came around 1990 and the drop since then can be explained by the availability of more efficient appliances. The taxes that were implemented from 1995 onwards, namely the tax on groundwater abstraction and the tap water tax itself, provided extra incentives for water saving measures.

Daily tap water use per household amounted to 351 litres in 1970, peaked at 365 litres in 1989, and was reduced to 287 litres in 2011. This is an 18 percent reduction in 41 years and implies a use of 105 $m^3$ per year for each household. The drop in use per household from 1990 onwards can be explained by the fact that the number of households continued to grow as a result of the ongoing trend towards smaller average household size – while total tap water use by households stabilised. In years with hot and dry summers, as was the case in 2003 and 2006, water use is usually a few percent above average, because people use more water for showers and watering plants.

**4.1.1 Development of tap water use by households, size of the population and number of households**



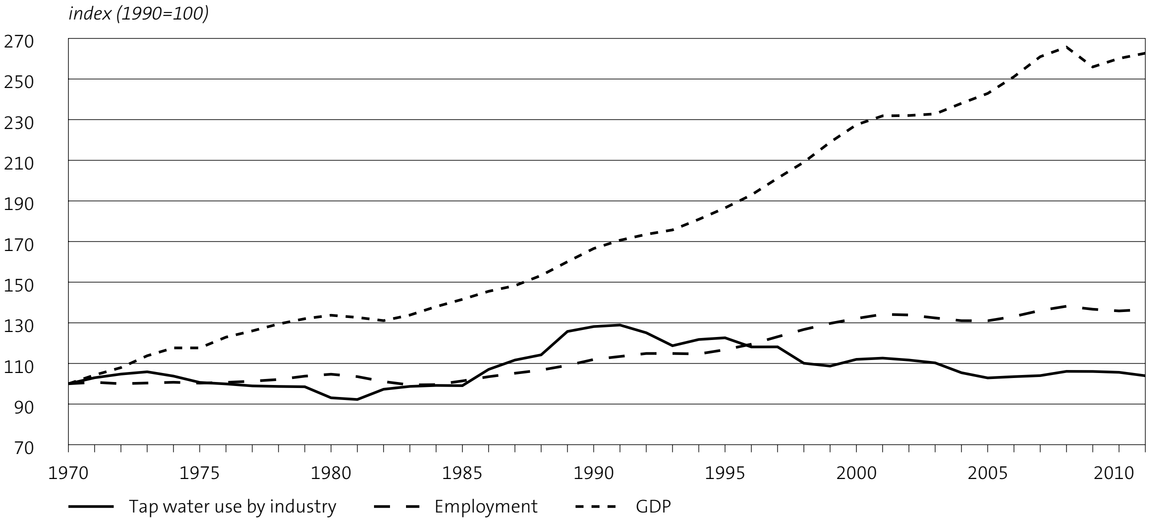

Source: VEWIN, 2010; 2012a, 2012b; Lodder, 2012; StatLine 2012.

### Tap water use by industries high during 1990s and stable since 2005

Tap water use levels by businesses were lowest around 1980, peaked around 1990, and returned to the 1970 levels in recent years. The drop in tap water use between 1973 and 1980 may have been the result of the economic slump caused by the two oil crises in 1973 and 1979. Between 1980 and 1990, as a result of the economic recovery, tap water use by industry grew by almost 40 percent (38). It peaked around 1990. However industries have progressively used less tap water since 1991. From 2005 onwards the water use has been more or less stable.

In 2011 tap water use by businesses decreased by 1.6 percent. The chemical industry, food and beverage manufacturers and agriculture are extensive users of tap water. In addition, oil refineries, and the health and social welfare sectors use significant amounts too.

**4.1.2 Volume change GDP, employment and tap water used for production**

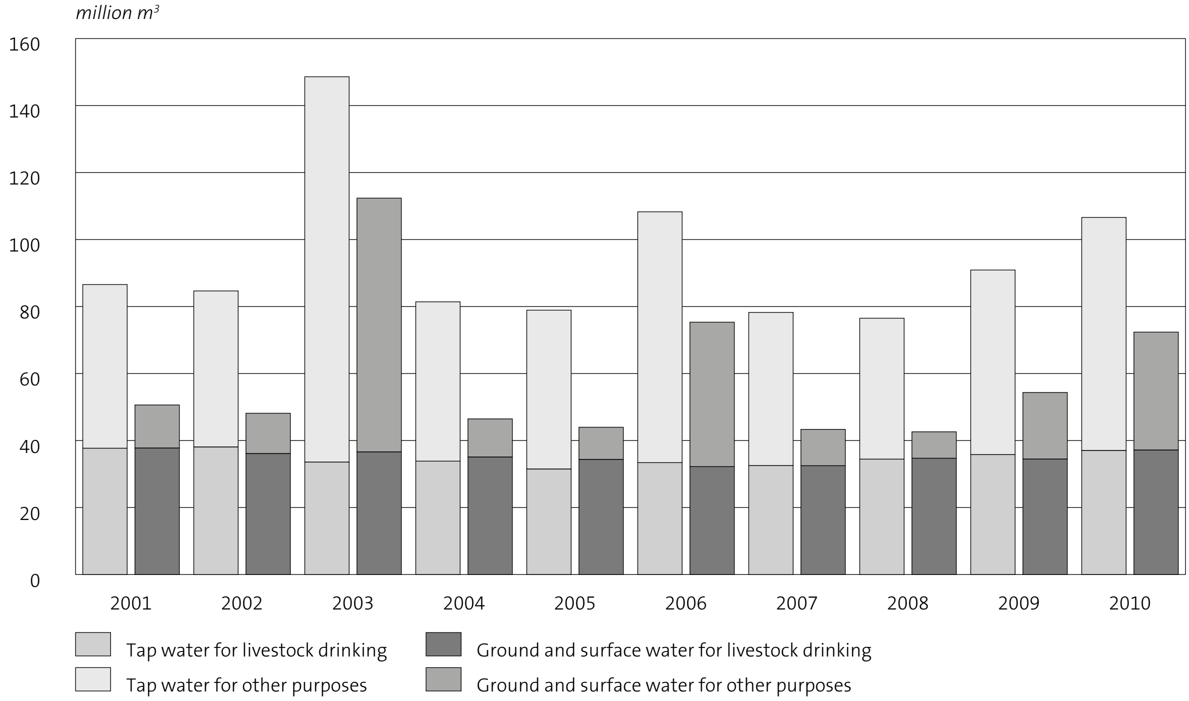



Source: VEWIN, 2010; 2012a; 2012b; Lodder, 2012; StatLine 2012.

### Water use in livestock production determined by weather and livestock numbers

Agriculture and horticulture have an average 5 percent share in the total amount of tap water used in the Netherlands, which shows a slight downward trend. The influence of the weather in warm and dry years is clear as more tap water is generally used. Drinking water for cattle and other livestock is a major category of tap water use. Tap water for drinking purposes showed a downward trend in recent years, from 77 percent in 2001 to 68 percent in 2010, while tap water used for other purposes as for cleaning in livestock production showed a growing trend. One major reason why less tap water is used for drinking is the dwindling number of livestock. In 2010, 17 percent less tap water was required for cattle than in 2001. Switching from tap water to ground water and/or surface water for drinking by livestock offers a further opportunity to reduce tap water use in livestock production. On the other hand, the constant quality of tap water is valuable for livestock.

### 4.1.3 Water used in livestock production[1)]




Source: Van der Meer and H. van der Veen, 2011; Van der Meer, 2012.
1) A new farm activity classification was adopted for 2009 and 2010, which may have a slight effect on the outcomes for 2009 and 2010.

Besides tap water, livestock also drink groundwater and surface water, so that close to two-thirds of ground and surface water abstracted by the sector was used for drinking in the period 2001–2010[3)]. The remaining use of fresh water abstracted from ground and surface water is mainly for irrigating crops such as green maize, and pastures. In agriculture, groundwater is mainly used for irrigation and for watering livestock. Water used for irrigation has gone up in 2009 and even more so in 2010 due to the dry weather particularly in spring. In 2010 agriculture had an 9 percent share in total groundwater abstraction. Crops in the Netherlands are predominantly grown under rain-fed conditions.

More farm land has been prepared for irrigation in recent years (De Rooij, 2011). The actual area that is irrigated at least once every growing season also increased in recent years. An average 6 percent of cultivated land was irrigated in the period 2004–2010. This means that most crops have to rely on the available fresh water sources within the soil for their growth. Normally these water sources are replenished in the course of the year.

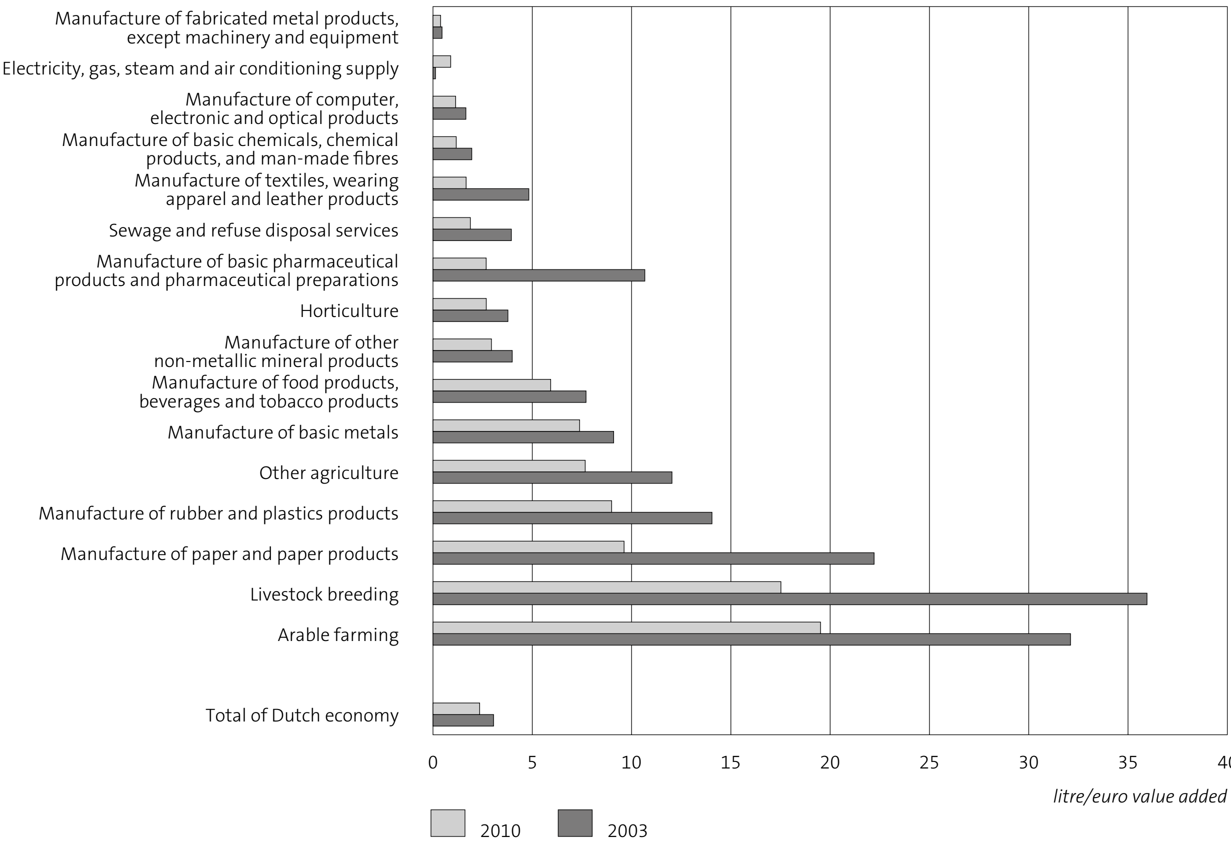
3) Van der Meer and Van der Veen, 2011; Van der Meer, 2012.

## Lower groundwater use intensity

Water use intensity for an industry can be defined as the use of water in litres divided by its value added.[4] On average in the period between 2003 and 2010, 2.53 litres of groundwater was abstracted for every euro of value added generated by the Dutch economy. In 2010 this was 2.35 litres, a little less than the 2.41 litres in 2009 and significantly less than the 3.05 litres in 2003. Arable farming and livestock breeding showed the highest water use intensity rates, followed by the manufacturing of paper and paper products, manufacturing of rubber and plastic products, and other agriculture. The industries with the highest use intensity rates used up to 12 times more water to earn a euro than the average for the Dutch economy[5].

In 2010 most sectors, with the exception of the electricity sector, showed lower groundwater intensities than in the warm and dry year 2003. The intensity for groundwater abstraction by the electricity industry was seven times higher because of a newly established cogeneration plant. This plant generates both electricity and steam, and for the latter it makes use of groundwater.

**4.1.4 Industries with the highest use intensities for groundwater**




[4] Value added is expressed in constant year 2005 prices.
[5] This figure may be slightly underestimated as for several industries that use small amounts of groundwater, the precise abstractions are not known.

Compared to 2009, the intensity slightly decreased in 2010. The first signals of a recovering economy were accompanied by a slight reduction in water use. However, we should caution against drawing firm conclusions, as groundwater abstraction and the resulting intensities are dependent on weather conditions. This is particularly true for agriculture, where water abstraction for irrigation is largely determined by water shortages resulting from warm and dry summer weather.

### Regional water use

There is a growing interest in obtaining regional data on water use and abstraction, in particular for the river basins[6]. Such data is relevant for analysis and reporting to the Water Framework Directive (WFD). The methodology for compiling regional water abstraction and use is described in a special report for Eurostat *Water abstraction and –use at River Basin Level* (Baas and Graveland, 2011). These figures have been updated for 2009 (Graveland and Baas, 2012)[7].

### Fresh ground water abstraction in all river basins dominated by water supply industry

Groundwater is predominantly abstracted and used by the water supply industry, which is present in each river basin. The Meuse region is the largest abstractor, responsible for 33 percent of total groundwater abstraction. In the Ems region, 89 percent is abstracted by the water supply industry, clearly the largest share across the different river basins.

**4.1.5 Abstraction of ground water per (sub-)River Basin, 2009**[1]

| | | Total NL | Rhine-North | Rhine-East | Rhine-Center | Rhine West | Ems | Meuse | Scheldt |
|---|---|---|---|---|---|---|---|---|---|
| **Fresh ground water** | NACE Rev.2 | *million m³* | | | | | | | |
| Total | | 1,011.2 | 73.2 | 188.9 | 121.4 | 227.8 | 41.9 | 334.0 | 23.9 |
| Agriculture, forestry, fishing | 01–03 | 73.9 | 4.1 | 19.1 | 9.3 | 1.1 | 0.5 | 38.9 | 0.9 |
| Public Water supply companies | 36 | 751.9 | 59.7 | 133.3 | 93.6 | 167.5 | 37.2 | 241.7 | 18.7 |
| Industry; power plants; etc. | 06–35; 37–99 | 185.3 | 9.3 | 36.5 | 18.5 | 59.2 | 4.3 | 53.4 | 4.2 |
| Private Households | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Source: Baas and Graveland (2011) ); Graveland and Baas (2012).

[1] This figure and the next are based on data compiled in 2011. In 2012 different items have been updated leading to slight adjustments. Previous figures for 2009 in this section may therefore be slightly different.

As Table 4.1.6 shows, there are large differences in the abstraction of surface water between the river basins. Water supply companies used only 5 percent of total surface water abstraction in 2009. Most surface water is abstracted in the Rhine-West (sub-) river basin, which is responsible for over 50 percent of total abstraction. The second largest user is the Meuse area

[6] The Netherlands is divided into 4 river basins: Ems, Meuse, Scheldt and Rhine. The Rhine basin is divided into 4 sub-basins: Rhine West, Rhine North, Rhine Centre and Rhine-East.

[7] It should be noted the data presented in this section have been disaggregated to NACE rev.2.

with 37 percent. Most power plants and major industries are located in these (sub-) river basins. In the Rhine-West, electricity supply and manufacturing are responsible for 48 percent of the country's fresh surface water abstraction. Besides the amounts of fresh water presented here, regions like Rhine-West, Scheldt and Ems also use significant amounts of (salt) marine water for cooling by power plants and for major industrial sites.

### 4.1.6 Abstraction of surface water per (sub-)River Basin, 2009

| | | Total NL | Rhine-North | Rhine-East | Rhine-Center | Rhine West | Ems | Meuse | Scheldt |
|---|---|---|---|---|---|---|---|---|---|
| **Fresh surface water** | NACE Rev.2 | *million m³* | | | | | | | |
| Total | | 10,654.5 | 488.7 | 277.1 | 100.3 | 5,385.4 | 49.0 | 3,901.0 | 452.8 |
| Agriculture, forestry, fishing | 01–03 | 19.3 | 3.3 | 1.6 | 1.5 | 7.7 | 1.3 | 3.6 | 0.3 |
| Public Water supply companies | 36 | 483.4 | 0.0 | 0.0 | 0.0 | 274.3 | 6.8 | 202.3 | 0.0 |
| Industry; power plants; etc. | 06–35; 37–99 | 10,151.8 | 485.4 | 275.5 | 98.8 | 5,103.5 | 41.0 | 3,695.1 | 452.5 |
| Private Households | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Source: Baas and Graveland (2011); Graveland and Baas (2012).

# 4.2 Emissions to water

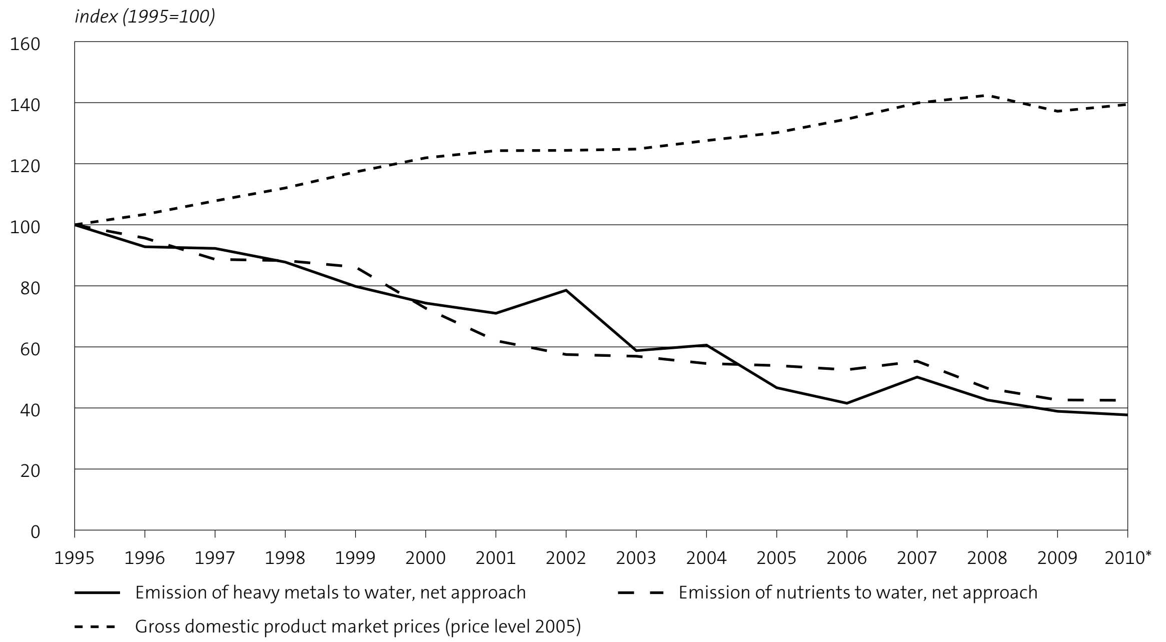
The availability of clean water is essential for humans and many other species on earth. However, nowadays surface waters are continually exposed to discharges of harmful substances by industries and households. These substances can cause severe damage to ecosystems in ditches, rivers and lakes. Therefore, in order to meet European environmental quality standards in the future, the European Commission introduced the European Water Framework Directive (WFD). The WFD states that all domestic surface waters should meet certain qualitative and quantitative targets by 2015. Two important groups of substances that play an important role in the WFD are heavy metals and nutrients. Heavy metals naturally occur in the environment, but are toxic in high concentrations. An excess amount of nutrients in the surface water causes algae and duckweed to grow rampant, which can lead to limited access of sunlight below the water surface, which makes it impossible for certain species of fish, aquatic plants and other organisms to survive. Because the emission of these pollutants are often directly linked to economic activities, it is essential to both reduce emission intensities of production processes and stimulate the decoupling between water emissions and economic growth.

The water accounts provide information about the emissions to water by industries and households and are fully consistent with the concepts of the national accounts. Furthermore, the water accounts provide indicators of the status of heavy metal pollution and eutrophication in surface waters. Due to its consistency with the national accounts, it is feasible to compare its physical emission data with economic indicators such as value added. This consistency also suits environmental-economic modelling. For a description of the methodology used to compile the water accounts see Statline. The data of the water accounts are also published on StatLine, the electronic database of Statistics Netherlands.

### Emissions to water decrease

The relation between economic growth and the emissions to water is an indicator for the environmental performance of an economy. If the emissions decrease with respect to economic growth, this indicates a better environmental performance.

**4.2.1 Relation between economic growth and emissions to water**

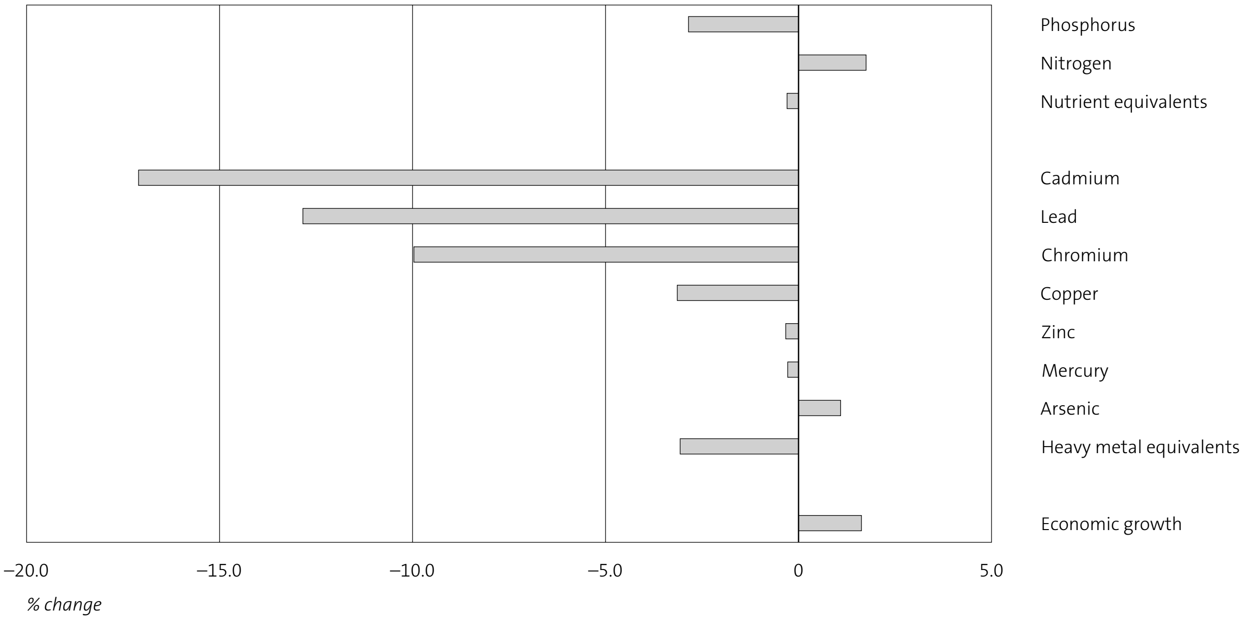



In terms of value added, between 1995 and 2010 the Dutch economy grew more than 39 percent, while in that same period the emissions of heavy metals were reduced by 62 percent and nutrient emissions by almost 58 percent. This implies that overall the Dutch economy showed strong environmental performance in terms of water emission efficiency. Over 2009 and 2010 one of the best performing sectors within manufacturing was the chemical industry. In 2009, despite the crisis, the growth in value added in this sector was almost 5 percent and in 2010 it exceeded 12 percent. From 1995 onwards the emissions to water of the chemical industry were reduced every year, both for nutrients and for heavy metals. However, there is also another sector within manufacturing that grew in 2010, i.e. the basic metal industry, which showed an increase in emissions to water of some heavy metals such as chromium and lead. This difference between sectors shows that although overall the decrease of heavy metals and nutrients emissions to water improved,, there is still room for further improvement on sector levels.

When we zoom in on the emission of different metals in recent years, we see that in 2009 and 2010, copper and mercury represent the main heavy metal categories in the water emission data. Together they represent over 75 percent. Therefore, between 2009 and 2010 the reduction in copper emissions was the largest contributor to the total reduction in those years, followed by cadmium with almost 38 percent. We further see that, despite its large share, mercury was of only minor importance to the total reduction that occurred. We further see that arsenic is the only metal with an increasing discharge, while cadmium, lead and chromium emissions showed the greatest improvements.

An important reason for less discharge of nearly all metals is the closure of a big chemical polluter. Between 2008 and 2010 the production of this major chemical firm gradually decreased and in 2010 it was completely shut down. This firm contributed by far the largest share in heavy metal discharge to surface waters.

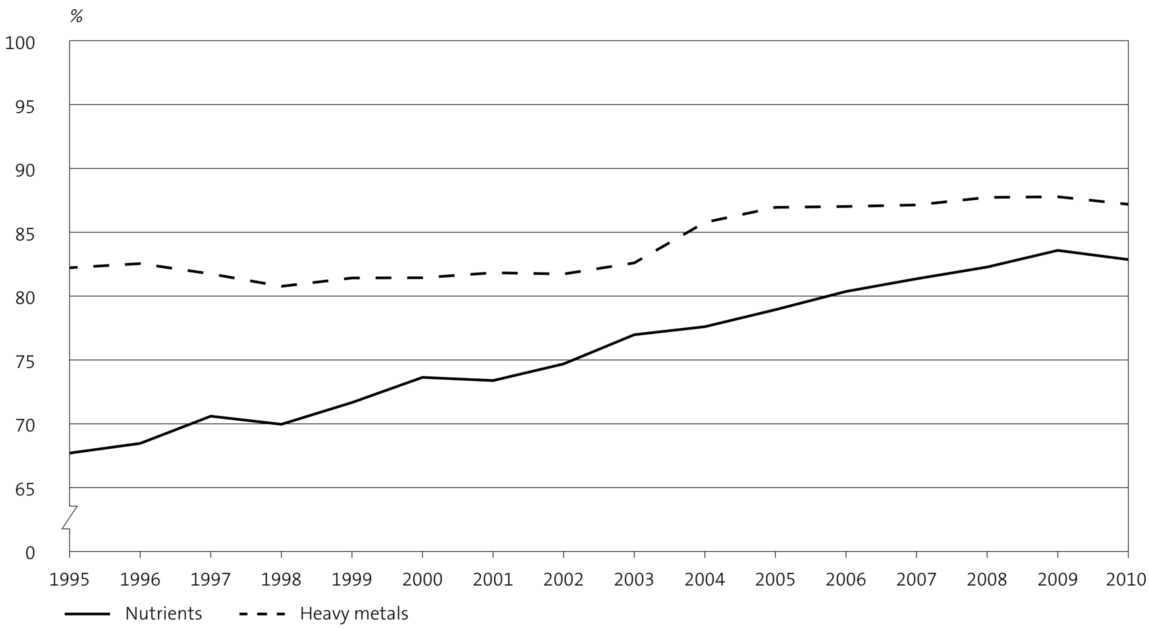
**4.2.2 Emissions to water net approach, 2009–2010**




### Treatment efficiency sewage industry improves

Influents are the amounts of substances in waste water that are transported to a waste water treatment plant. In the waste water treatment plant the harmful substances are removed from the water as much as possible. A higher percentage of removed substance means a better environmental performance by the sewage industry.

### 4.2.3 Purification efficiency of waste water treatment plants




The purification efficiency improved during the last decades, especially for nutrients. According to European legislation it is compulsory to remove at least 75 percent of all nutrients at urban waste water treatment plants. The Netherlands fulfills this percentage and therefore complies to this European legislation. There is no European legislation for heavy metals, but the national guideline is a removal of 70 to 90 percent. In this context, heavy metals are generally removed sufficiently (measured in equivalents), although there are differences between the underlying metals. For instance, arsenic is removed for only around 55 percent.

**Horticulture responsible for an increase in nutrient emissions**

Agriculture is an industry with high nutrient emission intensity. The emission intensity is a measure for the efficiency by which polluting substances are emitted in production processes. It is equal to the total emission divided by value added. Between 2009 and 2010, with respect to growth in value added, there is a small nutrient emission intensity decrease, However, the intensity of nutrients in agriculture is still over 50 kilos per euro. Agriculture consists of four activities where the two activities with the largest emission discharge are horticulture and arable farming.

In arable farming there has been a very strong decrease in nutrient emissions. In 1995 the emissions to water were still 720 thousand nutrient-equivalents, while in 2010 this was reduced to only 9 thousand nutrient-equivalents. The reason for this strong decline is a strict policy on the amount of discharge of manure. It is not allowed to spread manure in the surroundings of ditches, the so called manure-free zones.

In contrast to arable farming, emissions in horticulture have increased. In 2000, the emissions to water were almost 360 thousand nutrient-equivalents and in 2010 the emission levels increased to more than 400 thousand nutrient-equivalents. This increase is the result of increased production levels in greenhouse farming during that period. For the growth of their crops , the farmers use drain water and combine this with nitrogen and phosphorus. This leads to wastewater with high amounts of these two nutrients while it is discharged into surface water and sewers.

# Solid waste

# 5

# Solid waste

## 5.1

**Greenhouse gas emissions according to different frameworks**
- Decrease in waste production
- Mineral waste the largest waste category

# 5.1 Solid waste

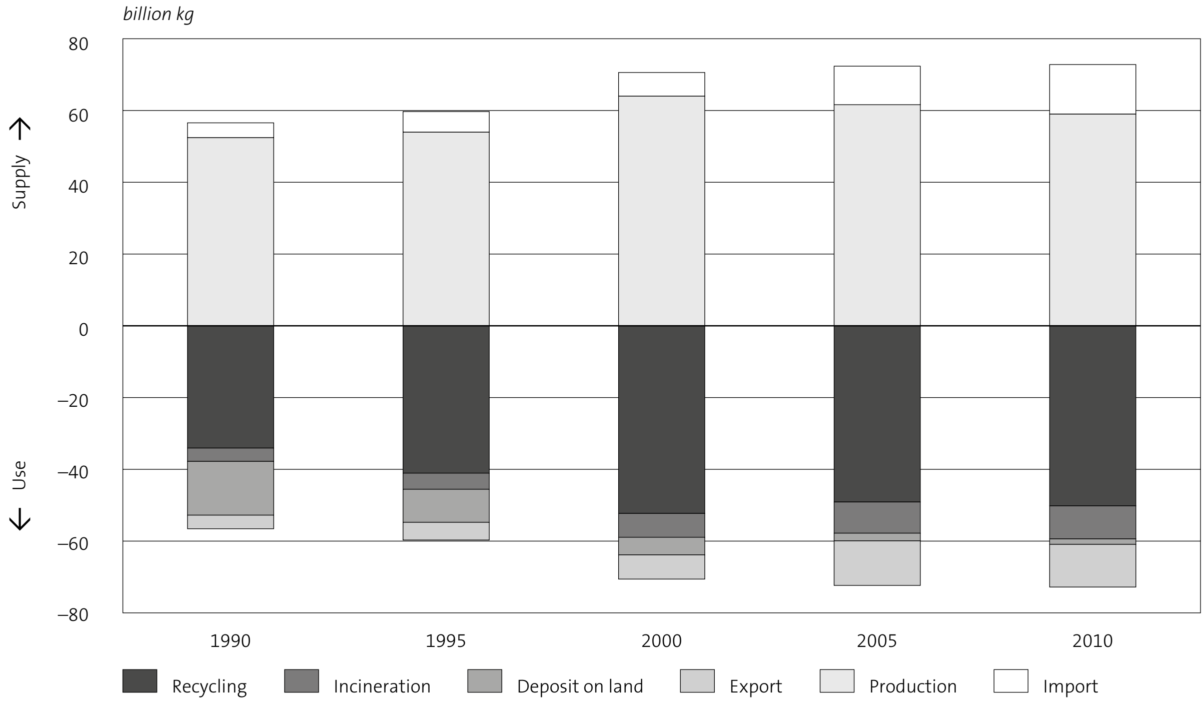
Treatment of solid waste involves recycling, incineration and disposal on landfill sites. Each treatment method causes different kinds of environmental problems. In general the most environmentally benign treatment is recycling, as recycling recovers natural resources. Waste incineration results in environmentally damaging gaseous emissions. A positive consequence of incineration is the recovery of energy. Disposal on land is the least favourable way to treat waste. Landfills take up space, are often permanent and require years of maintenance. Therefore Dutch waste policy focuses both on reducing waste generation and increasing the share of recycled waste.

The waste accounts describe the supply and use of solid waste with regard to the Dutch economy. Waste supply consists of imports and production of waste by economic actors like households and industries. Not included are contaminated soil and dredging spoils. The use of waste entails exports and treatment of waste like recycling, incineration and disposal on landfill sites. No distinction is made between waste incinerated with and without energy recovery. Waste is recorded at moment it is generated for the first time. Therefore, there is no double counting of waste in the waste accounts. For a detailed description of the used methodology and definitions see Delahaye (2006) and Delahaye et al. (2010). The waste accounts data are published on StatLine, the electronic database of Statistics Netherlands.

**Decrease in waste production**

In 2010 the Dutch economy (industry plus households) generated 59 billion kg of waste; this comes down to 3600 kg per capita. If lined up, the garbage trucks required to carry this amount of waste would circle the earth. Additionally to the waste production, nearly 14 billion kg of waste was imported. Of the total waste supply (production plus import) 69 percent is recycled in the Netherlands and 16 percent is exported for recycling or disposal. In 2010, waste deposited on landfill sites only accounted for 2 percent of the total waste use in the Netherlands. Successful changes in waste management policies caused a 90 percent decrease in the amount of waste deposited on land since 1990. A second positive development in waste treatment is the increase in recycled waste (as percentage of the total treatment in the Netherlands) from 65 percent in 1990 to 82 percent in 2010.

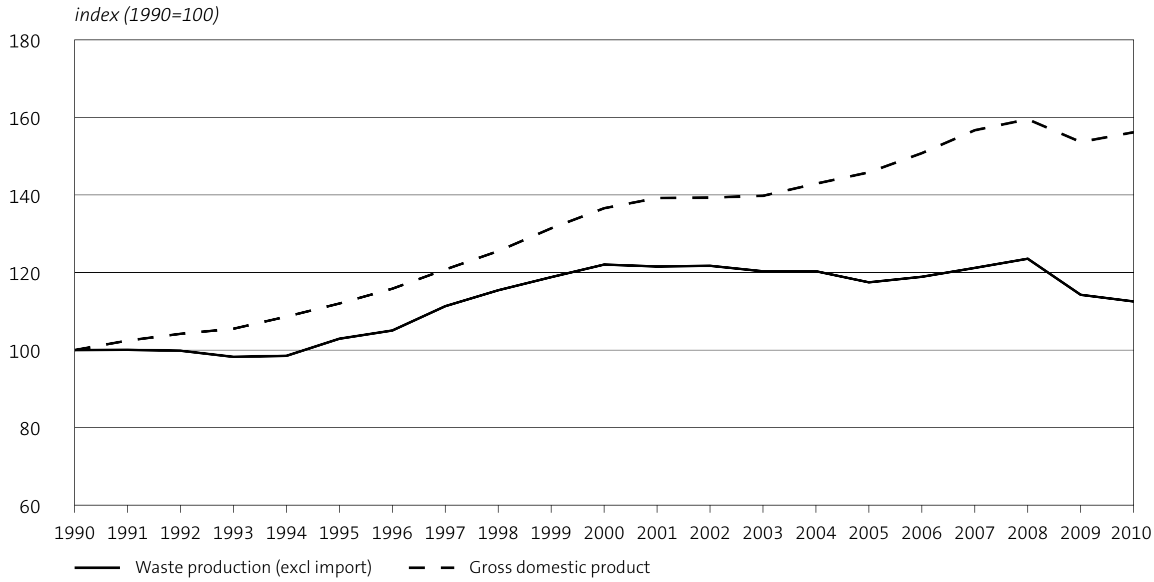
### 5.1.1 Supply and use of solid waste




Source: CBS, environmental accounts.

Between 1990 and 2000 waste generation saw a 22 percent increase. Since 2003, in spite of economic growth and increased consumption, the total amount of generated waste remained stable. In 2009 and 2010 the economic crisis attributed to a decrease in waste production.

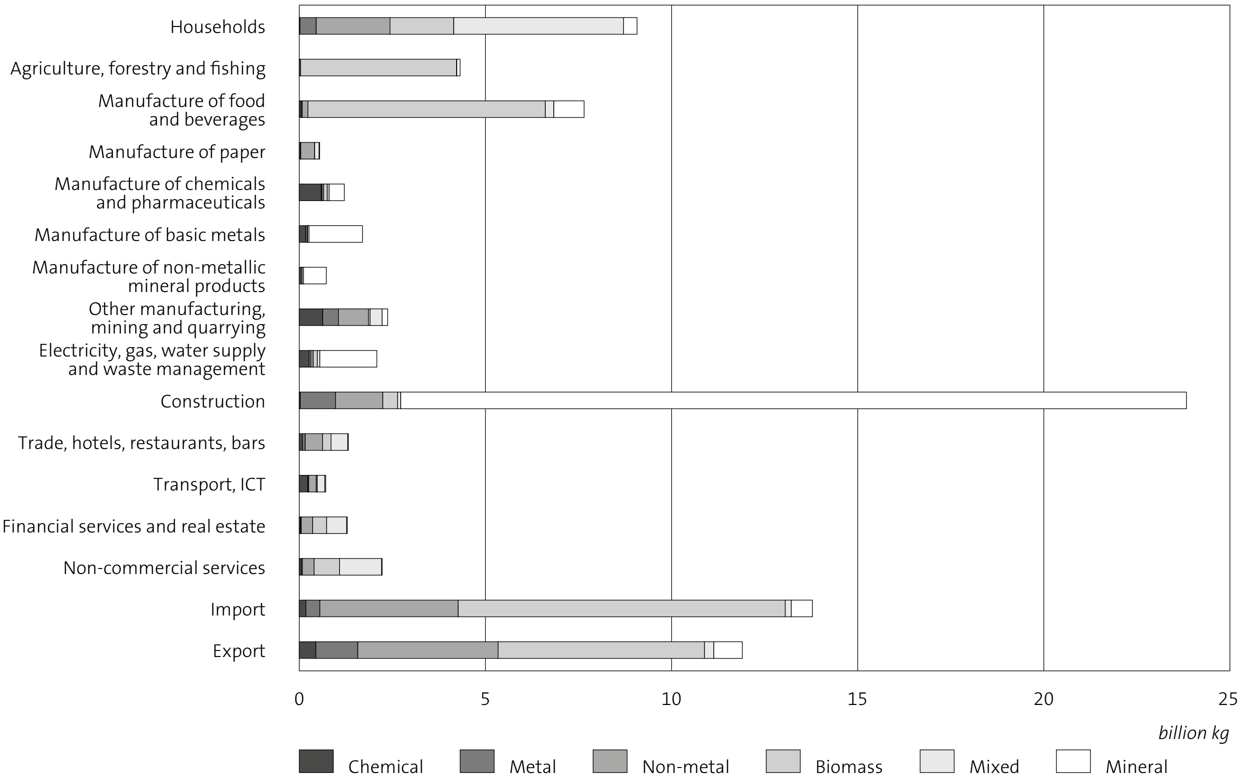
### 5.1.2 Volume change GDP and waste production



### Mineral waste the largest waste category

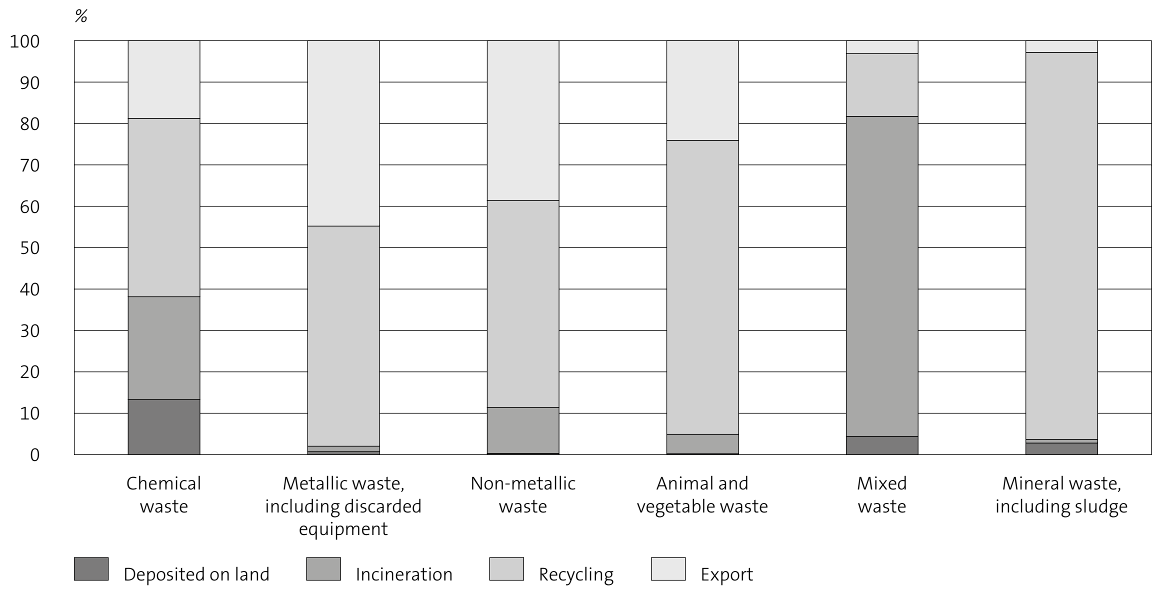
Waste can be grouped into different types, based on their material composition. Minerals constitute the largest part of total waste generated in the Netherlands, followed by biomass. The construction industry generates 79 percent of all mineral waste during demolition and construction activities. Other major producers of waste are households. Households typically generate a lot of mixed waste, on average 617 kilo per household. Agriculture and the manufactures of food products generated 74 percent of biomass waste, consisting of animal and vegetable waste. Most of the imported and exported waste consists of biomass like oil cake.

**5.1.3 Generation of different types of waste by actor, 2010**




Source: CBS, environmental accounts.

### 5.1.4 Waste use for different types of waste, 2010

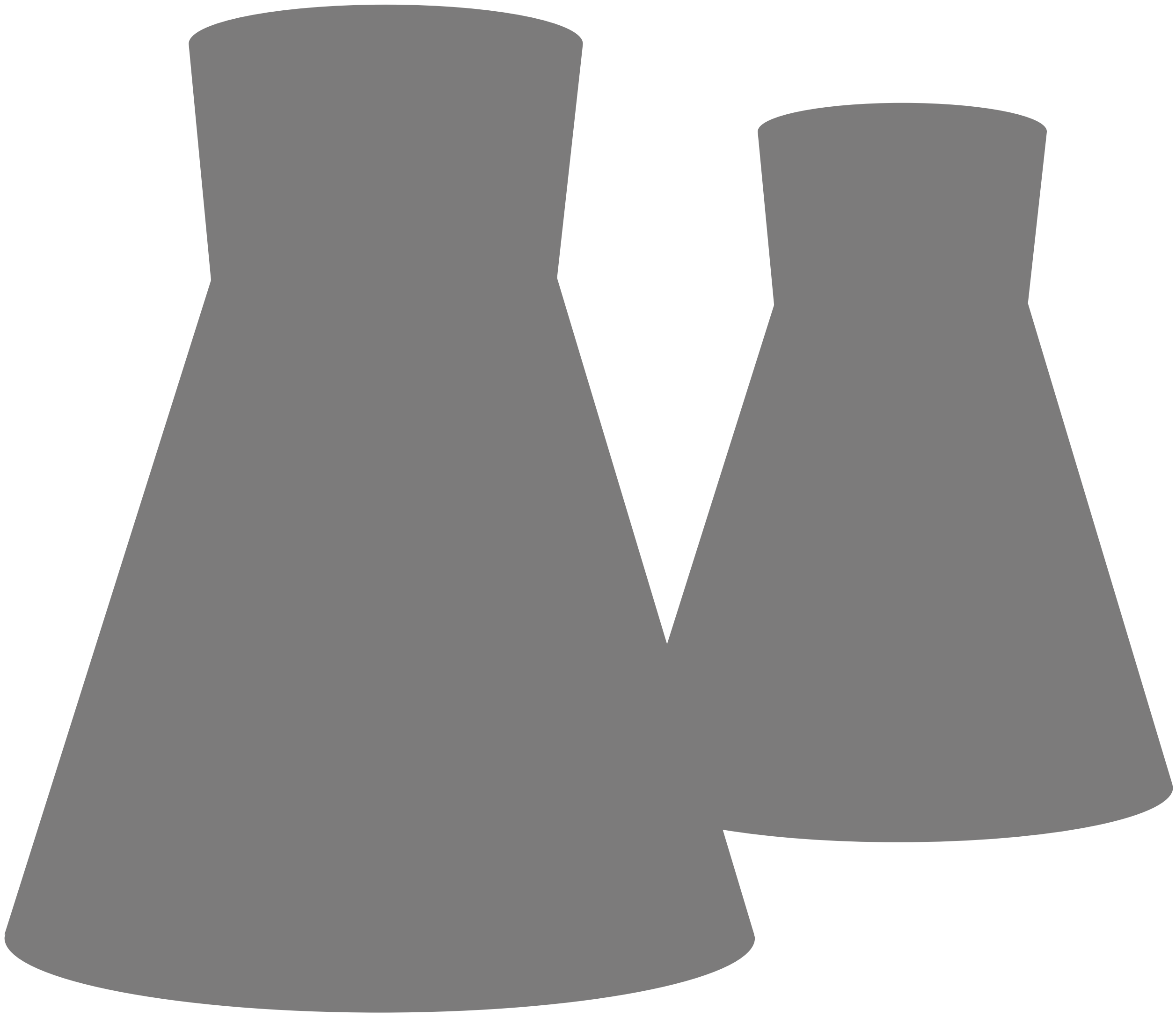



Source: CBS, environmental accounts.

The ways of using waste depend on the type of waste. For example, most of the mixed waste is incinerated, while a large part of metallic waste is exported. Waste in almost each category is to a large extent recycled. In the Netherlands, some 94 percent of the total supply of mineral waste and 71 percent of the total supply of biomass waste was recycled in 2010. The large shares of recycling are mainly due to Dutch waste policy stimulating waste recycling. As mentioned in the introduction, disposal on land is the least favourable way to treat waste. . In 2010, the part of disposal on land was very small. Chemical waste was most of all disposed on land and, unfortunately, since 2002 this part has grown. In 2002, it was just 3 percent, and in 2010 more than 13 percent of chemical waste was treated as landfill. Note that the total amount of chemical waste is much smaller than the total amount of mixed waste. As a consequence, and in relative terms, the part of disposed chemical waste is larger than that of mixed waste. In absolute terms, mixed waste contributes more to the growth of landfills.

# Greenhouse gas emissions and air pollution

# 6



# Greenhouse gas emissions and air pollution

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# 6.1 Greenhouse gas emissions according to different frameworks

Climate change is one of the major global challenges of our time. There is abundant scientific evidence that the emission of greenhouse gases caused by economic activities contributes to climate change (e.g. IPCC, 2007; PBL, 2010). Accelerating emissions of carbon dioxide, methane, and other greenhouse gases since the beginning of the 20th century have increased the average global temperature by about 0.8°C and altered global precipitation patterns (IPCC, 2007). Combustion of fossil fuels, deforestation, but also specific agricultural activities and industrial processes are the main drivers of the increased emission of greenhouse gases. Enhanced concentrations of greenhouse gases in the atmosphere will increase global temperatures by radiative forcing. Likewise, climate change has a direct impact on all kinds of economic processes. These impacts may be positive or negative, but it is expected that the overall impact will be primarily negative. In order to design effective mitigation policies, one must have a good conception of the economic driving forces of climate change. The air emission accounts can be used to analyse the environmental implications in terms of greenhouse gas emissions, of production and consumption patterns. Because of their compatibility with the national accounts, greenhouse gas data can be directly linked to the economic drivers of global warming.

There are several frameworks for estimating the greenhouse gas emissions for a country, yielding different results. Well-known are the emissions reported to the UNFCCC (United National Framework Convention on Climate Change) in particular under the Kyoto Protocol, but also environment statistics as well as the air emission accounts provide independent greenhouse gas estimates. The differences are not the result of disputes about the accuracy of the estimates themselves, but arise from different interpretations of what has to be counted. The inclusion or exclusion of certain elements depends on the concepts and definitions that underlie these frameworks. The estimates differ in their possible applications for analysis and policy making.

In this section we explain the above mentioned frameworks and their resulting estimates. A bridge table (see Table 6.1.1) provides insight in the relations between these different conceptions.

### 6.1.1 Bridge table for greenhouse gases

| | 1990 | 1995 | 2000 | 2005 | 2009 | 2010* | 2011* |
|---|---|---|---|---|---|---|---|
| | *Mton $CO_2$-eq.* | | | | | | |
| 1. Stationary sources[1] | 187 | 195 | 183 | 182 | 173 | 185 | 170 |
| 2. Mobile sources on Dutch territory | 34 | 36 | 40 | 42 | 42 | 42 | 42 |
| 3. Mobile sources according to IPCC | 31 | 34 | 38 | 39 | 38 | 38 | 39 |
| 4. Short cyclic $CO_2$ | 6 | 6 | 8 | 10 | 12 | 13 | 13 |
| **5. Total, IPCC (excl. LULUCF) = 1 + 3 - 4** | **213** | **223** | **213** | **211** | **199** | **210** | **196** |
| 6. Land Use, Land-Use Change and Forestry (LULUCF) | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **7. Total, IPCC (incl. LULUCF) = 5 + 6 (Kyoto-protocol)** | **217** | **226** | **216** | **214** | **202** | **213** | **199** |
| **8. Actual emissions in the Netherlands = 1 + 2** | **221** | **231** | **223** | **224** | **215** | **226** | **212** |
| 9. Residents abroad | 14 | 20 | 24 | 24 | 24 | 24 | 25 |
| 10. Non-residents in the Netherlands | 5 | 5 | 6 | 7 | 6 | 6 | 6 |
| **11. Total emissions by residents = 8 + 9 - 10** | **230** | **246** | **242** | **241** | **232** | **244** | **230** |

1) Stationairy sources are inclusive short-cyclic $CO_2$.

*1. Greenhouse gas emissions according to the IPCC regulation*

The IPCC (Intergovernmental Panel on Climate Change) has drawn up specific guidelines to estimate and report on national inventories of anthropogenic greenhouse gas emissions and removals (IPCC, 1996). "Anthropogenic" refers to greenhouse gas emissions and removals that are a direct result of human activities or are the result of natural processes that have been affected by human activities. In general the IPCC records all emissions that occur on the Dutch territory, with a few specificities. Emissions originating from the so-called short cyclic carbon cycle, such as the combustion of biomass and emission from biochemical processes, are left aside in the IPCC calculations. It is assumed that these emissions do not structurally contribute to higher greenhouse gas concentrations in the atmosphere. The emissions by road traffic are calculated according to the total domestic deliveries of motor fuels, regardless of the nationality of the user of the motor fuel or the location where the use takes place. For air transport and shipping only emissions caused in domestic transport are considered. A complicating factor is that distinction between international and domestic travel is based on destination of the travel, with the result that emissions from a ship sailing around the world and therefore traversing international waters, count as domestic travel if the destination is a national port. Emissions related to bunkering of airplanes and ships are mentioned in the IPCC reports as a memorandum item, but are not included in the targets of the Kyoto Protocol.

The IPCC guidelines include not only sources but also sinks – that is emissions absorbed by nature for instance through carbon sequestration, whereas these are excluded from air emission accounts and environment statistics. However, not all emissions absorbed by nature are included, only those that occur on so-called managed lands including managed forests which are areas under human influence. Emissions and sinks due to land-use changes are also taken into account[1].

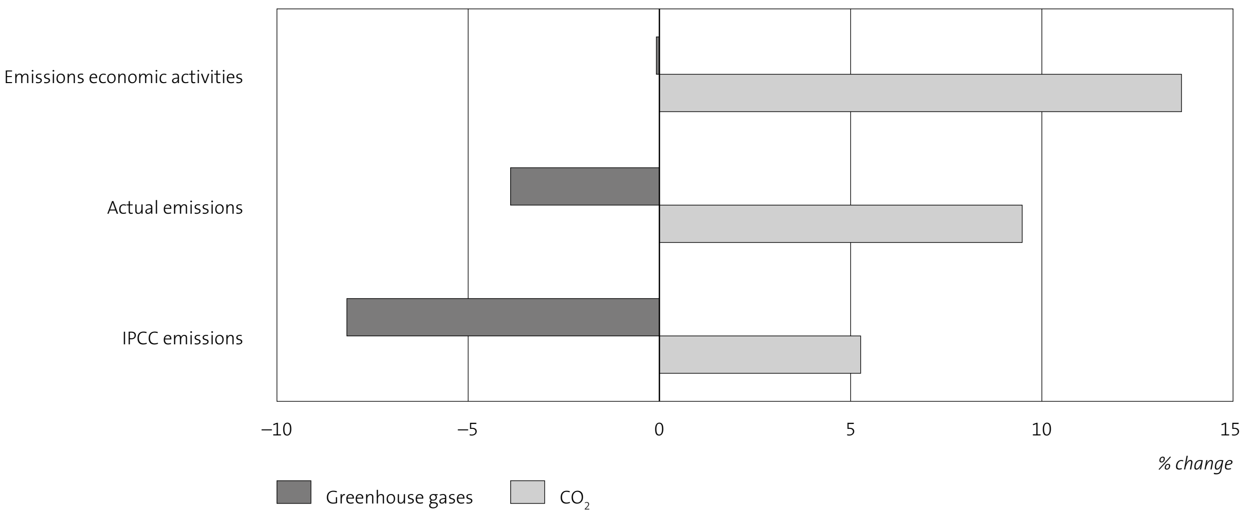
1) In the IPCC reports the category Land use, land use change and forestry (LULUCF) includes the total emissions and sinks for $CO_2$ from land use and forestry activities (IPCC, 1996). The category is either a net source if biomass harvest/destruction exceeds regrowth in the inventory year, or a net sink if regrowth exceeds harvest/destruction.

2. *Greenhouse gas emissions within the Dutch territory*
Statistics Netherlands annually publishes the actual greenhouse gas emission for the Netherlands. These are greenhouse gas emissions that actually take place within the Dutch territory. In contrast to the IPCC guidelines, all emissions by mobile sources that occur within the Dutch territory are accounted for, regardless of where the fuels are purchased. Also short cyclic carbon emissions are included in the actual emissions. With regard to international transport (inland shipping, seagoing vessels, air transport), only those emissions are included that occur within the national territory. The actual emissions are used as input for several modelling and scenario analyses, and are the basis for the calculation of the air emission accounts.

3. *Greenhouse gas emissions by the Dutch economy*
Besides the actual emissions, Statistics Netherlands also annually publishes the total greenhouse gas emissions by economic activities, which are calculated according to the national accounting principles. These include all emissions caused by the residents of a country, regardless where the emissions take place. For stationary emission sources the resident principle will generally converge with emission data as recorded in the emission inventories. For mobile sources, however, substantial differences may occur. Transport activities by residents, like road transport, shipping and air transport, and related emissions to air may also occur abroad. Likewise, non-residents may cause pollution within the Dutch territory. The greenhouse gas emissions caused by Dutch economic activities are thus equal to the actual emissions plus emissions caused by residents abroad minus emissions caused by non-residents on the Dutch national territory.

The total greenhouse gas emissions by the economy provide an important indicator for the environmental pressure caused by Dutch economic activities. The emissions can be compared directly with all sorts of macro-economic parameters from the national accounts, such as GDP, total employment etc. at the national level, but also for different industries. In addition, they can be used for all kind of environmental–economic analysis and modelling, such as decomposition analysis but also the calculation of the emission trade balance and the carbon footprint.

**6.1.2 Changes in $CO_2$ and greenhouse gas emissioins between 1990 and 2011 according to different frameworks**



### IPCC emissions decrease, emissions by economic activities increase

The total greenhouse gas emissions for the Netherlands according to the guidelines of the IPCC were equal to 196 Mton $CO_2$ equivalents in 2011[2]. This is 8 percent below the emission level in 1990, the base year for the Kyoto Protocol. The $CO_2$ emissions, however, increased by 5 percent during this period, which was less than the reductions in emissions of all other greenhouse gases ($CH_4$, $N_2O$, F-gases). These developments put the Netherlands on course to realise its Kyoto targets (see below). The emissions of greenhouse gases generated by the Dutch economy were equal to 230 Mton in 2011 which is approximately the same level as in 1990. These differences are primarily due to the omission of emissions by international transport which is only partly included in the Kyoto figures. Precisely in this period, international transport grew rapidly in the Netherlands, pushing up greenhouse gas emissions. Also, emissions from short-cyclic $CO_2$, for example the combustion of waste, have increased rapidly in this period. Finally, the actual greenhouse gas emissions in the Dutch territory have decreased since 1990 (-4 percent). Accordingly, the IPCC emission data presents the largest decrease in emissions.

### Emission data and the Dutch climate policy

The aim of the Dutch climate policy is to meet its obligation for emission reductions as stipulated in the Kyoto Protocol and to achieve further emission reductions for the medium-long period as has been agreed on within the European Union. For the Netherlands, the Kyoto target was set at a 6 percent emission reduction for the period 2008–2012 with respect to 1990, the base year for the Kyoto Protocol. This means that on average the Netherlands may emit 200 Mton $CO_2$ eq. each year, which is 1001 Mton for the entire period. As four of the five years have passed, 810 billion $CO_2$ equivalents have already been emitted. In 2012, therefore, emissions have to remain below 191 billion $CO_2$ equivalents to meet the target. However, to meet its Kyoto target, the Netherlands may also make use of the three flexible Kyoto mechanisms, namely emission trading, Joint Implementation (JI) and Clean Development Mechanism (CDM).

In 2007 the European Council already adopted a long-term climate objective, in which the EU strives to reduce the average global temperature increase to 2°C compared to pre-industrial levels (EC, 2007). To implement this objective, the European Council decided to realize an emission reduction in 2020 of at least 20 percent compared to 1990. The Netherlands has a binding national target to reduce emissions by 16 percent in 2020 in sectors not covered by the EU-ETS, such as transport, housing, agriculture and waste. The contribution to a global and broad (post-Kyoto) climate agreement of the EU will be 30 percent, provided that other developed countries contribute comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and capabilities. In addition, the European Council formulated goals for energy saving (20 percent of the estimated use in 2020), renewable energy (20 percent of the final use of the EU in 2020) and bio fuels (minimum of 10 percent of the total fuel consumption in 2020).

The Dutch climate policy and emission targets are primarily based on the emissions as calculated by the IPCC guidelines. These emissions, however, do not provide a complete picture of all emissions related to Dutch (economic) activities. Particularly, emissions caused

[2] Excluding LULUCF.

by Dutch transport activities are largely excluded, as only a small part is included in the IPCC emissions. Furthermore, an alternative to the frameworks presented here, which are all based on emissions inherent in production, is to calculate the emissions that are required to satisfy Dutch consumption.

# 6.2 Greenhouse gas emissions from production

The air emission accounts provide information about the contribution of the economy to climate change and the activities in which these emissions occur, so that the 'hotspots' in the production patterns can be identified. In addition, due to the compatibility with the national accounts framework, the greenhouse gas emissions can be directly linked to the output of the economic activities, so that the environmental performance of different industries can be compared by looking at decoupling, or by calculating emission intensities (eco-efficiency).

**Sharp decrease in greenhouse gas emissions by industries**

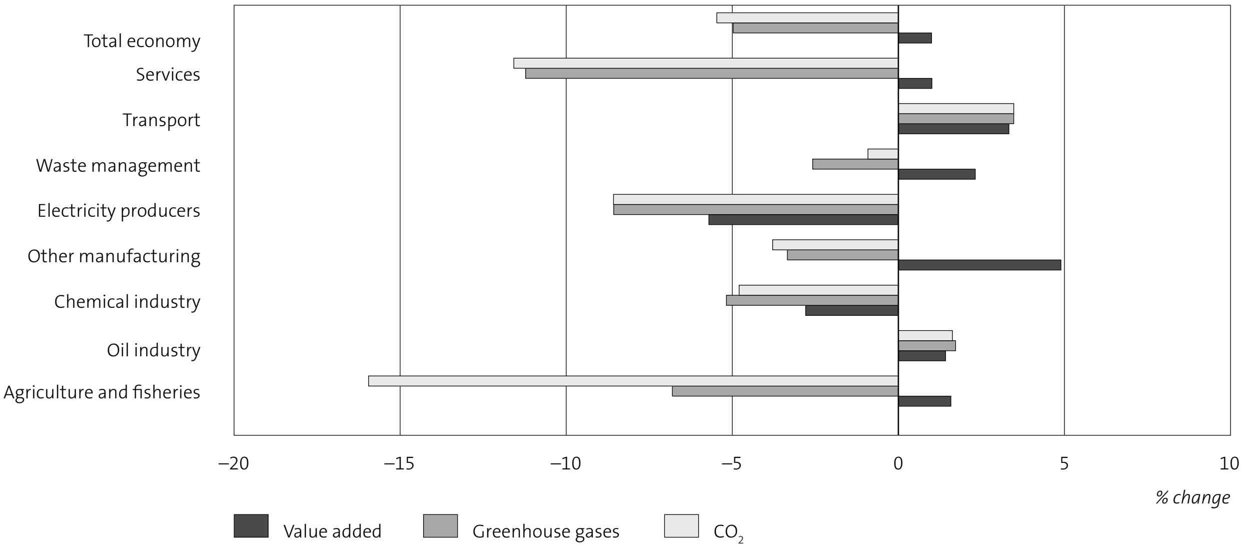
The total greenhouse gas emissions by industries equalled 191.3 Mton $CO_2$ eq. in 2011, which was 4.9 percent lower than in the previous year[3]. $CO_2$ emission even decreased by 5.4 percent. The sharp decrease is caused mainly by a dip in energy consumption due the mild winter and the start of economic stagnation which was felt by some of the emission intensive industries. Emissions of methane decreased by 2 percent, while emissions of nitrous oxide increased by 1 percent.

Greenhouse gas emissions in agriculture fell by 7 percent, mainly because less natural gas was combusted in horticulture. Methane emissions from cattle remained stable. In manufacturing, the start of the economic crisis had its effect on emission levels. Emissions decreased in most industries, particularly in the chemical industry, due to lower production levels. Demand for petrochemicals fell, particularly in the second half of 2011. On the other hand, emissions rose in the basic metal industry and the refineries, where the production processes are also very emission intensive. Energy companies produced less as more electricity was imported. As a result $CO_2$ emissions fell by 9 percent. Waste management produced less greenhouse gas emissions, although $CO_2$ emissions from waste incineration increased. Methane emissions from land fill sites fell by 7 percent. They have been falling for several years because less waste is deposited in landfill sites and historic emissions from existing sites are lessening. The increased emissions in the transport sector closely follow the larger transport activities. Particularly, emissions for

[3] The total emissions by the economy, which includes emissions by households, equalled 230.0 Mton CO2 eq. (see also section 1.1), which is 5.6 percent lower than in 2011.

inland shipping and air transport increased. Emissions fell in the service sectors as less natural gas was combusted to heat offices.

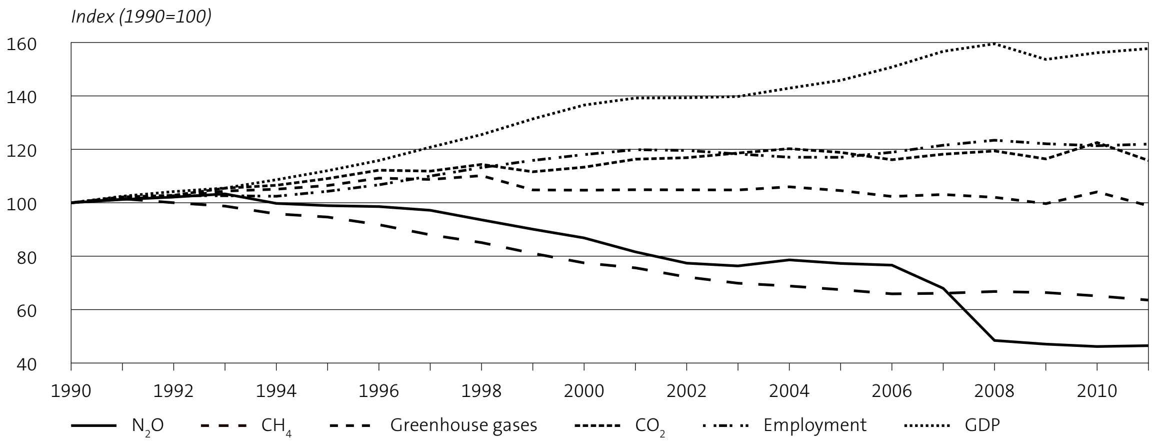
**6.2.1 Changes in value added, greenhouse gas and $CO_2$ emissions, 2010-2011**




## Emission intensity decreased in 2011

In 2011 the economy expanded by 1 percent, whereas greenhouse gas emissions fell by 5 percent. The emission intensity for greenhouse gases, which is an important measure of the environmental pressure caused by economic activities, improved. The main reason is the mild winter of 2011, in which less energy was used for heating offices and greenhouses in horticulture. This caused less $CO_2$ emissions per unit value added. In manufacturing, the emission intensity improved, except in the manufacture of chemicals and energy supply.

**6.2.2 Volume change GDP, employment and greenhouse gas emissions by industries**

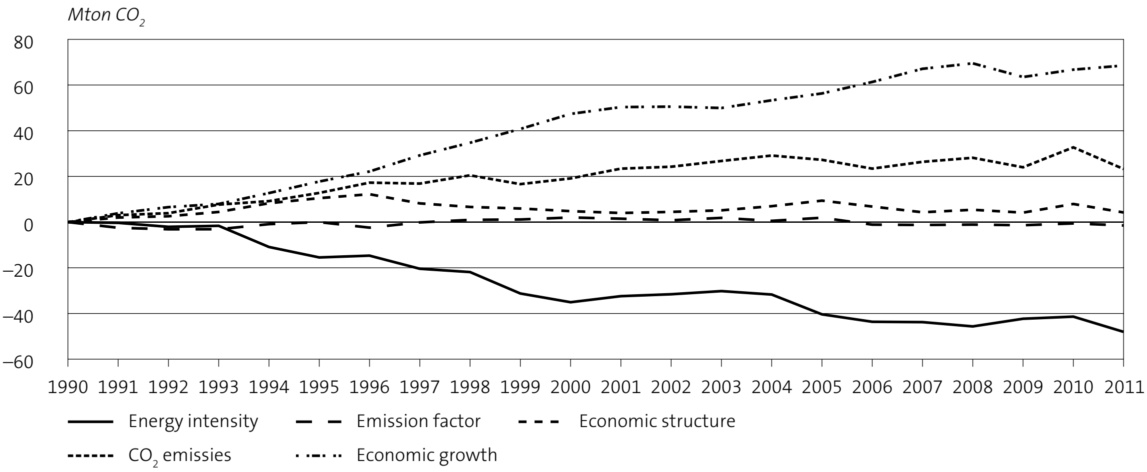


In the rather long period of 1990–2011, economic growth exceeded greenhouse gas emissions by far. While the economy grew at a rate of 58 percent and employment by 22 percent, the emissions of greenhouse gases by industries have decreased by 1 percent. This is the first time in 21 years that we observe absolute decoupling in the Netherlands with respect to the 1990 emission levels. Absolute decoupling here means lower emissions than in 1990 despite economic growth. For $CO_2$ emissions, there is still only relative decoupling, i.e. the emission rate increases by less than the GDP growth rate.

### More efficient energy use unable to stop the increase in $CO_2$ emissions

The change in the level of $CO_2$ emissions by economic activities in the period 1990–2011 can be explained by different factors. First of all, economic growth may have led to more $CO_2$ emissions. A change in the energy mix (the energy products used in the production process) may also have influenced emission levels. The economic structure may have changed, for example due to a change in the input-output relations of the intermediate use, or a change in composition of the final demand for products and services. Finally, eco-efficiency improvements of the production process may have decreased $CO_2$ emissions. Structural decomposition analysis allows us to account in detail for the factors underlying the changes in emissions.

**6.2.3 Structural decomposition analysis of $CO_2$ emissions**

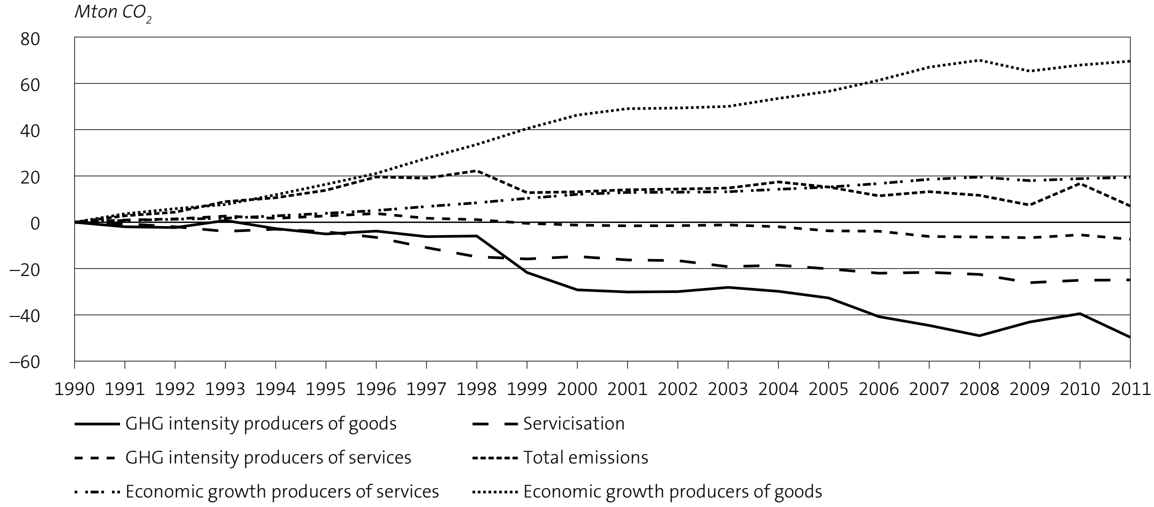



Economic growth clearly has been the driving force behind the increase in $CO_2$ emissions, which were only partially negated by an increase in efficiency (energy intensity effect). Emissions in 2011 would have been about 48 percent higher than in 1990 if there had been no change in efficiency and structure. The improvement of the energy intensity (energy saving) has reduced the increase in $CO_2$ emissions. Structural changes in the economy or changes in the mix of energy products clearly had less effect on the total change in emissions. The decrease in emissions between 2010 and 2011 was the result of a lower energy intensity.

### Higher share of service industries contributes to decoupling emissions and economic growth

Servicisation, which is the increase in the share service industries in the total economy, has been a key structural economic development of the past decades in many developing economies. In the Netherlands, the service industries grew faster than manufacturing, construction and agriculture. The share of the services sector in total value added rose from 67 percent in 1990 to 74 percent in 2011 at the expense of the producers of goods.

**6.2.4 Decomposition analysis greenhouse gas emissions, effect of servicisation**



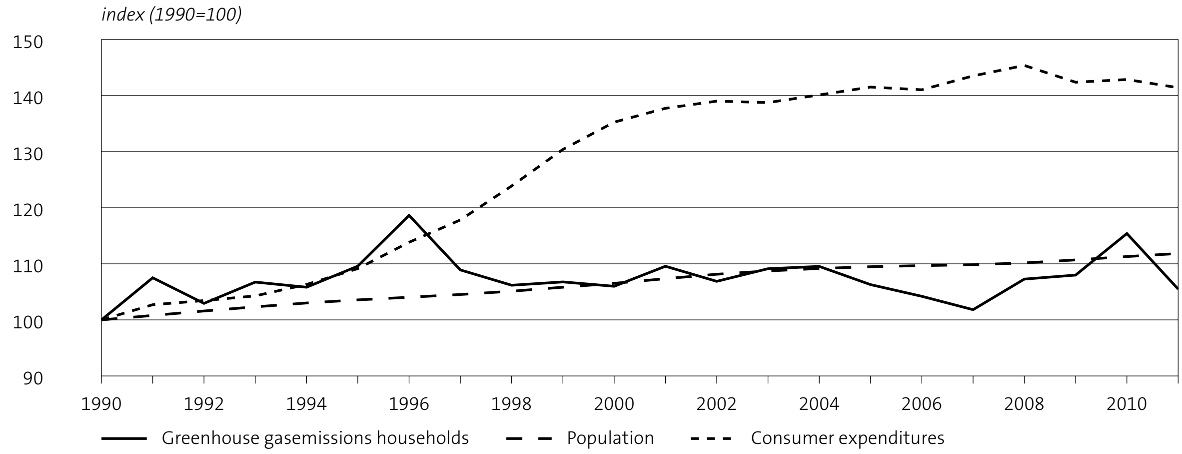

The shift to a more service-based economy also affects the emission of greenhouse gases. Since the production of services tends to be much less emission-intensive than the production of goods, the rise in the production of services has caused the economy as a whole to become less emission-intensive. The effect of servicisation can be determined by calculating what greenhouse gas emissions would have been if the share of services in the economy had remained the same. If the share of services in the economy had not increased since 1990, the greenhouse gas emissions in 2011 would have been 13 percent higher.

Servicisation explains one third of the decoupling between greenhouse gas emissions and economic growth. The remainder we can attribute to the more environmentally efficient production of goods, primarily by agriculture and the chemical industry. Efficiency in the services sector has hardly contributed to the decoupling. This is mainly because the transport sector largely determines the total greenhouse gas emissions of the service sectors, being responsible for about half of its greenhouse gas emissions. Its large share and rapid growth in recent years, plus its relatively minor gain in environmental efficiency means the transport sector has increased emission intensity within the overall services. The other service sectors have a significantly lower emission intensity, which has improved compared to 1990.

# 6.3 Greenhouse gas emissions from household activities

Households directly contribute to the emission of greenhouse gases by consuming energy products for heating, cooking and generating warm water, and by using motor fuels for driving. The air emission accounts provide information on the level of these emissions and provide the opportunity to compare these with monetary information from the national accounts. In this section we present the developments in the direct emissions by households and the underlying causes.

**6.3.1 Change in direct greenhouse gas emissions by households, populationand household consumer expenditure**



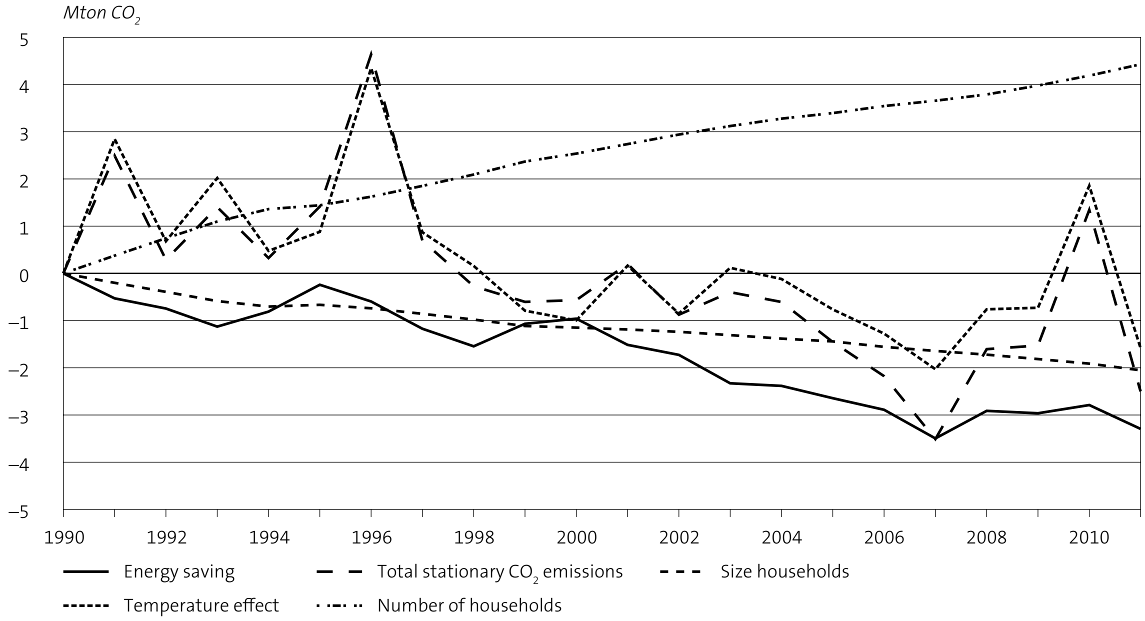

In 2011 direct greenhouse gas emissions from households declined by 3.3 percent with respect to 2010, despite an increase in population. The main reason for the drop in emissions was lower natural gas consumption for space heating (-7 percent) due to the mild winter. The $CO_2$ emitted by cars rose by 1 percent in 2011. Compared to industries, households cause minor direct emissions of greenhouse gases other than $CO_2$, such as $CH_4$ (methane) and $N_2O$ (nitrous oxide). $CH_4$ emissions fell by almost 13 percent due to lower natural gas consumption and more efficient combustion techniques of boilers.

Dutch households were responsible for 38.6 Mton of greenhouse gas emissions in 2011, which is 17 percent of the total emissions by economic activities. The development of these emissions can be compared directly with population growth or consumer expenditures. It turns out that the population and final consumption by households are growing faster than the emissions.

**Effect energy saving by households on emissions stabilising**

The $CO_2$ emissions by households that are produced in and around the home have fallen by 18 percent since 1990. These so-called emissions from stationary sources originate for the most part from the combustion of natural gas for space heating, production of warm water and cooking (93 percent). Emissions from wood stoves and fireplaces are responsible for 6 percent. The causes for the decrease in emission levels for stationary sources can be further analysed by decomposition analysis. The changes in emissions can be decomposed into several factors, including the number of households, the average size of households, the effect of the average temperature and an energy saving effect.

**6.3.2 Decomposition analysis for $CO_2$ emissions by households (stationary sources)**

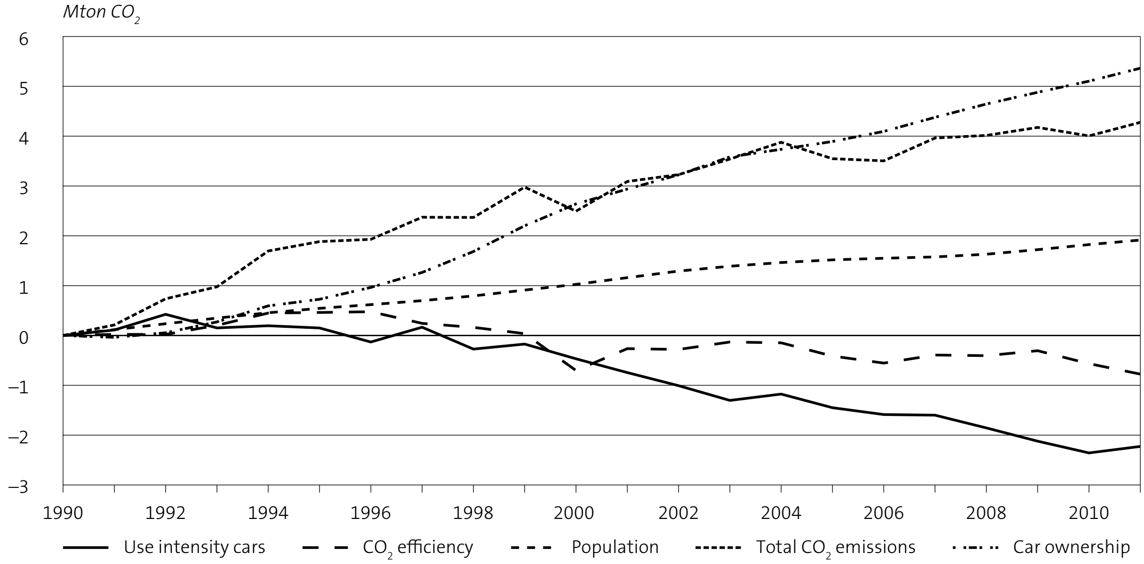



The gradual increase in the number of households caused a 4.4 Mton increase in the level of $CO_2$ emissions. All other factors had a lowering effect on the emissions. The weather conditions (average winter temperature) have a dominant effect particularly in years when winters are relatively cold, such as 1996 and 2010, when emissions peaked as more natural gas was combusted for heating. Overall, the average temperature had an increasing effect on emissions in the 1990s and a decreasing effect in the decade of 2000–2010. Policymakers are probably most interested in the effect of the energy saving that can be deduced form this analysis. It was responsible for an emission cut of 3.3 Mton between 1990 en 2011. Better home isolation and high efficiency boilers resulted in a 16 percent $CO_2$ reduction, which is on average 0.8 percent a year. The effects of energy saving were primarily realised after 2000. However, not much progress has been made since 2007.

**Increased car ownership raises $CO_2$ emissions**

$CO_2$ emissions due to the use of road vehicles by households increased by 29 percent on 1990. The causes for the increase in emission levels for mobile sources can be further analysed by decomposition analysis. The changes in emissions can be decomposed into several factors, including population growth, car ownership, traffic intensity (number of kilometres driven per car) and a $CO_2$ efficiency effect (emissions per kilometre). The impact of the population increase has been a 13 percent rise in emissions on 1990. However, the main contributor to higher $CO_2$ emissions is the increase in car ownership, with an upward effect of 37 percent. In 1990 there were three cars per ten Dutch inhabitants, in 2012 this had risen to four in ten. The effect is partially offset by the fact people drive their cars less (lower mileage). More households now own a second car, used mainly for short trips. Strikingly, $CO_2$ emissions per kilometre travelled has not changed much in 21 years. Since 2009, an improvement in the $CO_2$ efficiency can be observed. The average $CO_2$ emissions per vehicle kilometre from new passenger cars in the Netherlands have fallen sharply in the past three years. This is partly due to European standards, which have led to more fuel efficient cars on the market. The demand for fuel-efficient cars has risen under the influence of Dutch tax measures.

**6.3.3 Decomposition analysis for $CO_2$ emissions by households (mobile sources)**



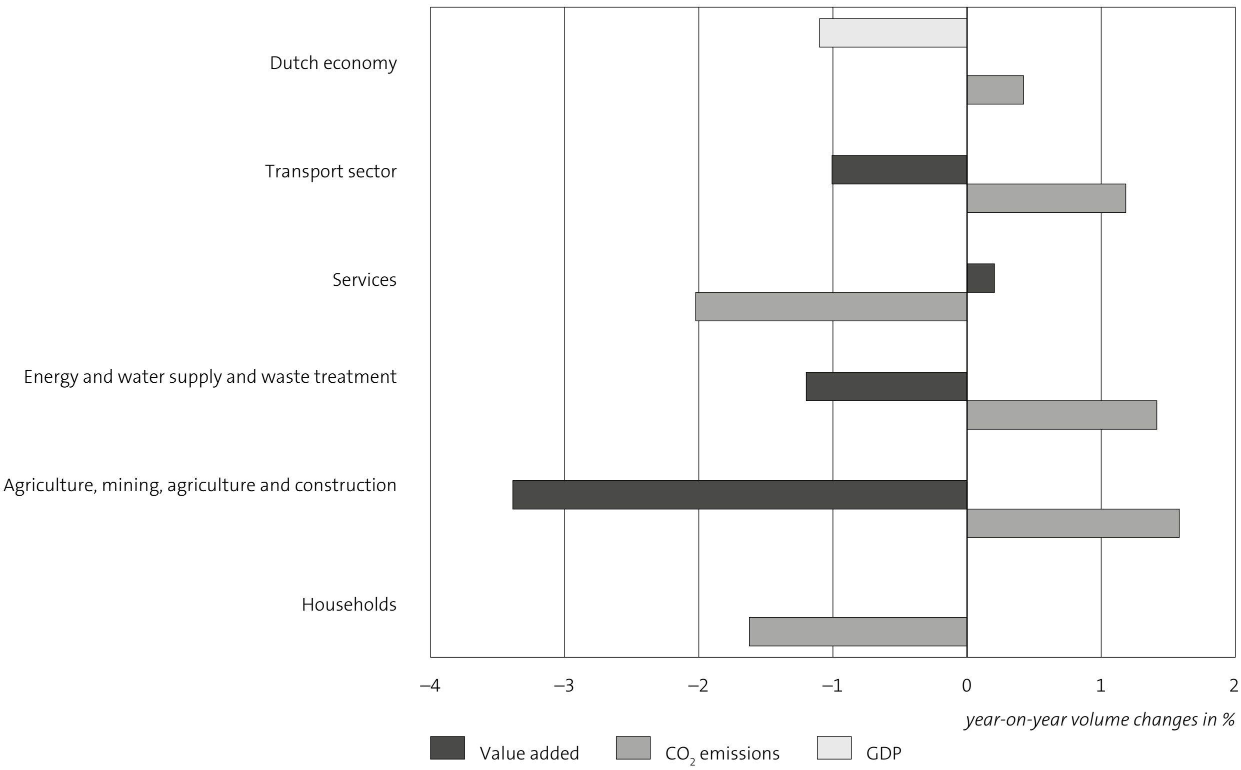

# 6.4 $CO_2$ emissions on quarterly basis

Accurate and timely measurements of the amount and the origin of the emitted greenhouse gases are essential to help governments achieve their objectives. Data on national greenhouse gas emissions (national emission inventory and environmental accounts) usually become available nine months after the end of the year under review. Quarterly based $CO_2$ emission data could serve as a short term indicator for policymakers and researchers to assess how the greenhouse gas emissions change in response to economic growth or decline, as carbon dioxide is the most important anthropogenic greenhouse gas. In 2011 Statistics Netherlands started publishing quarterly $CO_2$ emissions 45 days after the end of a quarter, at the same moment as the first quarterly GDP estimate is published. The quarterly $CO_2$ emissions are compatible with the national accounts and can be linked directly to economic output, allowing the comparison of the environmental performance of different industries.

### Slight rise in $CO_2$ emissions in the first quarter of 2012

Although the Dutch economy shrank by 1.1 percent, $CO_2$ emissions rose by 0.4 percent in the first quarter of 2012 compared to the same quarter of 2011[4]. February was very cold, while January and March were mild. So on balance the weather hardly played a role in the $CO_2$ calculation. The service industries and households used about the same amount of natural gas for space heating as in the first quarter of 2011 and therefore emitted about the same amount of $CO_2$.

**6.4.1 Change in $CO_2$ emissions and economic development, first quarter of 2012**




[4] According to the second estimate of Statistics Netherlands, the Dutch economy shrank 0.8 percent in the first quarter of 2012. This second estimate of economic growth is 0.3 percent higher than the first estimate of 15 May 2012.

The economic slowdown was mainly caused by a lower production of the construction industry. Construction is a relatively emission-extensive activity, especially in comparison with the very emission-intensive chemical and oil industry. So developments in construction have relatively little impact on emissions. A major reason for the increase in $CO_2$ emissions was the economic recovery of the chemical and oil industry, where production increased again. This increase in production coincided with an increase in emissions. The chemical sector is largely dependent on demands from abroad. The manufacturers of basic chemical products exported more than the first quarter of 2011.

The energy companies produced slightly less electricity. Electricity generation is associated with high $CO_2$ emissions. According to initial calculations energy use fell in the first quarter compared to the same quarter of 2011. Relatively more coal and blast furnace gas was used and less natural gas. Coal and blast furnace combustion causes relatively more emissions than the combustion of natural gas. The consumption of electricity in the Netherlands increased. More electricity was imported, which may create additional emissions abroad.

In the transport sector $CO_2$ emissions rose while the value added fell. Profits were under pressure from high fuel prices. The picture is varied in the transport sector. Production decreased for road transport, but increased for water transport. In air transport activities increased, but the high price of jet fuel had a negative effect on the development of value added.

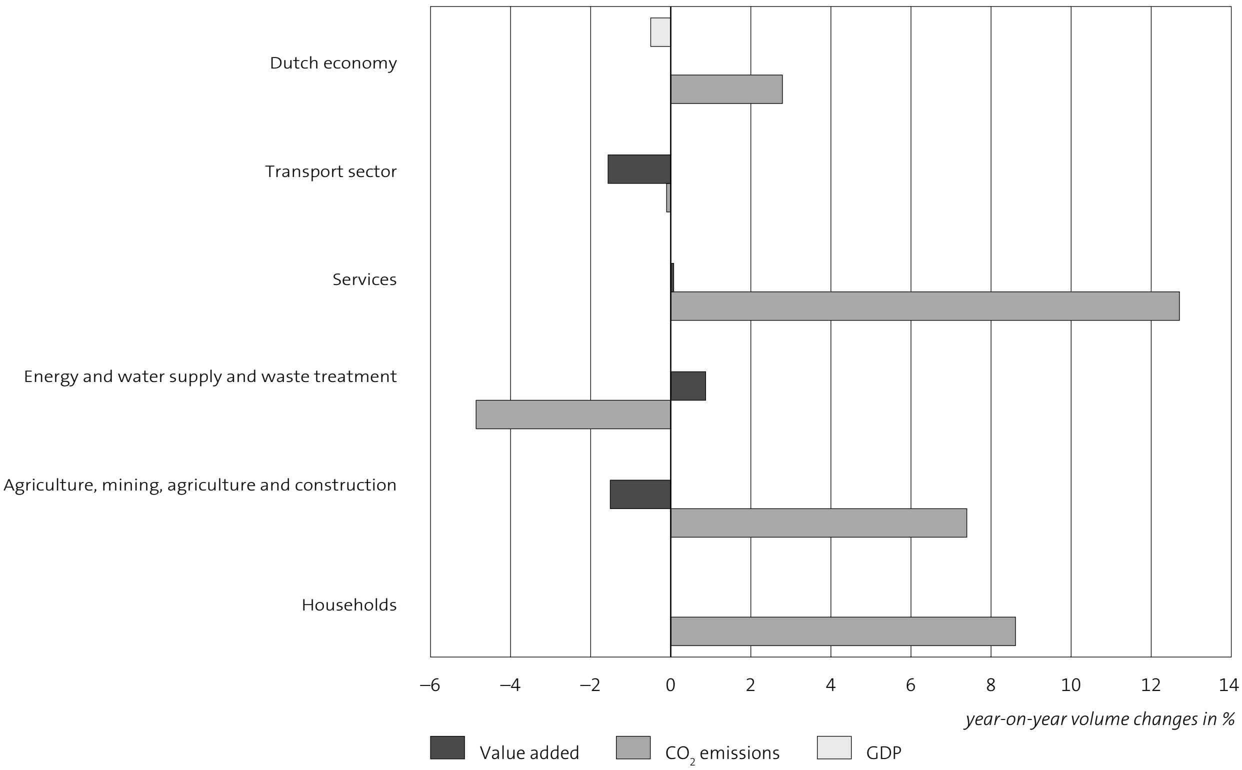
**Despite economic decline also rise in $CO_2$ emissions in second quarter of 2012**

In the second quarter of 2012 2.8 percent more $CO_2$ was emitted by the Dutch economy than the same quarter a year earlier. The economy shrank in the second quarter by 0.5 percent per annum. Emissions from energy producers, water companies and waste treatment decreased with 5 percent. Energy companies have produced much less electricity as more electricity was imported. The fuel mix for producing electricity, according to initial calculations deteriorated compared to the same quarter last year, resulting in the release of more emissions. Relatively, more coal and less natural gas was used.

A major reason for the increase in $CO_2$ emissions in manufacturing is the economic recovery of the chemical and oil industry. Production of these two very emission-intensive industries has grown over the past two quarters. The increase in production in the chemical and oil industries coincided with an increase in emissions. The chemical industry is largely dependent on demand from abroad. The manufactures of basic chemical products have exported more than the same quarter a year earlier. In the transport sector $CO_2$ emissions and added value decreased. Production of road transport and inland shipping decreased, while sea transport increased. In aviation transport performances increased slightly.

The month April was relatively cold. The service industries and households have combusted more natural gas for space heating than a year earlier and therefore emitted more $CO_2$. Without the weather effect the 2.8 percent increase in emissions from the total Dutch economy would change into a 1.3 percent decrease.

### 6.4.2 Change in $CO_2$ emissions and economic development, second quarter of 2012




# 6.5 Air pollution

Production and consumption activities cause the emission of a variety of substances to the air. Due to their physical and chemical characteristics some substances have effects on a global scale such as greenhouse gases. The air emissions discussed in this section, such as particulate matter or nitrogen oxides, have a local impact on human health or an impact on quality of the environment or they have regional impact. Air emissions of several substances can be aggregated by weighting them by their respective impacts to form indicators to measure their contribution to a variety of environmental themes that are important from a policy perspective. The themes discussed here are acidification, PM10 emissions, smog formation, and ozone layer depletion.[5)]

For a description of the methodology used see CBS (2010). The data of the air emission accounts can be found on StatLine, the electronic database of Statistics Netherlands.

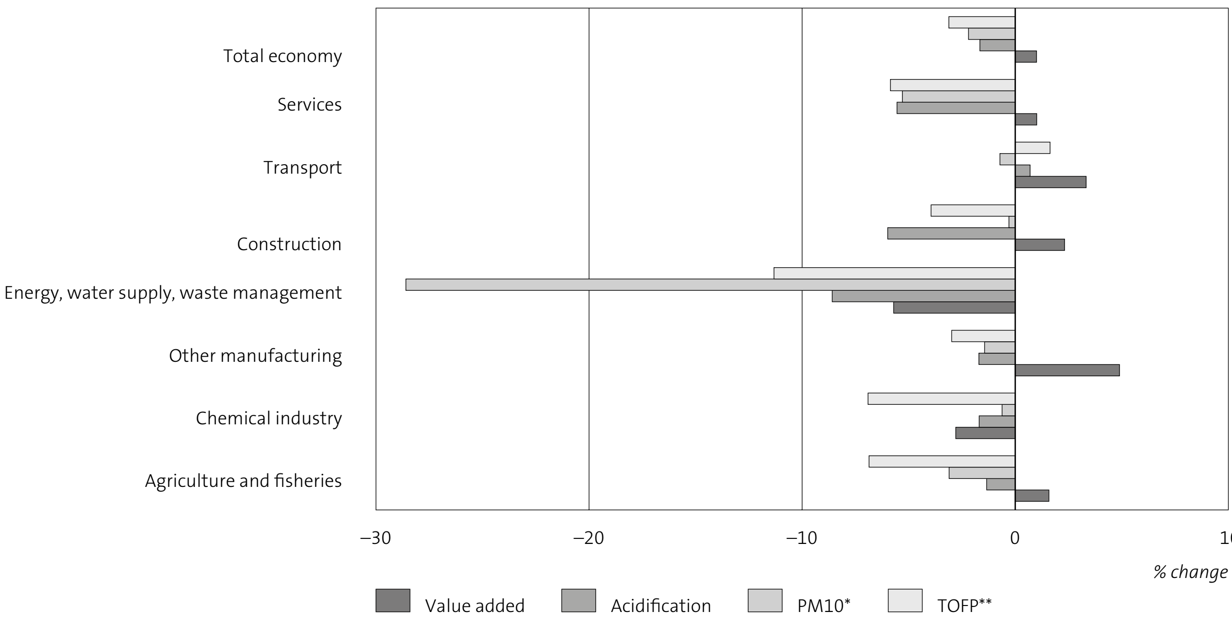
5) Smog formation and emission of particulate matter are not officially 'environmental themes' under the Dutch National Environmental Policy plan number II, but belong to the theme 'transboundary air pollution'. Emissions of substances that contribute to ozone layer depletion, is the sole exception here, having an effect globally as is the case for the greenhouse gas emissions.

### Emissions of acidifying pollutants decreased in 2011

Acidification is caused by the emissions and deposition of nitrogen oxides ($NO_x$), sulphur dioxide ($SO_2$) and ammonia ($NH_3$). The combined emissions of these acidifying substances, expressed as acid equivalents, in contrast to the 1 percent increase in 2010, decreased in 2011 by 2 percent. Since 2000 acidifying emissions have declined with 28 percent.

Acidification leads to damage to natural areas such as forests and heaths. Because acidification also affects ground and surface water, it forms a threat to drinking water. For the acidifying emissions in particular the agricultural sector and the transport sector are responsible. This is mainly due to the ammonia emissions from livestock farming and the emissions of nitrogen oxides and sulfur dioxide by transport over water. The quantities of emissions from these sectors are much higher those from refineries and households.

**6.5.1 Change in value added, emissions of acidifying substances, particulate matter (PM10) and smog, 2010–2011 [6)]**




* PM10, Particulate matter (with aerodynamic diameter less than or equal to a nominal 10 microns).
** TOFP, Tropospheric Ozone Formation Potential, is an indicator for the formation of tropospheric ozone.

The emissions of nitrogen oxides ($NO_x$) in 2011 declined by 3 percent. In particular road transport contributed to this decrease (minus 5 percent) although production grew with 2 percent. In road transport the growing number of vehicles with cleaner engines helped to cut emissions. The emissions resulting from transport over water and air transport, however, increased with respectively 2 and 5 percent, mainly due to growth in sales of inland shipping and aviation activities. Electricity companies reduced $NO_x$ emissions again (-14 percent). Strict environmental

6) Figures for 2011 are provisional, as some sources are not complete and/or definitive.

measures taken at power plants have resulted in a reduction of more than 50 percent with respect to 2000.

Households too have steadily decreased their $NO_x$ emissions to half of the 2000 emission level. This is predominantly due to the continuously improved performance of car engines because of tightening the European exhaust gas standards. Energy efficiency improvement in space heating, insulation coverage, new better performing houses and the application of less polluting boilers have contributed as well.

Sulphur dioxide emissions decreased by 2 percent in 2011. Sulphur dioxide emissions are mainly caused by water transport (56 percent), followed by the oil industry (13 percent), electricity production (7 percent), and the basic metal industry (6 percent). Advancing technology and implementation of environmental policies resulted in a reduction in emissions. The influence of policy, for example, can be drawn from the regulation of the so-called MARPOL Convention for the Maritime POLution, issued by the International Maritime Organisation (IMO). The MARPOL Convention puts restrictions on the sulphur content of marine fuel oil used by vessels, with the aim to prevent pollution from vessels. Gradually, the allowable sulphur content in fuel oil is reduced to begin with in defined protected areas called (Sulphur) emission control areas. The oil industry realized a reduction again of 2 percent after a 30 percent reduction already in 2009 and 29 percent in 2010. This was largely achieved through the application of desulphurisation of flue gas and by increased use of natural gas instead of crude oil in the refining process, which has much lower sulphur concentrations. Because the sulfur content in kerosene was further reduced, transport by air achieved a 9 percent decrease of Sulphur dioxide emissions in 2011.

Ammonia emissions, primarily stemming from livestock and from the application of manure on arable land, stayed practically at the same level in 2011 as in 2010. The ($NO_x$) emissions are responsible for over half of the emissions of acidifying pollutants, ammonia for one third and sulphur dioxide emissions only for 15 percent in 2011. The shares of $SO_2$ and $NH_3$ has decreased since 2000.

### PM10 and emissions of ozone precursors decreased in 2011

The total emissions of particulate matter in 2011 decreased by 2 percent compared to 2010. Especially the farming sector and the manufacturers of basic metals reduced their emissions in 2011. Emissions of ozone precursors ($CH_4$, CO, NMVOC, $NO_x$) are weighted by their tropospheric ozone formation potentials, or smog formation in short. These emissions overall showed decline of 3 percent across all activities.

**6.5.2 Contributions to value added and environmental themes in 2011**

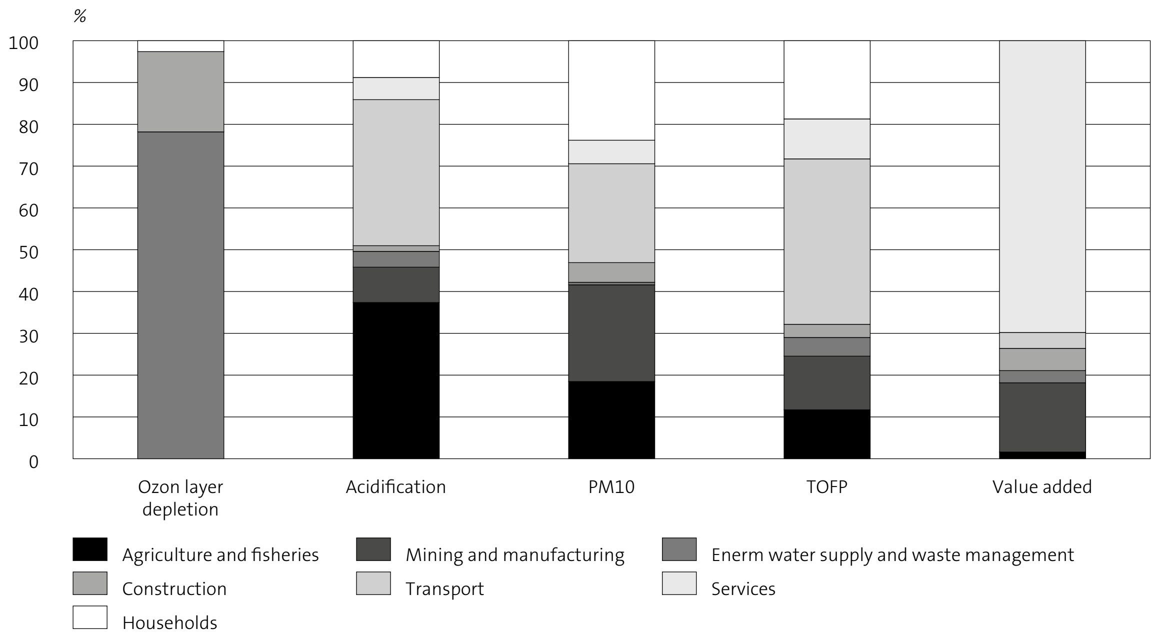
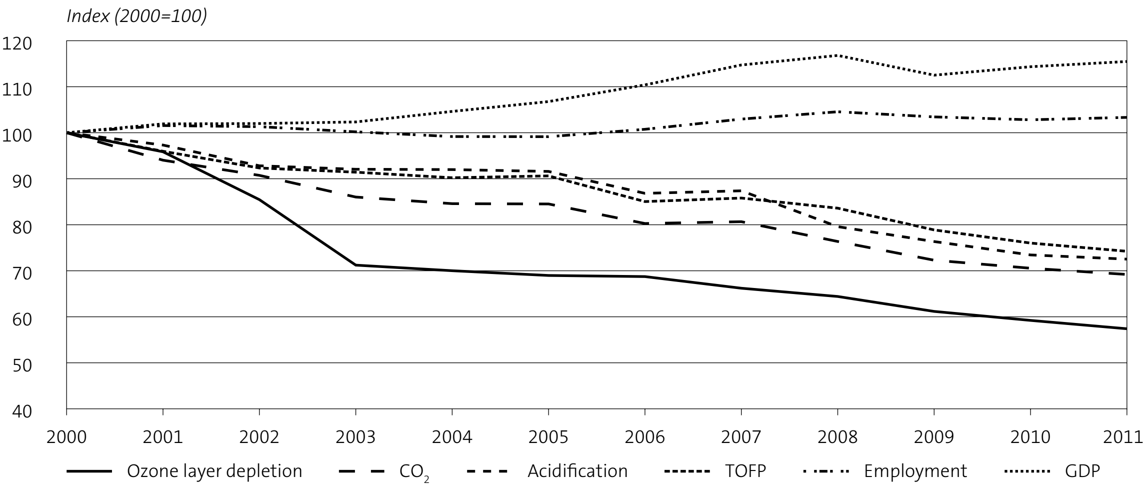



Figure 6.5.2 provides a breakdown of the environmental themes and value added in 2011 by economic sectors and households. It demonstrates that whereas services (excluding transport) are responsible for 70 percent of value added, their contribution to environmental themes is small with 11 percent at most. Acidification is dominated by agriculture and transport, while ozone layer depletion is primarily driven by waste management and construction. Contribution to smog formation is dominated by transport emissions and to a lesser extent by households. PM10 emissions originate from a mixture of sectors where transport, households, mining and manufacturing and agriculture all contribute significantly.

### Non-greenhouse gas emissions to air decoupled from economic growth in 2011

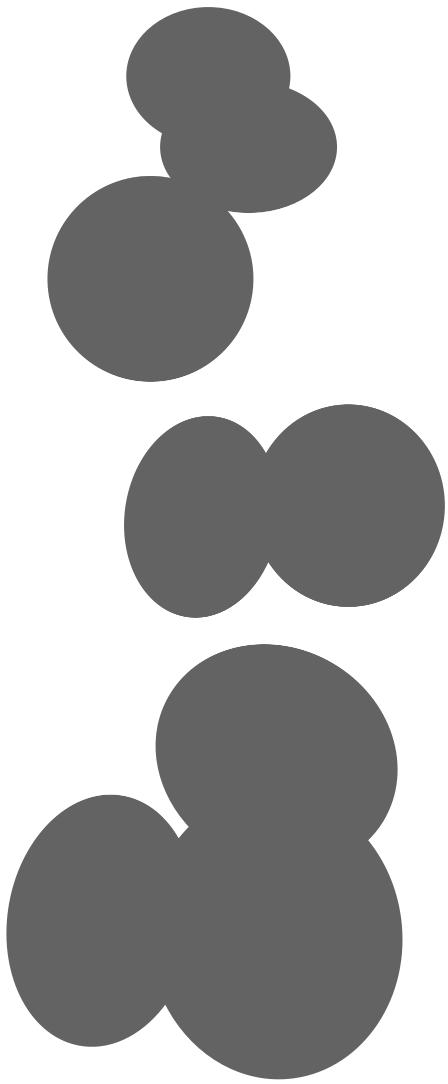
Between 2000 and 2011 the Dutch economy grew at a rate varying between 0 to 4 percent annually with the exception of 2009. Employment increased continuously as well with short interruptions in 2003, 2004 and 2009. At the same time the emission of all substances to air were cut by 25 percent or more, with the exception of $CO_2$ and $CH_4$ emissions (for details see section 6.2) The drop in all local air pollutants described in this section implies that absolute decoupling has taken place in the Netherlands since 2000. Gases contributing to ozone layer depletion were no exception, showing absolute decoupling. These are emissions are still decreasing, although the major reductions were achieved in the period prior to 2003. Emission levels for substances contributing to acidification and smog formation generally show the same pattern of reduction since 2000.

### 6.5.3 Volume changes in GDP, employment and several environmental themes



# Policy instruments and economic opportunities

# 7



# Policy instruments and economic opportunities

## 7.1

**Environmental taxes and fees**
- Environmental tax revenue drop
- Largest energy tax payers: households and manufacturing
- Revenues from environmental fees keep on growing

## 7.2

**Environmental subsidies and transfers**
- Transfers for environmental protection only 0.4 percent of total government transfers
- Share environmentally motivated subsidies/transfers in government expenditure remains stable
- Three quarters of all environmental subsidies for management of energy resources
- Implicit environmental subsidies increased in 2010

## 7.3

**$CO_2$ emission permits**
- ETS companies contribute less than 10 percent to GDP
- Excess of $CO_2$ emission permits rising further in 2011
- Intensified securing activity for permits led to even larger stocks of allowances and credits
- Volume of emission permits traded since 2005: allowances peaked in 2009, credits up again in 2011
- Emissions trading in the Netherlands still for more than half by non-residents
- Prices of $CO_2$ permits further down in 2011 and 2012
- Grandfathered allowances valued at over a billion euro a year
- The energy sector had to secure less than 35 million euro worth of permits for their 2011 emissions
- References

## 7.4

**Environmental protection expenditure**
- Environmental costs decreased in 2009
- Higher percentage government in net environmental costs after transfers
- Environmental investments decreased in 2009

## 7.5

**Economic opportunities for the environmental goods and services sector**
- Recovery value added of EGSS in 2010, employment under pressure
- Recycling and wholesale in waste and scrap partially recovered in 2010
- Value added renewable energy production stable in 2010 due to less wind
- Construction activities in EGSS under pressure
- Many activities contribute to value added EGSS
- Relative contribution of EGSS to GDP grew in 2010

# 7.1 Environmental taxes and fees

By producing waste, emitting pollutants into air and water, and using natural resources, everybody puts pressure on the environment. People's contribution to the environmental problem can also be created in an indirect way: by buying goods and services in which emissions are discharged during the production process. One of the government's policy instruments to reduce environmental damage is to impose taxes and fees on harmful products and activities.

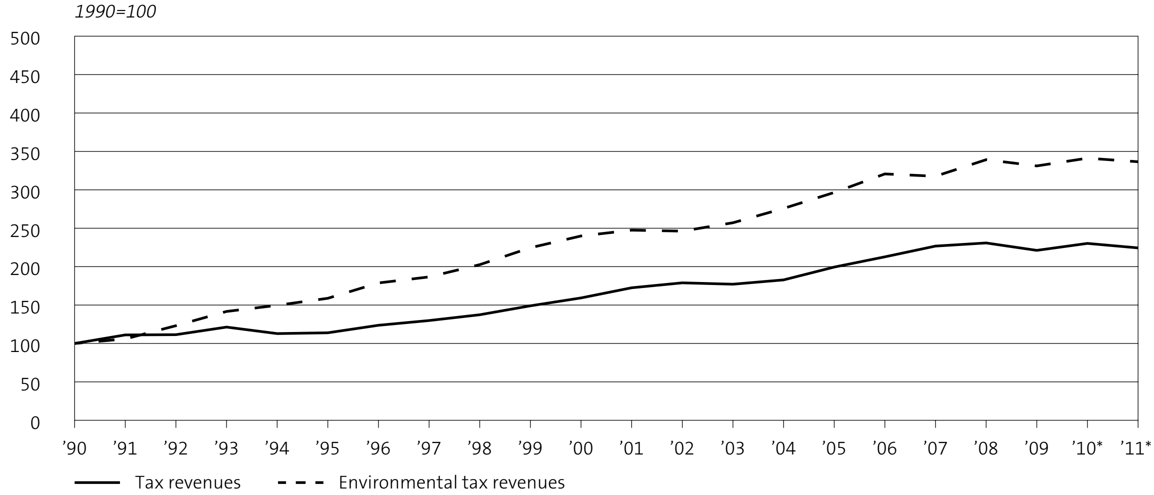
In the Netherlands, a distinction is made between environmental taxes and environmental fees. At Statistics Netherlands, annual data is compiled on environment-related taxes and fees. The difference between these two lies in what is done with the revenues. According to SEEA (UN et al., 2012) and the Eurostat (2001 and 2011a) statistical guides, an environmental tax is "A tax of which the tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment". Taxes are a government's main source of income. The government can use the revenues from environmental taxes for all kinds of purposes. Examples of this first category are energy tax, excise duty on petrol and other motor fuels, and motor vehicle tax. In contrast to environmental tax revenues, revenues from environmental fees have a predefined destination. Environmental fees are introduced to bear the costs of specific environmental services that are provided or financed by the government. It is in particular local, executive government that charges environmental fees. Examples of this second category are the municipal refuse rate and the sewage charges that are paid to water boards for the sanitation of waste water.

The current section reports on the revenues from the various environmental taxes and fees and shows who are actually paying the levies. The first part deals with results for environmental taxes. It will then elaborate the results for environmental fees. The data can be found in StatLine, Statistics Netherlands' online database. For a description of the methodology the reader is referred to CBS (2010).

### Environmental tax revenue drop

In 2011, government collected 19.6 billion euro in environmental taxes. Compared to the previous year, government income from environmental taxes went down by 1 percent. Revenues from environmental taxes have more than tripled over the last two decades but then flattened off. This trend is in line with the trend for total tax revenues; tax revenues have more than doubled since the early nineties, reaching a peak in 2008. They have so far remained stable.

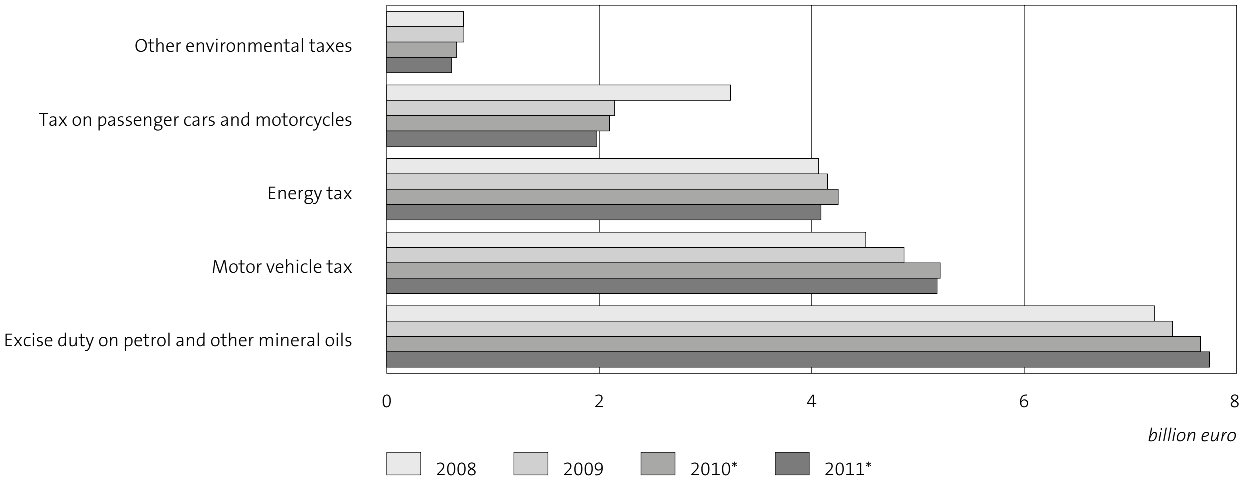
### 7.1.1 Development environmental tax revenues and total tax revenues




In 2011, green taxes accounted for 14.0 percent of total taxes. What environmental tax reform aims at is shifting away the tax burden from taxes on income and capital and toward taxes on consumption, pollution, and the inefficient use of energy and resources. This shift can be monitored by looking at the share of the so-called green taxes in total income from taxes and social contributions. This share has been fairly constant as of 1999. Between 1990 and 1999, the share of environmental taxes rose markedly from 9.4 to 14.1 percent.

Dutch government imposes environmental taxes especially in the domains of energy and transport. Important revenue-generating green taxes are excise duties on petrol and other motor fuels, motor vehicle tax and energy tax. Revenues from these environmental taxes in 2011 amounted to 7.7 billion euro, 5.2 billion euro and 4.1 billion euro, respectively. It was the energy tax and tax on passenger cars and motorcycles (BPM) that mainly caused the environmental tax revenues to fall in 2011. Income from energy tax dropped by 3.8 percent, which was caused by a decreased energy use in 2011 compared to 2010. Income from tax on passenger cars and motorcycles declined by 5.6 percent to 2.0 billion euro. This substantial decrease in the revenues from the import or sales tax on motor vehicles was partly due to the popularity of BPM exempted cars. On 1 January 2009, the Dutch government introduced a BPM exemption policy for fuel-efficient cars. In 2008, the year prior to the introduction of the exemption, government levied 3.2 billion euro in tax on passenger cars and motorcycles, which was nearly 40 percent more than in 2011. Revenues from motor vehicle tax and minor environmental taxes, such as tax on packaging and tax on the abstraction of water, showed a decrease as well. The only environmental tax that showed growth for 2011 was excise duties on petrol and other mineral oils. This environmental tax increased by 1.1 percent.

### 7.1.2 Environmental tax revenues by tax type

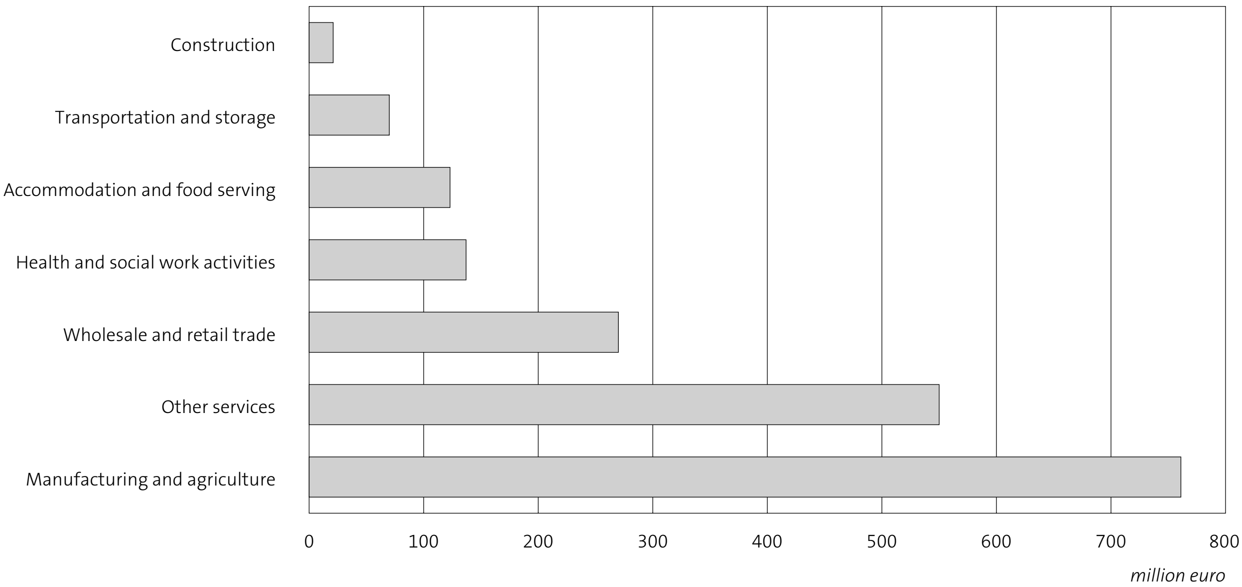



## Largest energy tax payers: households and manufacturing

Energy tax is an indirect tax. Energy companies transfer the energy tax that they have paid to the users of energy, which raises the energy price. The amount of taxes that is paid per unit of energy varies per sector and per user category. For example, in 2011 households paid an average 3.1 million euro on energy tax per gigajoule energy used. On the other hand, producers only paid an average 0.7 million euro per gigajoule. This is because tax rates are higher for small users of energy compared to heavy users. In 2011, households were responsible for more than half of the energy tax paid.

Companies use energy for all kinds of purposes, such as heating, lighting and electrical equipment. Within the sector of producers, manufacturing as well as wholesale and retail trade are the largest energy tax payers. Within manufacturing it is mainly industrial processes that are energy-consuming, and not so much the heating as such. In general, manufacturing is an industry that is paying a small amount of taxes per unit of energy used. Still, of all producers in total, this industry is paying most of the energy tax because it uses an immense amount of energy. Service industries that are paying a substantial amount of energy tax are the healthcare and accommodation and food serving sectors.

**7.1.3 Energy tax payments by producers, 2011***




## Revenues from environmental fees keep on growing

Compared to revenues from environmental taxes, revenues from environmental fees amount to a much smaller total: in 2011, revenues from environmental fees were 4.5 times lower than revenues from environmental taxes. In 2011, local government levied 4.3 billion euro in environmental fees. Dutch government imposes environmental fees in the environmental domain of pollution. Pollution is a traditional environmental problem, and in this field local government directly comes into action. As in the year before, in 2011 revenues from environmental fees increased. This upward movement could be detected for several environmental fees. Municipalities charged 1.4 billion euro for sewage charges, an increase of 4.7 percent compared to 2010. Revenues from levies on water pollution as charged by water boards rose by 4.4 percent to 1.2 billion euro. What made the tariffs for levies on water pollution rise by more than the inflation was the increasing investments in water quality. Households proved to pay most of this increase: this sector paid almost three quarters of the costs for cleaning waste water. Revenues from the municipal refuse rate remained stable in 2011. Certain smaller environmental fees such as levies on after-care of refuse dumps are the responsibility of provinces. Together, these provincial fees accounted for a mere 100 million euro.

# 7.2 Environmental subsidies and transfers

Environmental subsidies are important economic instruments for achieving national environmental policy objectives and for compliance with international agreements. Subsidies, including tax exemptions, receive a great deal of attention in the political arena. Environmental subsidies are used to promote a wide variety of activities that aim to protect the environment, use resources more efficiently and safeguard natural resources via improved management. It is therefore important to gain a better understanding about their size, beneficiaries, and development over time.

The Netherlands has a large variety in subsidy schemes. Some focus on mitigating current expenditures for environmental protection or resource management activities by economic agents, such as the SDE scheme, which is a production-based subsidy for producers of renewable energy. Other schemes are of a capital nature and focus on reducing the (private) costs that result from investments in equipment, installations and accessories directly used for environmental protection. Some schemes result in actual payments, while others allow for tax exemptions. Moreover, individual subsidy schemes differ in terms of their origin (central government, municipalities, EU) and the domain they apply to (air, water, etc.).

In 2010 Statistics Netherlands executed a pilot project for Eurostat testing the statistical framework for environmental subsidies/transfers that is currently being developed within Eurostat, the UN and the OECD, and contributed to ongoing discussions in this field (Graveland, Edens and Tebbens, 2011). The framework with definitions, concepts and classifications will be further developed by the Task Force on environmental transfers under Eurostat's umbrella, in place since 2010. Also involved in the development was the London Group on Environmental Accounting, as part of the SEEA revision that has led to the SEEA 2012.

In this paragraph we present experimental results for a time series of government expenditures and transfers by purpose, environmental subsidies and other transfers for 2005–2010, and the allocation of these subsidies/transfers to environmental domain. In Environmental Accounts of the Netherlands 2010 (Statistics Netherlands, 2011b) the methodology, definitions and scope of the presented figures are discussed.

**Transfers for environmental protection only 0.4 percent of total government transfers**

Table 7.2.1 provides a general overview of total expenditures and transfers by the Dutch government sector in 2010, according to purpose based upon COFOG (Classification of the Functions of Government, UN). Transfers make up more than half of the total expenditures, with social transfers being the largest category. Subsidies, as defined in the national accounts, constitute a mere 3.1 percent of total government expenditures. Subsidies here include only the so called explicit subsidies on environmental protection, which are direct monetary transfers from the government to the beneficiaries.

**7.2.1 Total government expenditure and transfers by purpose (COFOG), 2010**

| COFOG | Total expenses | Total transfers | Social transfers | Subsidies | Income transfers | Capital transfers |
|---|---|---|---|---|---|---|
| | *million euro* | | | | | |
| General public services | 34,882 | 9,917 | | 298 | 7,133 | 2,486 |
| Defence | 8,325 | 194 | | 16 | 137 | 41 |
| Public order and safety | 12,389 | 227 | | 127 | 96 | 4 |
| Economic affairs | 35,613 | 9,140 | | 6,217 | 468 | 2,455 |
| Environmental protection | 10,400 | 675 | | 138 | 152 | 385 |
| Housing and community amenities | 4,141 | 356 | | 40 | 48 | 268 |
| Health | 48,978 | 43,333 | 42,317 | 967 | 47 | 2 |
| Recreation, culture and religion | 10,810 | 2,355 | – | 337 | 1,611 | 407 |
| Education | 34,319 | 3,437 | 1,684 | 377 | 75 | 1,301 |
| Social protection | 101,356 | 88,320 | 87,143 | 679 | 461 | 37 |
| **Total** | **301,213** | **157,954** | **131,144** | **9,196** | **10,228** | **7,386** |

When we look at the individual purpose categories, transfers for environmental protection amount to 675 million euro in 2010. This is only 0.4 percent of total transfers by the government sector, and about 0.2 percent of total expenditures by the government sector.

**7.2.2 Transfers for environmental protection by central government by type of transfer (current prices)**

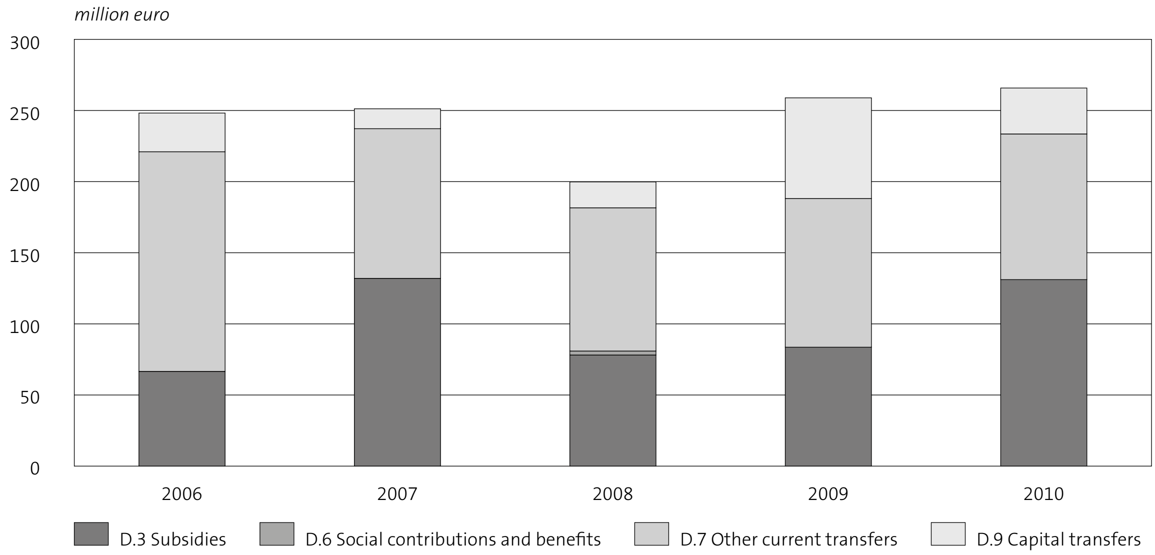



Figure 7.2.2 shows a time series of transfers for environmental broken down by type of transfer (the D-classification of the SNA), for the central government (“Rijk”) sector to non-government sectors and has thus a more narrow scope than Table 7.2.1 as it considers only the central government and it excludes other government sectors as recipients. Subsidies make up almost 50 percent of transfers in 2010. Other current transfers account for almost 40 percent, followed by capital transfers which are a little over 10 percent. The amount of transfers expressed in current prices varies between 200 (in 2008) and 266 million euro (in 2010). Capital transfers are transactions, either in cash or in kind, in which the ownership of an asset (other than cash and inventories) is transferred from one institutional unit to another, or in which cash is transferred

to enable the recipient to acquire another asset, or in which the funds realised by the disposal of another asset are transferred. Current transfers consist of all transfers that are not transfer of capital. Current transfers are classified into two main categories: – general government – other sectors (OECD).

### Share environmentally motivated subsidies/transfers in government expenditure remains stable

The annual amount of transfers provided, varies between 764 and 1,158 million euro for the period 2005–2010. Expressed as percentage of central government expenditure, environmentally motivated subsidies are more or less constant at 0.6 percent. Not all subsidy/transfer schemes are labelled individually, “Renewable energy”, “Other LNV[1]” and “Other A-NL[2]” include multiple schemes. “Other A-NL” includes several schemes that target air quality and mitigate climate change. Some schemes have a more temporary character (e.g. demolition of cars and vans) than others (e.g. MEP/SDE to facilitate transition towards more sustainable E-supply). Total environmentally motivated subsidies/transfers increased 9 percent with respect to 2009. The increase in the category Renewable energy (other than MEP) between 2009 and 2010 relates to schemes on energy savings (insulated glazing) and on geothermal energy.

**7.2.3 Environmentally motivated subsidies/transfers**

| Subsidy scheme | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| | *million euro* | | | | | |
| MEP/SDE | 532.3 | 629.6 | 455.3 | 628.4 | 676.5 | 678.1 |
| ProMT | 4.5 | 5.5 | 4.8 | 5.3 | 6.8 | 18.4 |
| SMOM | 5.1 | 7.4 | 6.7 | 7.2 | 9.1 | 9.5 |
| Diesel particulate filters | 0.0 | 0.7 | 151.1 | 72.3 | 26.5 | 22.2 |
| EOS/NEO | 8.0 | 16.5 | 29.0 | 45.7 | 61.9 | 70.5 |
| Renewable energy (other than MEP) | 21.7 | 11.6 | 8.7 | 4.5 | 29.9 | 95.8 |
| Demolition of cars and vans | 0.0 | 0.0 | 0.0 | 0.0 | 35.0 | 47.2 |
| Other A-NL | 63.5 | 72.1 | 57.2 | 36.8 | 53.0 | 48.5 |
| Sustainable fisheries | 3.3 | 30.4 | 0.8 | 20.5 | 5.0 | 6.9 |
| Sustainable production methods | 0.0 | 1.8 | 13.8 | 25.4 | 24.9 | 17.0 |
| SN/SAN | 94.4 | 122.5 | 124.3 | 129.7 | 128.8 | 143.1 |
| Other LNV | 31.2 | 0.4 | 1.6 | 0.9 | 0.8 | 0.7 |
| Total | 763.9 | 898.6 | 853.3 | 976.6 | 1,058.2 | 1,157.9 |
| Percentage of total expenditure by central government | 0.57% | 0.63% | 0.56% | 0.61% | 0.61% | 0.63% |

1) LNV refers to the former Ministry of Agriculture, Nature and Food Quality, presently incorporated in the Ministry of Economic Affairs, Agriculture & Innovation.
2) A-NL refers to NL Agency (Agentschap NL).

**Overview of main subsidy / transfer schemes**

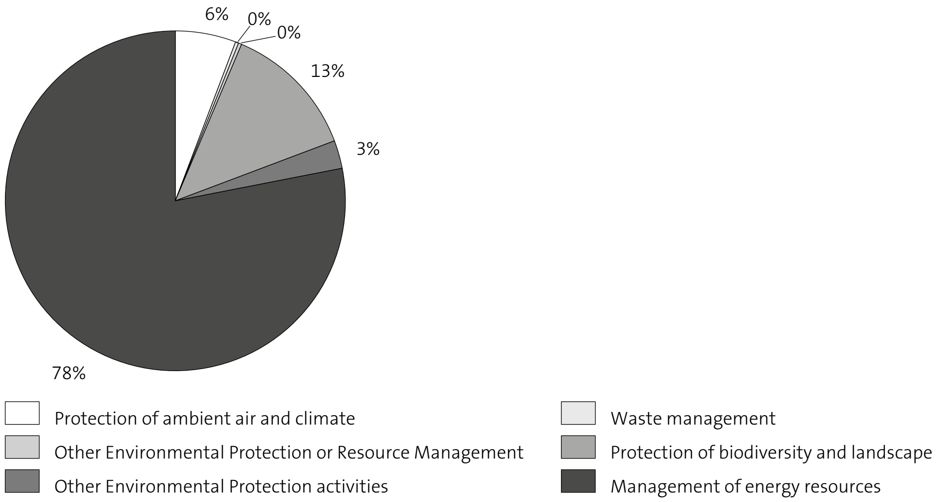
- MEP/SDE: (in Dutch: Milieukwaliteit Elektriciteitsproductie). Scheme for subsidising electricity producers that produce renewable energy (wind, solar, biomass, hydro). The MEP is succeeded by the SDE (in Dutch: Stimulering Duurzame Energieproductie). The SDE is a grant that pays (a part of) projects in the field of renewable gas and renewable electricity that are not yet economically profitable, and is therefore wider than the MEP.
- SMOM: (In Dutch: Subsidieregeling Maatschappelijke Organisaties en Milieu). Scheme that supports societal initiatives (only NGOs are eligible) in the domain of environment and sustainable development.
- ProMT: Environment & Technology Programme (In Dutch: Programma Milieu & Technologie). This subsidy encourages the development and application of innovative processes, products and services, from which environmental benefits can be expected. ProMT supports small and medium sized enterprises (SMEs, in Dutch: MKB) in the development and demonstration phase of environmental innovations.
- VAMIL (In Dutch: Vrije of willekeurige Afschrijving MILieu-investeringen): Scheme which allows freedom of choice for the rate and timing of depreciation of environmental investments. During a period of accelerated depreciation this will result in benefits in the form of reduced profit taxes. The VAMIL is not supposed to provide net tax reduction over the entire life of an investment, as in later years, with lower depreciation profit taxes will be higher. VAMIL is just advantageous for entrepreneurs in terms of gained liquidity. As long as environmental investment is increasing, total benefiist are likely to be positive. In periods when environmental investment is decreasing, the possibilities for accelerated benefits will reduce and as a result, benefits in this period may be lower than higher profit taxes, with a negative total implicit subsidy as a result.
- MIA (In Dutch: Milieu InvesteringsAftrek): MIA is a tax relief scheme for entrepreneurs willing to invest in environmentally-friendly or environmentally improved equipment. This environmental investment deduction scheme provides up to 40% deduction from taxable profit.
- EIA: Energy Investment Deduction, with a tax deduction of up to 40% deduction from taxable profit. It is a tax relief scheme for entrepreneurs that invests in energy-efficient equipment or renewable energy technology. In contrast to VAMIL, EIA and MIA actually do provide net tax reduction over the lifetime of the related investment.
- Green investment: a tax incentive scheme for investments in green projects that benefit nature and the environment. Investors are exempted from the usual 1.2 percent tax on wealth and in addition obtain an additional 1.3 percent tax break, so in total a reduction 2.5 percent is obtained. These investments go to green funds, with which environmental projects such as wind turbines and organic farms are funded. That can be done at rates below the market rates, benefiting investors in green projects.
- WBSO (In Dutch: Wet bevordering Speur- en Ontwikkelingswerk): Dutch tax incentive scheme for innovation and promotion of research. Resident companies investing in research & development (R&D) can receive a grant that partly compensates the labour costs for R&D. Part of these grants can be assigned to environmental R&D.
- BPM (In Dutch: Belasting op Personenauto's en Motorrijwielen) is a tax paid when purchasing a car or motorcycle. This tax is levied in addition to VAT (% over current value), and duty (cars / motorcycle from outside EU-territory). As a new environmentally motivated adjustment of the tax measure, since 2010, the amount of BPM for cars is partly determined by its level of CO2 emissions (gram per kilometre 172 according to test data of the type of the car). One is exempted from BPM if the emissions of the car fall below the limit set by the responsible authority. However, given the fact that the principle of budget neutrality should be met with this measure, one could question whether this in fact constitutes an off budget subsidy. For now, we have included the lost tax revenues by government from the exempted cars as an implicit subsidy.

## Three quarters of all environmental subsidies for management of energy resources

The environmental motivated transfers may also be categorized into different environmental domains based upon the Eurostat classification of Environmental protection Activities and Expenditure (CEPA 2000) and the Classification of Resource Management Activities (CReMA)[3)]. The share of the production of energy from renewable resources and energy savings, was 74 percent in 2009. The share of this category increased in 2010 to 78 percent. The second largest objective in 2010 is the Protection of biodiversity and landscape with 13 percent (CEPA category 6) and the Protection of ambient air and climate (CEPA 1) with 6 percent. With a share of 58 percent the MEP/SDE scheme to stimulate the production of renewable energy by far is the most important environmental subsidy provided by the Dutch government. It is important to emphasize that here all subsidies are allocated entirely to a single CEPA or CreMA category, although in some cases a single scheme may benefit multiple environmental objectives.

3) In future the separated CEPA, CREMA, CRUMA classifications, presumably will be integrated in a single classifications regarding environmental & resource activities within an overarching so-called 'Classification of Environmental Activities (CEA)'.

**7.2.4 Environmental subsidies/transfers allocated to domain, 2010**




### Implicit environmental subsidies increased in 2010

Implicit subsidies consist of foregone tax revenues due to various fiscal measures, such as tax exemptions or reductions in tariffs. The various measures have subsequently been classified as environmentally motivated, based on a review of their objectives. Like the environmentally motivated explicit subsidies the implicit subsidies showed an increase between 2009 and 2010. Fiscal measures to stimulate consumers to buy more efficient cars contributed to this increase. Also the MIA tax exemptions grew, which is aimed at increasing investments in environmentally-friendly or environmentally improved equipment; this may be the result of the extensions of the types investment eligible for this scheme.

### 7.2.5 Environmentally motivated implicit subsidies

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| | *million euro* | | | | | |
| **Wage taxes (reductions in)** | | | | | | |
| WBSO | 36 | 38 | 38 | 43 | 66 | 65 |
| **Environmental investments (exemptions)** | | | | | | |
| VAMIL | –130 | 34 | 50 | 23 | 35 | 52 |
| EIA | 117 | 286 | 160 | 116 | 88 | 115 |
| MIA | 60 | 94 | 94 | 50 | 65 | 123 |
| Forestry related | 6 | 6 | 11 | 9 | 9 | 9 |
| **Wealth taxes (reductions in)** | | | | | | |
| Forest and nature landscapes | 4 | 4 | 4 | 5 | 5 | 6 |
| Green investments | 91 | 115 | 131 | 157 | 150 | 162 |
| **BPM/MRB (reductions in)** | | | | | | |
| Energy efficient vehicles (e.g. electric / hybrid) | 25 | 14 | 14 | 5 | 16 | 65 |
| Diesel cars with PM filter | 15 | 29 | 39 | 0 | 0 | 0 |
| **Excise duties (reductions in)** | | | | | | |
| Biofuels | 0 | 50 | 0 | 0 | 0 | 0 |
| **Inheritance tax (exemption)** | | | | | | |
| Nature landscapes | 0 | 0 | 0 | 3 | 4 | 3 |
| **Total** | **224** | **670** | **541** | **411** | **438** | **600** |

Source: Ministry of Finance, 2005–2011.

Our study of the environmentally motivated explicit (on budget) and implicit subsidies by the central government in the Netherlands is not yet complete nor flawless. Further research by Statistics Netherlands in consultation with the relevant government departments and agencies is required. We have achieved by using similar data sources for the 2005–2010 period, the compilation of reliable figures on developments. Both the explicit, especially schemes on insulation and geothermal heat, and implicit subsidies, for example on more efficient vehicles, grew between 2009 and 2010. As a share of total expenditures by the central government the environmentally motivated explicit remains small, 0.6 percent in 2010.

# 7.3 $CO_2$ emission permits

The Kyoto Protocol is an international agreement that sets binding targets for the reduction of greenhouse gas emissions. For the Netherlands, the Kyoto target for the period 2008–2012 – the first Kyoto commitment period – was set at a 6 percent emission reduction with respect to 1990, the base year for the Kyoto Protocol. This means that the Netherlands as a whole may emit 1001.3 Mton $CO_2$ equivalents during this 5 year period, which is the national emission cap. The Dutch government has received from the United Nations a total of 1001.3 million Assigned Amounts Units (AAU) or 'Kyoto units', each equivalent to one ton of $CO_2$ equivalent emission. At the end of the Kyoto commitment period, the Netherlands must surrender enough permits to cover the actual emissions that occurred during the period.

The Protocol stipulates that countries should meet their targets primarily through national measures. However, the Protocol also allows the use of the three so-called flexible mechanisms, namely emission trading (ET), Joint Implementation (JI) and the Clean Development Mechanism (CDM). Emission trading is the trading of emission permits via the market, which allow the owner to emit one ton of $CO_2$ equivalents. The European Union Emissions Trading System (EU ETS) was launched in 2005. Although the EU ETS also covers limited amounts of other greenhouse gases like $N_2O$ in the Netherlands, we will focus on $CO_2$. The ETS sector consists of large energy and emission-intensive enterprises. These operators are obliged to participate in the EU ETS[4]. We will refer to them as ETS companies. Based on a national allocation plan the Dutch government has reserved, from its total of 1001.3 million AAU allowances for the ETS sector (EUAs), in particular the $CO_2$ emissions. Apart from 16 million allowances that were destined for auctioning in the Kyoto period, all allowances are allocated free of charge (grandfathered) to the existing ETS companies and a limited deposit is for allocation to new entrants to the ETS sector and for legal proceedings[5]. So the ETS companies themselves bear the risk for their emissions.

If a company emits less $CO_2$ in a particular year than their allocated allowances, it can sell the surplus on the market or save it for surrender or sale later on. Companies that emit more than their allowances will have to secure additional permits or risk a fine. In countries that participate in the EU ETS, companies that still have a shortage of permits at the moment of surrender face a 100 euro fine per ton of $CO_2$ (Dutch Emissions Authority, 2009). The fine doesn't relieve them of their obligation to submit enough permits. Apart from companies that are obliged to participate – the operators – other parties such as financial institutions or individuals are also allowed to participate in permit trading – the traders[6]. Each participating country must have a national emissions authority to register and facilitate emission trading in the country.

A distinction can be made between the first trading period, 2005–2007, and the second, 2008–2012 of the EU ETS. Whereas the first period aimed to test the registration system and trading operations, the current trading period of the EU ETS that is coming to an end concurs with the official first commitment period under the Kyoto protocol. A distinction is also made between the emission year, which is the calendar year, and the trade year. Within the compliance cycle, operators obtain allowances for emissions in the current year (T) at the end of February. They have to file their emissions report on emission of the previous year (T-1) to the NEA, the Dutch Emissions Authority[7] at the end of March. Then they have to surrender permits related to emission of the previous year (T-1) no later than 30 April. This implies, however, that the trade in permits continues for months after the end of the emission year.

4) It covers around 10,500 installations across the 27 EU member states plus Iceland, Liechtenstein and Norway. Some sectors such as aviation, shipping, road transport and other services are not required to participate in the $CO_2$-trading system. A limited number of (smaller) companies have requested to participate as operators under the EU ETS.

5) In this chapter 'permit' is used as a generic term that covers both allowances and credits. Although allowances and credits both represent the right to emit one ton of $CO_2$, their prices differ due to different risks and conditionalities.

6) In the Dutch $CO_2$ Emissions Trading Registry these parties have a 'person holding account' and are referred to as 'persons'.

7) The Dutch Emissions Authority (NEa) is a government organisation whose mission is to monitor compliance with laws and regulations governing the trade in $CO_2$ as well as $NO_x$ emissions. The NEa supports the implementation of emissions trading, and acts as an independent regulator to monitor and review compliance.

In this chapter we present detailed physical balances for $CO_2$ emission permits in the Netherlands, as well as economic aspects including price data and value of secured permits. Part of the aggregated data of emission permits and emission trading can be found on the website of the Dutch Emissions Authority (http://www.emissieautoriteit.nl/english). For detailed descriptions of the carbon dioxide emissions in the Dutch economy and in the context of the Kyoto protocol, we refer to chapter 6.

**ETS companies contribute less than 10 percent to GDP**

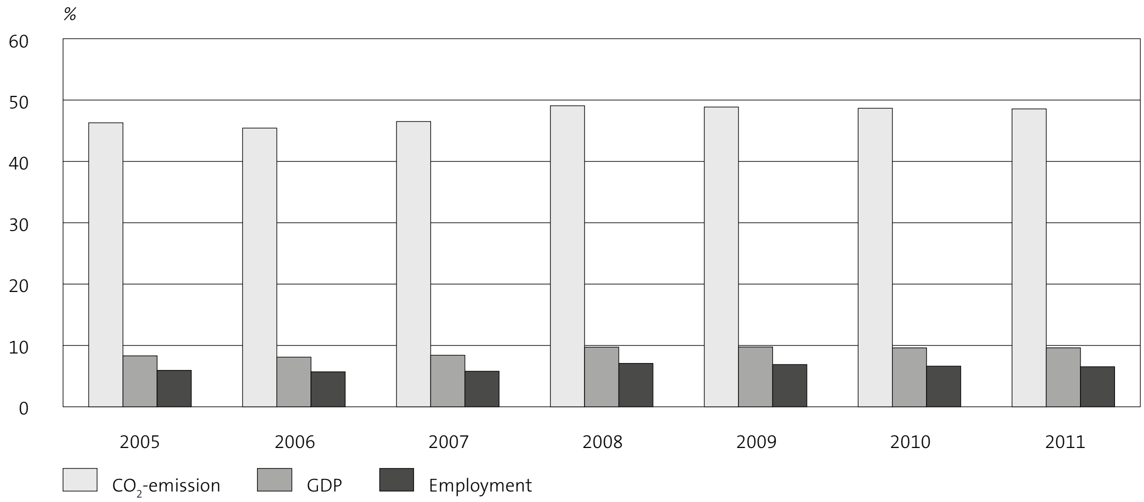
The total $CO_2$ emissions from the Dutch companies that are under the obligation to participate in the EU ETS in 2011 amounted to 80.0 Mton[8)]. This is 5.6 percent less than the 84.7 Mton of $CO_2$ emitted in 2010. In 2011, ETS companies accounted for about 49 percent of total $CO_2$ emissions caused by industries in the Dutch economy. This share has decreased slightly since 2008 but is 2 percent more than in 2005–2007.

The Dutch Registry of the Dutch Emissions Authority included about 830 parties since its inception in 2005. Fewer than 600 were still active in 2011. Operators form the majority with close to 400 active account users in 2011. Around 360 traders have set-up an account in the Registry since its inception. In 2011 only 140 accounts remained active, 60 less than in 2010, meaning over 60 percent of the traders had closed their accounts (Dutch Emissions Authority, 2012A).

As Figure 7.3.1 shows, the joint contribution to GDP of the companies participating in the EU ETS amounted to 9.6 percent in 2011. ETS companies only have a 6.5 percent share in total employment. This illustrates that only the most emission-intensive firms have to participate in emissions trading. Although more companies started to participate in the second trading period, starting in 2008, this hardly led to an increase in their share of GDP.

8) The Netherlands has opted to include also $N_2O$ emissions from nitric acid production in the emission trading system. Therefore this and the other figures in this chapter include the $N_2O$ emissions. The $N_2O$ emissions are small compared to the total $CO_2$ emissions under the Dutch ETS system (about 0.6-0.7 percent).

**7.3.1 Share of ETS companies in $CO_2$ emissions of industry, GDP and employment**



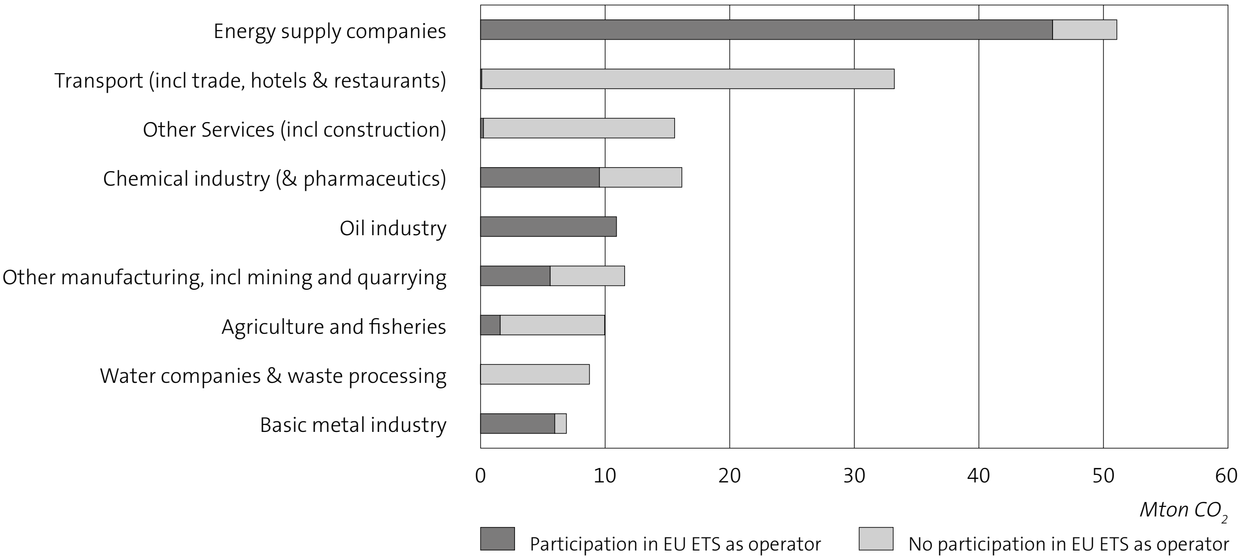

The share of companies participating in the EU ETS as measured by their share in the $CO_2$ emissions can be very different, as only companies with production plants with large thermal power installations are obliged to participate[9]. As Figure 7.3.2 shows, almost all companies in energy supply (90 percent), the oil industry (100 percent), the manufacturers of basic metals (86 percent), and a large part (59 percent) of the chemical and pharmaceutical industry participate in the EU ETS as operators.

Other sectors of industry such as water companies and waste processing hardly participate in ETS. Only 16 percent of agriculture and fisheries is represented, as only some major horticultural holdings are obliged to participate in the trading system. Less than 1 percent of the transport sector, including trade, hotels and restaurants that accounted for 20 percent of the total Dutch $CO_2$ emissions in 2011 is represented. From 2012 onwards airlines will be obliged to participate in the EU ETS as well. As a result the share of their ETS emission in total emissions will go up.

Only 1.5 percent of the $CO_2$ emissions of the remaining ‘other services including construction’ are accountable under the trading system: these are mainly a few large university hospitals that participate.

[9] Some additional companies are included within the system in areas specifically designated by the authorities.

**7.3.2 $CO_2$ emissions of industries and the share of participation in the ETS as operators, 2011**



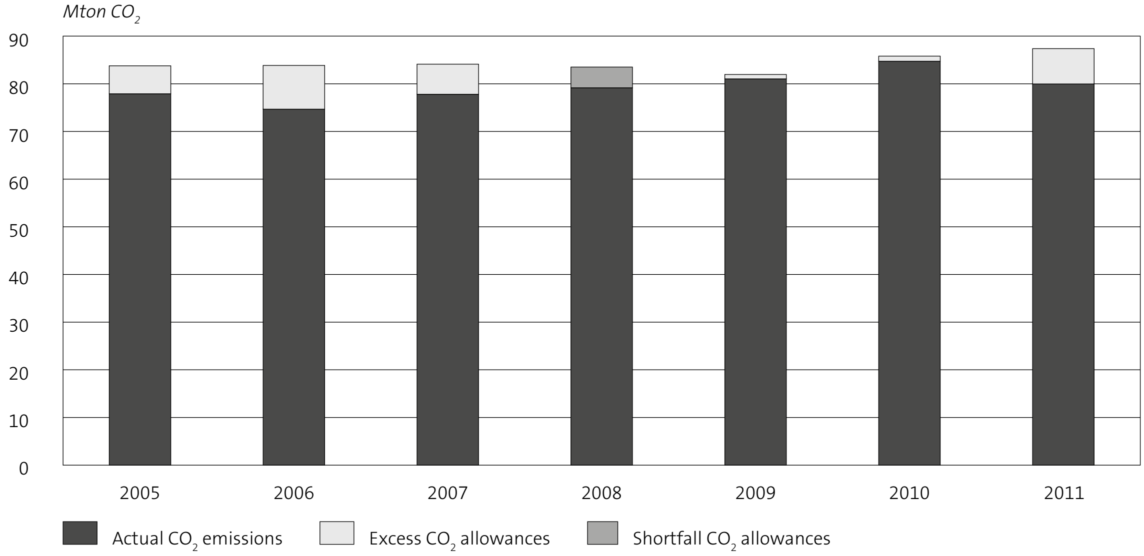

### Excess of $CO_2$ emission permits rising further in 2011

Although fewer allowances were intended for allocation in the second trading period in an attempt to downsize the market, this has hardly worked. Allocation was lowest in 2008, right in the middle of the seven years the EU ETS is in place. But allocation has grown strongly ever since. The allocations were the highest in 2010 and even more so in 2011, since the start of EU ETS. The national emissions were at their highest levels in 2008 and 2010. There has been an overall shortage in allowances only for 2008. This shortage amounted to 4.3 million in $CO_2$ permits.

In 2011, the ETS companies together emitted 80.0 Mton of $CO_2$, a reduction of over 6 percent, while allocated allowances had gone up. The growth of allocated allowances is the result of the allocation of allowances to new entrants[10)], including some power plants and industrial sites with chemical industry. The resulting emissions is even 8.5 percent below the amount of allocated emission allowances received at the start of the year. The significant and strongly growing surplus of allowances in 2011 is partly explained by the economic slowdown. Although $CO_2$ emissions nationwide had partly recovered in 2010 (see chapter 6) they dropped in 2011 to close to the 2009 level. This is still helpful in attempts to mitigate for climate change.
As a result there was no shortage but a surplus of allowances for the country as a whole in 2010 and even more so in 2011. This surplus rose quickly, with incentives for emission reductions getting low and remaining far below expectations. Although a still significant part of the industry sites operated by the ETS companies have faced a shortfall of allowances since 2008. For 2011 still 29 percent of the operator sites faced a shortfall of allowances (Dutch Emissions Authority, 2012A). This is significantly less than in 2010 when it was well over 40 percent of these sites.

10) Newcomers are business locations that either expand their activities and resulting $CO_2$-emissions or those that are entirely new in the business and emit for the first time.

### 7.3.3 Emission allowances allocated and actual $CO_2$-emissions ETS sector




Source: Dutch Emission Authority, 2010B; 2012B; Statistics Netherlands 2012.

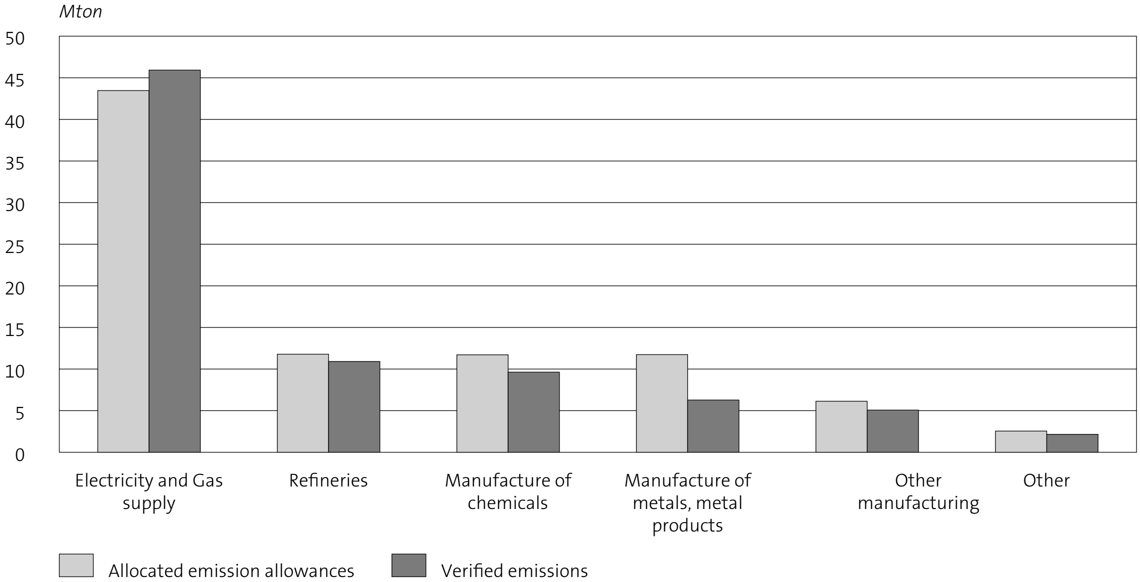
[1] The 'Actual $CO_2$ emissions' emissions and 'Excess $CO_2$ allowances' together represent the allocated $CO_2$ allowances.

The electricity and gas supply industry in 2011 again was the only industry with a shortage of emission allowances (Figure 7.3.4). Their $CO_2$ emissions proved to be 6 percent higher than the allowances they obtained for 2011 based on the allocation procedure. In 2010, with 17 percent higher $CO_2$ emissions compared to the allocation, the shortfall was more severe. For the shortfall of allowances in 2011 this industry still had to secure additional permits for at least 2.5 Mton of $CO_2$ emissions compared to securing extra permits for at least 7.3 Mton of $CO_2$ in 2010 [11].
The basic metal industry possessed more than half (55 percent) of the excess allowances among the industries with excess allowances. This large surplus in the metal industry is connected with the shortage in the electricity and gas supply industry. The basic metal industry obtains allowances connected to the combustion of cokes oven gas and gas from blast-furnaces. In practice, however, these gases are not emitted but delivered to and used for generating electricity. Subsequently, these emissions are not assigned to the basic metal industry when the amounts required to surrender are assessed. Due to an agreement, the electricity producer receives part of the allowances originally allocated to the basic metal industry.

In addition to large differences of emissions among industries, there are also large differences in emissions between the operator locations. Emissions are quite unequally distributed across the operators that participate in the EU ETS. The distribution of $CO_2$ emissions on business locations in 2011 is very heterogeneous, like in previous years. The 5 percent of operator locations that emitted most $CO_2$ were responsible for over 70 percent of total $CO_2$ emissions. Unlike the 50 percent of operators that emitted the least amounts of $CO_2$ in 2011 which were only responsible for 2.2 percent of the total $CO_2$ emissions (Dutch Emissions Authority, 2012B).

[11] In the first trading period, electricity companies had obtained allowances for free but nevertheless raised the price of electricity for their customers. For this reason, the electricity companies experienced a cut in the second period on their quantity of allowances. These withheld allowances were partly distributed to other industries through the new allocation plan, and as a premium to compensate them for higher electricity prices.

### 7.3.4 Allocated emission allowances and actual $CO_2$ emissions ETS sector, 2011




Source: Dutch Emissions Authority, 2012B; 2012C; Statistics Netherlands 2012.

**Intensified securing activity for permits led to even larger stocks of allowances and credits**

For policy purposes it is relevant to monitor the total amount of permits held by residents of the Dutch economy (both operators and traders) as well as changes therein during the accounting period. This can be expressed by a balance sheet such as depicted in Figure 7.3.5 which presents stocks and flows of permits, both allowances and credits at the aggregated macro level. These aggregates build on highly disaggregated data at the level of individual account holders and transaction. The opening stock represents all permits owned by Dutch residents on 1 January of the year. For instance on 1 January 2005 the opening stock was zero as allowances were grandfathered for the first time in the course of the year. The closing stock represents permits owned on 31 December for each year which equals the opening stocks of the subsequent year. The permits in the opening stock that are awaiting surrender principally represent a liability to the government caused by emissions in the previous year.

In the course of the year changes in stocks stem from either surrender or grandfathering, or from market transactions. Surrender takes place in the year after the emissions actually took place. The balance sheet can also be broken down into institutional sectors or industries. Between 2005 and 2008 closing stocks of permits remained fairly stable at a level that represent in between 80 – 90 Mton of $CO_2$. The closing stocks have been growing since 2009, first in 2009 and 2010 at a rate of about 13 Mton. However in 2011 residential account holders were able to secure more permits over that what was actually required to cover their $CO_2$ emissions. This was the case for the credits in particular. The surplus of allocated allowances over the number required to surrender added significantly to the closing stocks too.

### 7.3.5 Balance sheet of $CO_2$ permits [1)]

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| | *$CO_2$ permits (= tons of $CO_2$)* | | | | | | |
| 1 Opening stock 1 January | – | 80,055,818 | 77,954,443 | 86,087,847 | 87,856,973 | 100,974,058 | 111,941,342 |
| 2 Allocated free of charge (grandfathered) | 86,093,888 | 86,949,294 | 87,233,598 | 76,801,532 | 83,703,076 | 84,974,375 | 88,831,673 |
| 3 Purchased - permits (allowances) | 41,327,069 | 80,230,575 | 85,467,121 | 168,951,989 | 191,515,413 | 170,119,571 | 161,845,444 |
| Of which free permits [2)] | 36,507,692 | 62,955,944 | 63,772,342 | 117,438,701 | 119,167,730 | 113,375,936 | 113,861,496 |
| Of which non-free permits [3)] | | | | | | 4,000,000 | |
| Of which from ROW [4)] | 4,819,377 | 17,274,631 | 21,694,779 | 51,513,288 | 72,347,683 | 52,743,635 | 47,983,948 |
| 4 Purchased - credits | | | | 58,791,531 | 50,333,828 | 48,028,922 | 79,229,517 |
| Of which purchased | | | | 30,841,275 | 25,789,984 | 25,822,587 | 43,313,69 |
| Of which from domestic projects | – | – | – | – | – | – | – |
| Of which from ROW | | | | 27,950,256 | 24,543,844 | 22,206,335 | 35,915,821 |
| 5 Sold - permits (allowances) | 52,534,809 | 96,145,634 | 86,725,533 | 180,136,186 | 178,637,082 | 173,362,339 | 156,197,411 |
| Of which free and non-free permits [5)] | 42,545,762 | 71,652,275 | 65,984,722 | 127,074,283 | 108,276,031 | 113,609,251 | 108,641,695 |
| Of which to ROW [4)] | 9,989,047 | 24,493,359 | 20,740,811 | 53,061,903 | 70,361,051 | 59,753,088 | 47,555,716 |
| 6 Sold - credits | | | | 31,525,560 | 46,462,897 | 40,534,779 | 49,640,885 |
| Of which to other residents | | | | 16,539,418 | 23,754,984 | 22,524,463 | 27,528,136 |
| Of which to ROW | | | | 14,986,142 | 22,707,913 | 18,010,316 | 22,112,749 |
| 7 Losses (cancelled permits) [6)] | – | – | 10 | – | 20 | – | 63,633 |
| 8 Surrendered, permits, credits, etc. | – | 80,354,338 | 76,887,804 | 79,698,681 | 83,512,670 | 81,071,420 | 84,616,050 |
| 9 Closing stock | 80,055,818 | 77,954,443 | 86,087,847 | 87,856,973 | 100,974,058 | 111,941,822 | 137,098,673 |

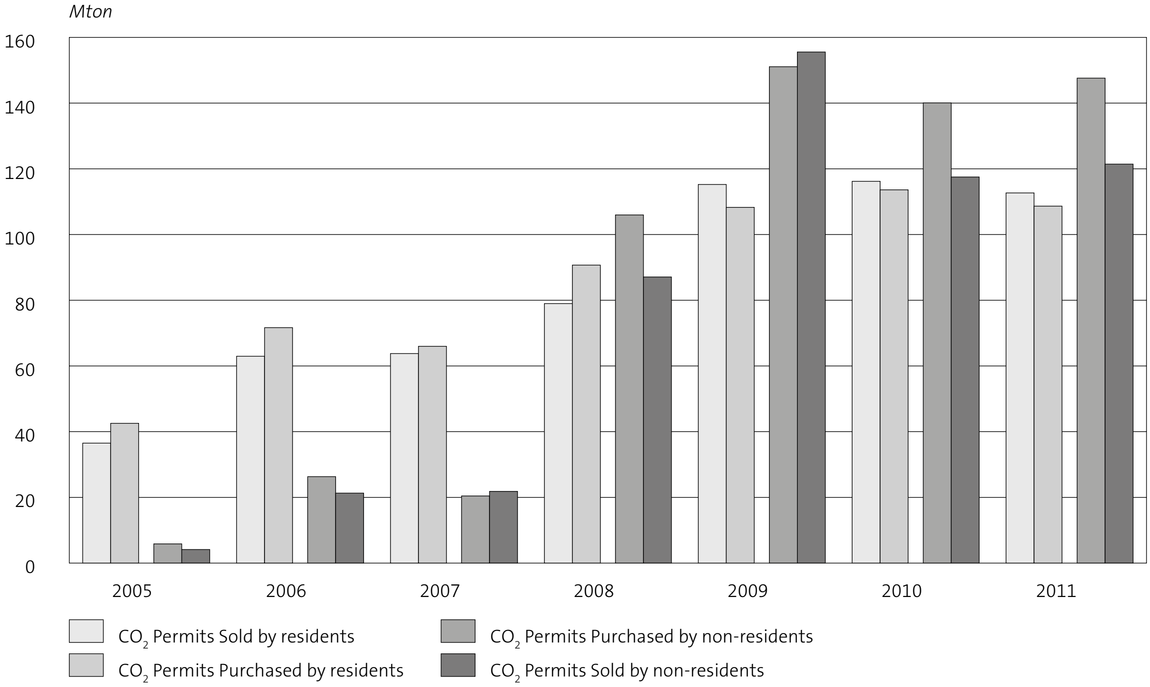
Source: Dutch Emissions Authority, 2012B; 2012C; Statistics Netherlands 2012.

1) Excluding non-residents with a (person) account in the Dutch $CO_2$ Emissions Trading Registry
2) Free permits are allowances originally obtained for free via grandfathering.
3) Non-free permits are allowances originally allocated via auctioning by the National Authority.
4) ROW: Rest of the World. This covers purchase from and sold to non residents abroad.
5) Distinction between free and non-free permits in their initial allocation cannot be made here, as sale of same permit can take place several times. Free permits are allowances initially obtained for free via grandfathering. Non-free permits are allowances initially allocated via auctioning by the National Authority.
6) Replaced, and handed over (voluntary and additional surrendered permits, etc.).

**Volume of emission permits traded since 2005: allowances peaked in 2009, credits up again in 2011**

The volume of the trade in emission permits grew strongly until 2009. In 2010 and 2011, however, the volume in permits sold on the market stagnated and fell below the 2009 level where it accounted for 231 and 230 Mton $CO_2$ respectively. This is still 5 times more than in 2005 when trading started. The permits sold constituted 2.6 times the number of allowances originally grandfathered by the government at the start of 2011. This means that account holders have traded and exchanged permits over five times in the course of the emission year until the moment of surrender. Part of this trade was with parties abroad. The volume of the trade for allowances and credits combined is larger than for EUAs alone. A traded volume of 23 percent extra for the number of credits purchased in 2008 and almost 50 percent extra for the CERs and ERUs purchased in 2011.

### 7.3.6 $CO_2$ permits traded via accounts by residents and non-residents in the Dutch $CO_2$ Emissions Trading Registry [1)]




1) This is the figure for the AAU-EUAs alone, consequently without the CERs or eventually ERUs.
This represent the accounts in the register held by both residents and non-residential accountholders.
Source: Dutch Emissions Authority, 2012C; Statistics Netherlands 2012.

The amount traded, in particular sold, by operators has proved to be more or less constant over time with permits sold annually corresponding to 25 – 45 million tons of $CO_2$. However in 2011 significantly more permits were sold by operators, corresponding to 60 million tons of $CO_2$. Particularly the sale (and buying) of CERs grew strongly compared to 2010 and before. The permits purchased by operators started from close to zero in 2005 and varied in subsequent years between 17 (2007) and 33 million (2010). In 2011 the purchase of permits, both allowances and credits, rose to close to 60 million tons of $CO_2$.

The previous situation, which was that permits held by residents were predominantly traded by account holders, had changed greatly by 2011. The traders accounted for only 51 percent of the permits purchased and 53 percent permits sold by Dutch residents in 2011. This is much less than the 74 and 71 percent in 2010. The foreign parties in the Dutch register will add to this figure still, as foreign account holders can only participate with a person holding account. Their trading activities remained large and comparable to recent years.

The share of purchases and sales for all account holders by the traders fell from almost 90 percent in 2010 to little over 80 percent in 2011. Their objectives and risks are different from those of the operators. Operators with large emissions have to operate with care as they have to safeguard sufficient numbers of permits so that they can surrender the required number of permits at the end of the year to avoid fines[12]. Although they seem to have learned how to trade the permits or act more strategically in recent years and safeguard permits, prices are now low. This particularly holds for the allowances, in 2011 much more credits were sold than purchased. Among the operators, the energy companies dominated the permit trade. Their dominance even rose to 80 percent of the purchases and 74 percent of the sales.

### Emissions trading in the Netherlands still for more than half by non-residents

It is important to note that non-residents are also able to hold an account with the Dutch Emission Authority. The number of non-residents has grown steadily since the start of emission trading. Not surprisingly perhaps, the share of non-residents in the trade volume had also increased until 2009. to close to 60 percent. However in 2010 the share stopped growing and a decline was observed (for the EUAs), as is shown in Figure 7.3.6. In 2011 the share of trade performed by non-residents slightly grew again to about 55 percent for the total number traded (either purchase or sale).

The volume of trade with trading partners abroad has grown steadily. For the Dutch residents in the register, the share in volume of permits traded, either purchased or sold, has grown from 19 percent in 2005 to 55 percent in 2010 and little less in 2011 with a peak of 69 percent in 2009. Particularly since 2008, the start of the first Kyoto commitment period, the overall trade volume and the volume and share of trade with foreign parties have gone up rapidly. Already in 2008 more than half of the traded volume was with foreign parties. The number of permits traded has been falling since 2009. This decline may partially be explained by the identification and prompt ban of the so-called VAT fraud on trade in permits in the EU ETS system in 2009. Also the number of accounts had fallen. In 2011 the trade remained roughly at the same level. Till 2009 the number of allowances purchased for the accounts altogether matched the number of allowances purchased, whereas in 2010 and in 2011 significantly more allowances were purchased.

Stocks of permits by residents are steadily growing as Figure 7.3.5 shows. In 2011 the closing stock was up by 70 percent overall on 2005[13]. Since 2006 the closing stocks were higher each year than the year before. For the foreign account holders the closing stock has also grown since 2005, particularly in 2010 and 2011. In 2011 closing stock was 1.8 times the opening stock. Closing stocks for electricity and gas supply and manufacturing have been reasonably constant since 2005.

### Prices of $CO_2$ permits further down in 2011 and 2012

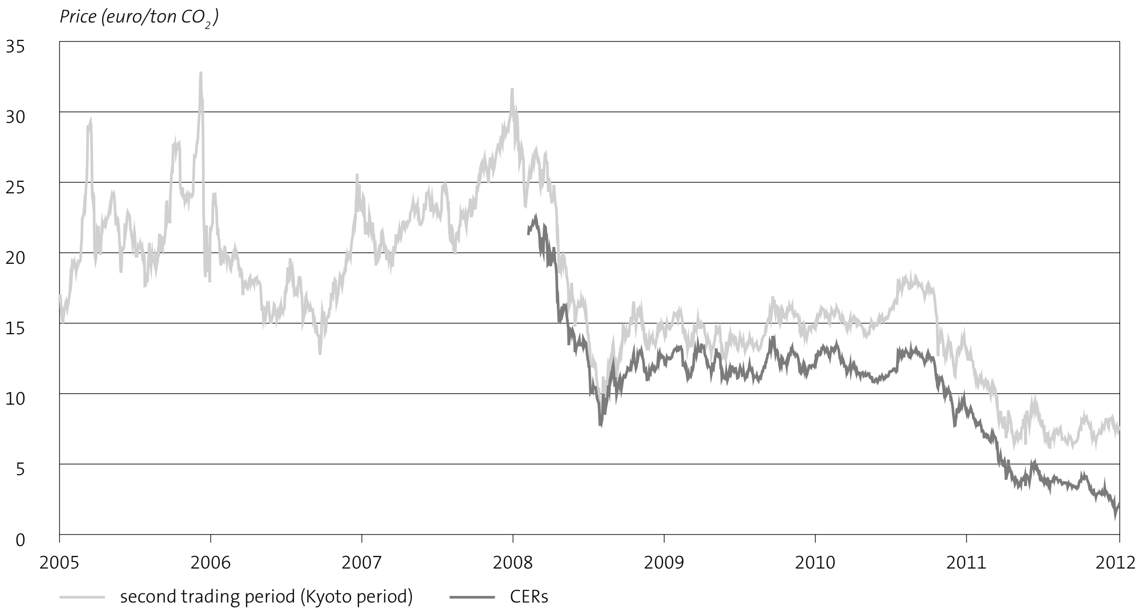
At the start of the second trading period (2008–2012) the price of the allowances was over 20 euro per ton of $CO_2$. Early on in 2008 the price went up because fewer allowances were allocated, which in turn created scarcity on the market for permits. By mid 2008, however, prices began to fall again. Due to the financial and economic crises, production in several industries fell sharply, accompanied with lower greenhouse gas emissions. Companies increasingly faced

[12] The trade of permits does not necessarily reflect the economic activities taking place in a particular year as trading can continue after 31 December until the surrender takes place around May of the following year. Moreover permits can be saved for a subsequent year.
[13] This holds for residents with operator and/or person account in the national register. Limited number of residents has an account in foreign register.

excess emission and offered many permits on the market, cutting the price. After a relatively short dip below 14 euro per ton $CO_2$ at the beginning of 2009, prices recovered somewhat to around 14 – 15 euro per ton $CO_2$ where they stayed until the fourth quarter of 2011. Then the price fell to around 7 euro per ton $CO_2$.

Due to the excess of permits, and even more for the credits, the permit price, could not recover in any sense from the economic downturn. The growth in $CO_2$ emissions started to slow down significantly and sometimes even showed lower levels than before, or than anticipated.

### 7.3.7 Price of $CO_2$ allowances (EUA Futures Contracts) and CERs




Source: Point Carbon, Historic Data 2012.

The price of CER emission reduction credits is closely related to the price of permits. Temporal changes point recurrently in the same direction over time. The price of CER is somewhat lower due to differences in the conditions and opportunities for surrender. Allowances face fewer limitations which lead to a higher permit price of an average 3.2 euro per ton $CO_2$. The difference between the prices for allowances (EUAs etc.) and for credits (particularly CERs) close to 2 euro per ton $CO_2$. In 2010 it was 2.70 euro, whereas in 2008, in 2011 and the first three quarters of 2012 it came close to 4 euro. The effect, however, is that in relative terms the price of CERs recently ended in less than half of the EUAs' value. The large excess of permits and the excess of the less trusted CERs in the marked are somehow reflected in the carbon prices at the spot and future markets for permits and credits in Europe. The relatively low price for $CO_2$ permits in general does limit incentives for entrepreneurs to invest in innovative technologies such as energy efficient equipment, wind energy or solar power, which was one of the reasons for the implementation of a cap and trade system.

## Grandfathered allowances valued at over a billion euro a year

Since the inception of the European emission trading system, practically all $CO_2$ permits have been grandfathered – given for free predominantly based on historic emissions – by the Dutch government. In 2010 a first set of 8 million permits have been allocated through auctioning for the very first time since the start of the EU ETS. This was repeated in 2011 for an extra 4 million allowances. Such exercises mean additional costs to the ETS companies. These allowances can also be auctioned by the government and can be destined for a domestic operator or person holding accounts, or to non-residents. In 2011 most of the auctioned permits went to non-residents (Dutch Emissions Authority, 2012C).

The permits that have been grandfathered can be valued by using the daily carbon prices at the spot market or associated 'financial futures' in the course of the year for which the allowances are meant in order to limit the actual emissions that are supposed to occur in that year. This enables industries to comply with the $CO_2$-emission target set by the government[14]. The price of relevant 'futures' in 2011 moved between 7 and 18 euro per ton of $CO_2$ emitted in 2011 and hovered close to 14 euro. The $CO_2$ allowances grandfathered in 2011, representing close to 89 Mton of $CO_2$, can hence provisionally be valued at close to 1.20 billion euro in 2011. Likewise using an average permit price of 14.8 euro per ton of $CO_2$ in 2010, the value of the grandfathered permits was approximately 1.27 billion euro.

## The energy sector had to secure less than 35 million euro worth of permits for their 2011 emissions

The energy companies, as operators cause large amounts of $CO_2$ emissions, in 2011 again faced a shortfall of permits based on the allocation procedure, corresponding to 2.46 Mton of $CO_2$, although only about a third of the shortfall in 2010. Using the aforementioned daily carbon prices, a provisional estimate can be given of the costs to industries that faced a lack of allowances. These had to be secured, either via direct purchase of allowances, credits (CERs) available at the carbon market[15], or taken from remaining stocks of permits acquired by the company itself from previous years. On the other hand, revenues can be obtained by industries that sell their excess of allowances. In 2011 $CO_2$ permits had to be secured by the energy supply industry with a corresponding value of 34 million euro far less compared to the corresponding value of over 150 million euro in 2010. The manufacturers of basic metals, assuming they were able to sell all their excess allowances, could obtain the largest revenues, with a corresponding value of 75 million euro in 2011[16].

14) These are rough estimates as they are solely based on the average price of futures of EUA-AAUs (permits). The value of credits predominantly obtained by the government such as CERs and ERUs were not taken into account. An alternative option would be to use the average price during the course of the year in which the $CO_2$ emissions were actually generated.

15) These are credits from the secondary market.

16) This calculation ignores the permits available from the person holding accounts and from foreign parties (non-existing in the register), as well as certified emission reductions (CER) directly obtained from CDM projects in developing countries (primary market). The result therefore is only indicative. An exact estimate of the actual price of the transactions undertaken is currently not available and therefore annual averages are used.

# 7.4 Environmental protection expenditure

The Dutch government, in cooperation with private enterprise, takes all kinds of measures to protect the environment. Such measures result in costs for industries, households and the government itself. Environmental protection includes all measures aimed to prevent the damaging consequences of human activities or acts on the environment. It includes expenditures for measures to improve the environmental quality of air, water (including waste water), soil and groundwater, waste and noise. Data on environmental expenditure and its financing are available for the economic sectors government, enterprises and households. The methodology for the compilation of environmental protection expenditure statistics can be found on the website of Statistics Netherlands[17]. The data on environmental expenditure can be found on StatLine, the electronic database of Statistics Netherlands.

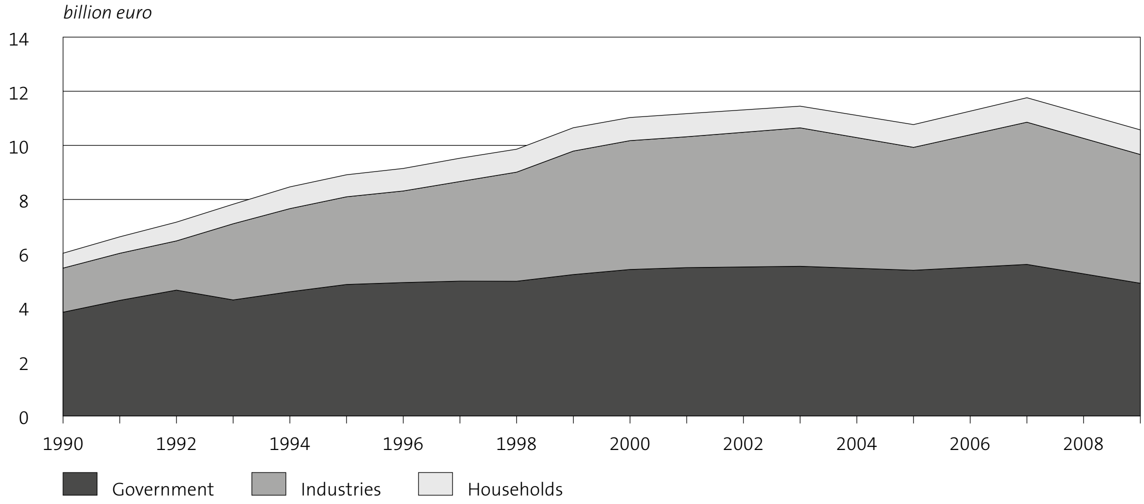
### Environmental costs decreased in 2009

The environmental costs are equal to the annual costs of activities related to the environment and include capital costs, current operational costs, personnel costs etc. From 1990 to 2007 environmental costs, expressed in the price level of 2009, almost doubled from about 6 billion euro in 1990 to almost 12 billion euro in 2007[18]. From 1999 onwards the growth rate of the environmental costs has steadily levelled off, reaching its maximum value of almost 12 billion euro in 2007. In 2009 the environmental costs had decreased to about 10.5 billion euro. Environmental costs decreased most for central government. Environmental costs for enterprises fell by 7 percent.

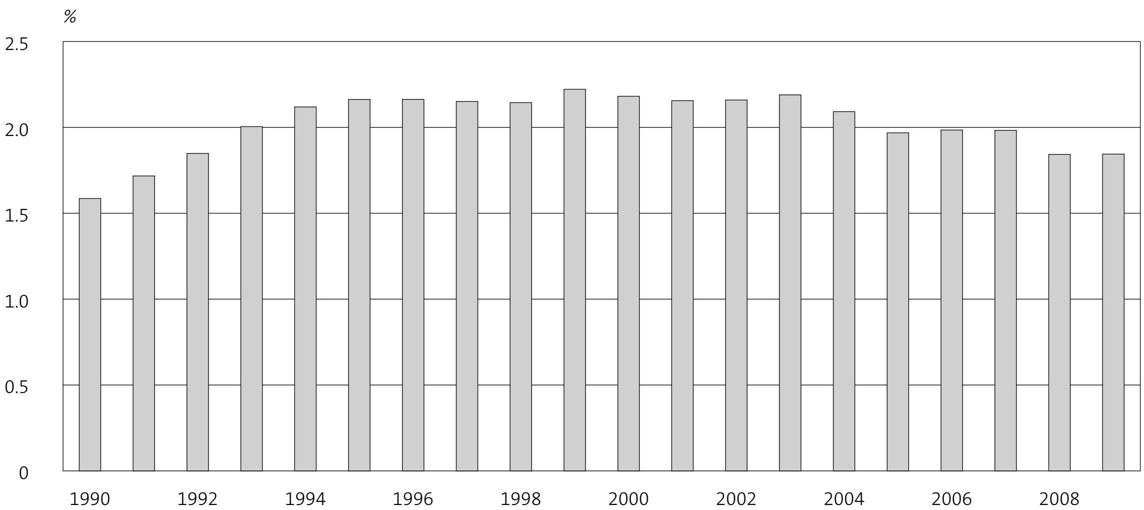
17) http://www.cbs.nl/en-GB/menu/themas/natuur-milieu/methoden/dataverzameling/korte-onderzoeksbeschrijvingen/2010-environmental-protection-expenditure-pub.htm

18) In this chapter environmental costs and investments are expressed in constant prices (price level of 2009). Expenditure and investments related to traffic and transport has been attributed to households. Since 1993 the specialised producers are analysed and integrally incorporated in the figures. In 1990-1992 the specialised producers were estimated in the business sector. For 2002, 2004, 2006 and 2008 averages were calculated for total environmental costs and investments because direct information was missing.

**7.4.1 Environmental costs by sector (price level 2009)**




**7.4.2 Total environmental costs as percentage of GDP**

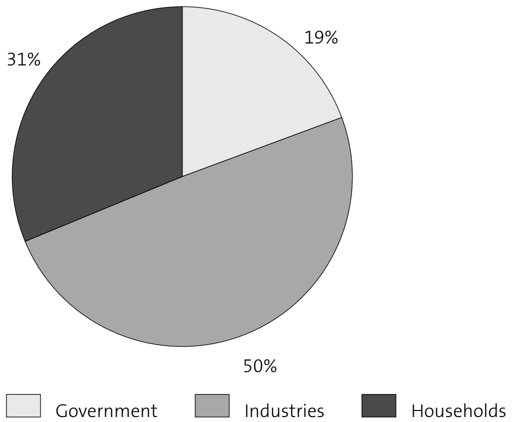



Expressed as a percentage of GDP the environmental expenditures decreased from almost 2 percent in the period 2005–2007 to 1.8 percent in 2008 and 2009. This indicates that relatively speaking the burden on society for protecting the environment is decreasing.

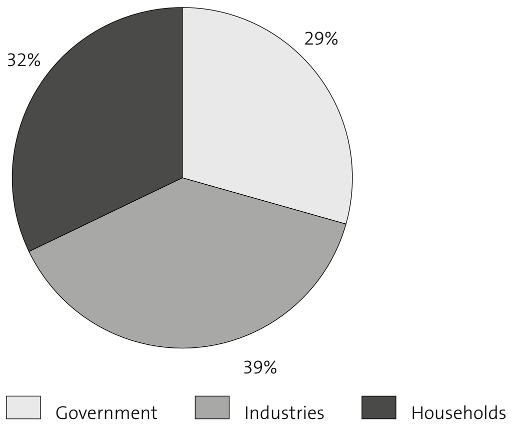
### Higher percentage government in net environmental costs after transfers

The net environmental costs after transfers, which are equal to environmental costs plus levies minus subsidies, show the contribution of a sector to the financing of environmental measures. For example, households have relatively little direct environmental costs, but their net environmental costs after transfers are high because they pay a lot in environmental taxes and fees. In 1991 industries contributed exactly half of the total net environmental costs, while government contributed less than a fifth and households paid for about a third of the total environmental costs.

**7.4.3 Net environmental costs by sector in 1991**




**7.4.4 Net environmental casts by sector in 2009**

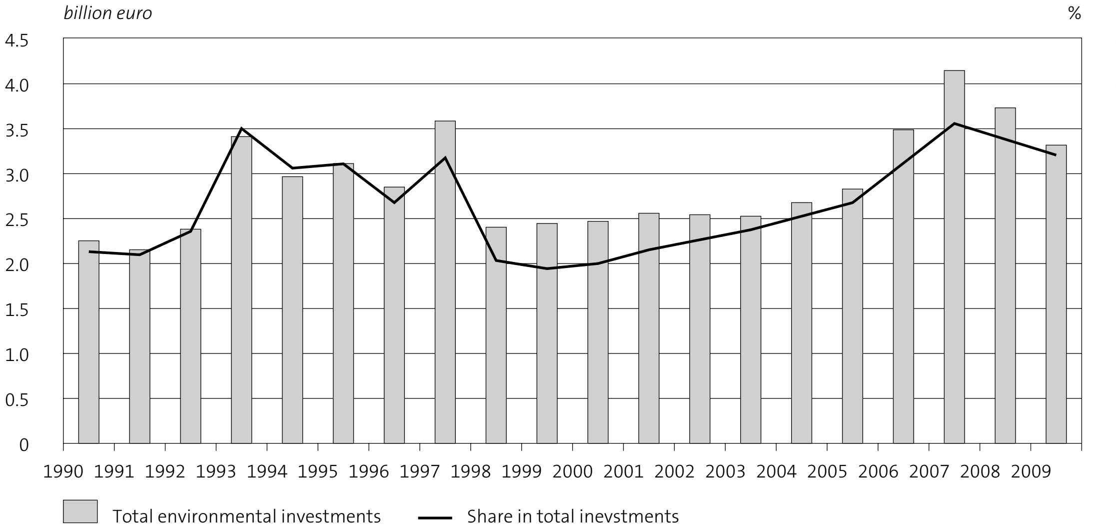



In the period 1991–2009 the share of government in net environmental costs after transfers increased at the expense of enterprises. This shift from enterprises to government inverted in the period 2007–2009 from 34 percent for government and 37 percent for enterprises in 2007 to 29 percent for government and 39 percent for enterprises in 2009. The share of households remained constant. Households pay many levies including water and sewerage charges and the waste product levy.

### Environmental investments decreased in 2009

Environmental investments are extra capital goods intended to protect, restore or improve the environment which do not repay themselves within three years. Examples are wastewater treatment plants and the construction of impervious surfaces. Also included are provisions for the production of renewable energy, such as windmills, solar panels and installations for biomass combustion. In 2007 total Dutch environmental investments had increased by 50 percent on 2005 reaching its peak level of over 4 billion euro. As a result of the financial crises, environmental investments had fallen in 2009 to 3.3 billion euro, which is down 17 percent on 2007. Environmental investments in 2009, however, were still higher than in 2005.

**7.4.5 Environmental investments (price level 2009) and its share in total investments**




In terms of GDP, environmental investments in 2009 had decreased relative to 2007. The about 0.7 percent of GDP of 2007 was down to just below 0.6 percent in 2009. This brought the 2009 investment level as a percentage of GDP to just below the 2006 level. Although 2007 saw the highest environmental investment level of the period 1990–2009 in constant prices, in terms of GDP the period 1993–1995 and the year 1997 saw higher levels. Both in constant prices and as a percentage of GDP environmental investments were relatively low in the period 1998–2005.

The steady increase in total environmental investments as percentage of total investments that started around 2000 came to a halt in 2007. Since then there has been a modest decrease in environmental investments relative to total investments. It went from 3.5 percent in 2007 to about 3.2 percent in 2009. This upward to downward deflection occurs at the same relative environmental investment level of 3.5 percent as in 1993. The lowest relative level of environmental investments as percentage of total investments in the period 1990–2009 is about 2 percent.

# 7.5 Economic opportunities for the environmental goods and services sector

In order to reduce the pressures on the environment that lead to resource depletion and deterioration, environmental measures are becoming more and more stringent. Dutch policymakers are very interested in the economic consequences of environmental measures and environmental concerns. They approach these topics from two perspectives. They focus on the financial burden placed on the polluting industries as they have to invest in pollution abatement control in order to comply with environmental regulations. And they focus on environmental measures that will bring about new economic activities that may create new jobs and stimulate economic growth. Policymakers therefore need information about companies and institutions that "produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration" (Eurostat, 2009). All these companies and institutions belong to the environmental goods and services sector (EGSS). EGSS statistics are intended to measure the size of the 'green economy' in the Netherlands. The green economy contributes to total employment, total production and to the Dutch gross domestic product.

According to the definition used in the Eurostat handbook on the EGSS (Eurostat, 2009) the sector consists of a heterogeneous set of producers of environmental goods and services. This definition was also adopted by SEEA (UN et al., 2012). Various activities come under the definition of the EGSS. A quantitative overview of the EGSS for 1995–2010[19)] is presented in this section. The data are compiled according to the guidelines of the handbook for EGSS (Eurostat, 2009). Data collection is based on three methodological studies carried out at Statistics Netherlands (commissioned by Eurostat). An overview of these studies is presented in a methodological paper on the EGSS available at the website of Statistics Netherlands (Statistics Netherlands, 2012a).

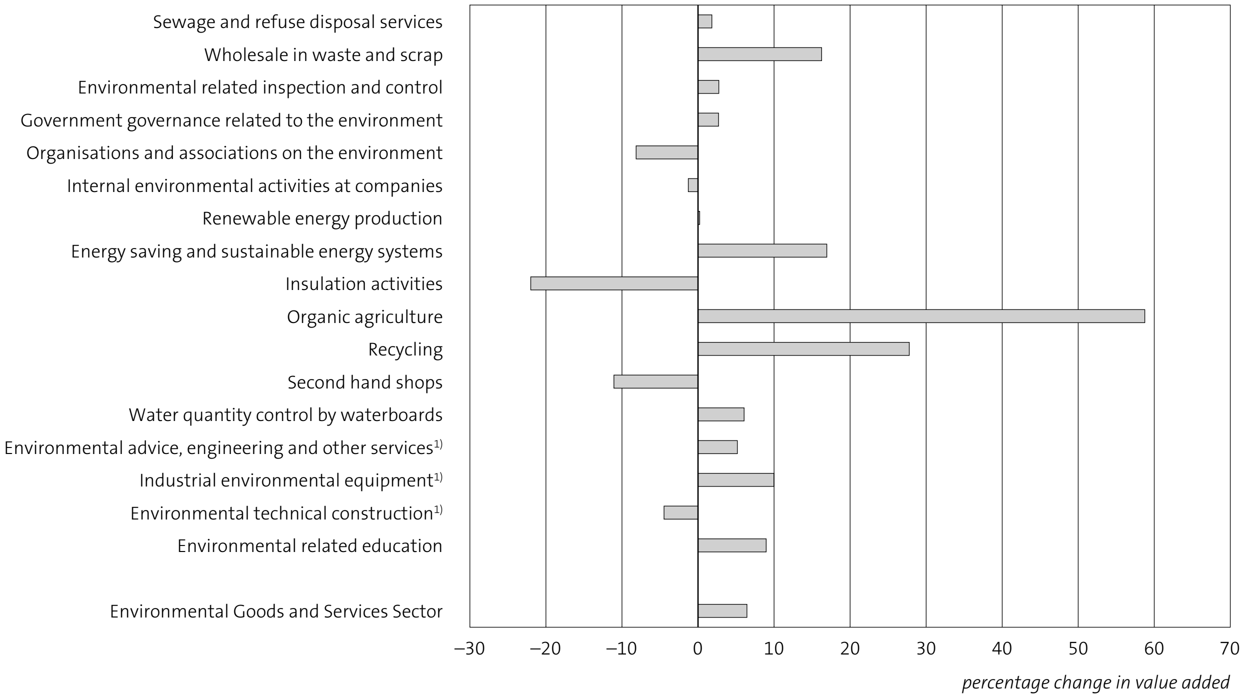
**Recovery value added of EGSS in 2010, employment under pressure**

The economic development of the EGSS came to a halt due to the financial crisis and the economic recession in 2009 (Statistics Netherlands, 2011a). Value added in current prices fell by 3 percent in 2009 compared to 2008[20)]. Production in current prices fell as well. Employment, on the other hand, rose by 2 percent. In 2010 value added was up by 6 percent on 2009, while production rose by 3 percent while employment remained more or less stable. The economic revival of EGSS in terms of value added can be interpreted as a partial rebound effect.

19) Figures for the complete time series (1995–2010) have been revised after the set-up of a new population database. New companies have been identified as companies belonging to the EGSS. Time series have been adjusted based upon these new insights.

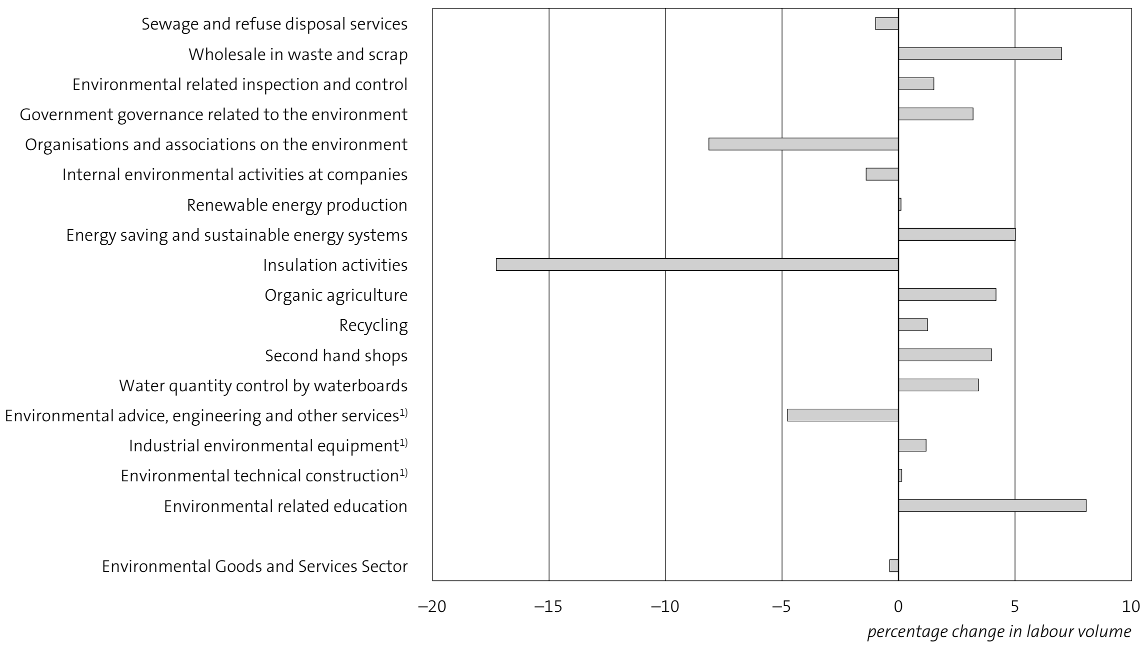
20) One should be careful in drawing too strong conclusions from data on developments in economic variables in 2008–2009–2010. Due to the set up of a new system for production statistics, first implemented for the reporting years 2009 and 2010, the economic figures presented for certain activities in 2010 may not be completely comparable with the corresponding 2008 and 2009 values. So complete comparability cannot be guaranteed.

## 7.5.1 Change in value added for different activities in EGSS, 2009–2010 (current prices)




[1] Not related to energy saving and sustainable energy systems.

## 7.5.2 Change in labour volume for different activities in EGSS, 2009–2010




[1] Not related to energy saving and sustainable energy systems.

### Recycling and wholesale in waste and scrap partially recovered in 2010

A more detailed look at the EGSS (see Figures 7.5.1 and 7.5.2) shows that companies specialised in recycling started to recover in 2010. Value added increased by more than 25 percent. Their value added in 2010 was still below that of 2008, so the recovery, although there, was not complete (partial rebound effect). The recycling industry received more waste in 2010 than in 2009, as a result of which it was able to recycle more materials. The increase in labour volume in recycling is much smaller than the increase in value added.

Value added also increased in ‘wholesale in waste and scrap’. The level of value added of wholesale in waste and scrap is still lower in 2010 than it was in 2008, so the partial rebound effect was in place here as well. Wholesale in waste and scrap sold more second-hand cars and traded more in waste metals in 2010. Their role as an intermediate between sellers and buyers became more important in 2010 due to improving market conditions. Labour volume development is more or less in line with the development of value added.

The production (in volume terms) of organic agriculture grew slowly over the last previous years and this was also the case in 2010. Acreage of organic agriculture was estimated at almost 54 000 hectare in 2010, a growth of 3.9 percent compared to 2009 (EL&I, 2011). Total acreage of agriculture decreased over the previous years. As a consequence, the share of organic agriculture in total agriculture is growing over time. Price developments in agriculture in 2010 were very favourable for farmers in general compared to 2009 [21]. This is one of the main reasons why value added in current prices increased in 2010. Organic products are also imported from foreign countries: in between 250–300 million euro in 2007 (LEI, 2009). Imports of organic products have not been taken into account in the EGSS, because these flows do not generate ‘EGSS-jobs’ and ‘EGSS value added’ in the Netherlands. Retail turnover of organic products grew 14 percent in 2010 compared to 2009 (EL&I, 2011).

Sewage and refusal disposal services are not much influenced by economic fluctuations. Waste and wastewater produced by households and industries still needs to be disposed and cleaned. Value added therefore increased moderately by 2 percent in 2010.

### Value added renewable energy production stable in 2010 due to less wind

In physical terms, more renewable electricity was produced in 2010 than in 2009, especially due to more combustion of biomass by electricity producers and more waste incineration. After years of increased production of wind energy, a decline is observed in 2010 (Statistics Netherlands, 2011a). This decline can be explained by a very low wind supply. In 2010 the Windex (a measure of wind supply) was at its lowest ever estimated. This lack of wind was not compensated by investments in new windmills. Investments in windmills were at a record low since 1990. Realisation of a windmill project is often a very time consuming business due to planning sessions and legal procedures, financing processes, construction time and delivery time. Price developments for producers of renewable energy were also unfavourable in 2010

[21] It is assumed that price developments in production and intermediate consumption of total agriculture are representative for organic agriculture.

compared to 2009. Therefore value added growth for renewable energy production was close to zero in 2010.

There was positive growth in the value added from innovative sustainable energy systems and energy saving in 2010, whereas a very small dip was recorded in 2009. Employment related to sustainable energy systems and energy saving, just like as in 2009, grew in 2010. 'Sustainable energy policy' has become more prominent on the agenda of policymakers in the last few years. Possibly there are spillover effects of these measures on the economy, but it is hard to prove causality.

### Construction activities in EGSS under pressure

Insulation activities by construction companies decreased significantly in 2010 compared to 2009. Construction is under pressure since the 2009 crisis and this has its repercussions for the EGSS. Fewer new houses and buildings were built in 2010 than in 2009 and as a consequence insulation activities declined too. Also civil engineering activities (construction activity) related to investments in waste management facilities diminished in 2010 compared to 2009.

Second-hand shops were smaller in 2010 than in 2009. Second-hand retail trade of commodities decreased in 2010, possibly due to the continuation of the crisis which made households more economical in general. The substitution effect between new and second-hand commodities is possibly not strong enough to foster value added of second-hand shops in 2010.

A slight decrease in employment was recorded in environmental advice, engineering and other services (services oriented) not related to sustainable energy systems and energy saving. Employment of consultants and architects is under pressure here. This is possibly related to the stagnancy in construction.

Manufacturing of industrial equipment created more production and value added in 2010. Possibly these companies profited from better export markets fostering their production activities. Employment was kept more or less stable in the manufacturing of industrial equipment.

### Many activities contribute to value added EGSS

The EGSS contributed 12.7 billion euro to the Dutch gross domestic product and 117 thousand full-time equivalents (FTE) to employment in 2010. Total production value equalled 31 billion euro (see Figure 7.5.3). In 1995 the EGSS contributed 5.7 billion euro to the Dutch gross domestic product and 82 thousand full-time equivalents to employment[22].

22) These numbers for the year 1995 are quite different than the numbers presented in previous publications by Statistics Netherlands. This has two main reasons. The scope of the activity 'insulation activities' is defined narrower than it was defined in earlier publications. In earlier publications insulation activities were defined as insulation activities including installation of heating, ventilation, and air conditioning systems (quite a broad definition). Insulation activities do now exclude these vertical integrated processes and figures presented for insulation activities are only about pure insulation. To the contrary, the scope of the activity 'environmental technical construction' is defined more broad than it was defined in previous publications. Civil engineering activities related to investments in sewer systems and other construction activities related to investments of waste management are now included in the scope of the EGSS while these civil engineering activities were not in the scope in earlier publications. The whole time series have been adjusted in order to facilitate analysis over time for the EGSS.

### 7.5.3 The Environmental Goods and Services Sector in the Netherlands

| Group | Activities | Production | | Value added | | Employment | |
|---|---|---|---|---|---|---|---|
| | | 1995 | 2010 | 1995 | 2010 | 1995 | 2010 |
| | | *billion euro* | | | | *man-years (x1,000)* | |
| | Sewage and refuse disposal services | 3.8 | 9.5 | 1.5 | 3.4 | 20.7 | 27.6 |
| | Wholesale in waste and scrap | 1.5 | 2.7 | 1.2 | 2.3 | 4.8 | 5.6 |
| | Environmental related inspection and control | 0.0 | 0.2 | 0.0 | 0.1 | 0.1 | 2.5 |
| | Government governance related to the environment | 0.7 | 1.4 | 0.4 | 0.6 | 6.9 | 6.4 |
| | Organisations and associations on the environment | 0.0 | 0.1 | 0.0 | 0.1 | 0.9 | 1.7 |
| | Internal environmental activities at companies | 1.3 | 1.4 | 0.6 | 0.5 | 10.5 | 5.0 |
| | Renewable energy production | 0.1 | 1.0 | 0.1 | 0.6 | 0.4 | 2.3 |
| | Insulation activities | 0.3 | 0.8 | 0.1 | 0.4 | 4.0 | 6.3 |
| | Organic agriculture | 0.1 | 1.3 | 0.1 | 0.5 | 0.9 | 2.5 |
| | Recycling | 0.3 | 1.2 | 0.1 | 0.2 | 1.4 | 2.9 |
| | Second hand shops | 0.1 | 0.2 | 0.0 | 0.1 | 2.1 | 5.0 |
| | Water quantity control by waterboards | 0.5 | 1.2 | 0.3 | 0.6 | 3.6 | 4.0 |
| | Energy saving and sustainable energy systems | 1.6 | 4.0 | 0.5 | 1.3 | 8.1 | 15.8 |
| | Environmental advice, engineering and other services[1] | 0.6 | 1.9 | 0.3 | 0.9 | 5.4 | 11.5 |
| | Industrial environmental equipment[1] | 0.8 | 1.3 | 0.2 | 0.4 | 4.2 | 6.2 |
| | Environmental technical construction[1] | 1.0 | 2.4 | 0.3 | 0.7 | 7.7 | 11.2 |
| | Environmental related education | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.5 |
| **Total Environmental Goods and Services Sector** | | 12.9 | 30.8 | 5.7 | 12.7 | 82.3 | 116.9 |

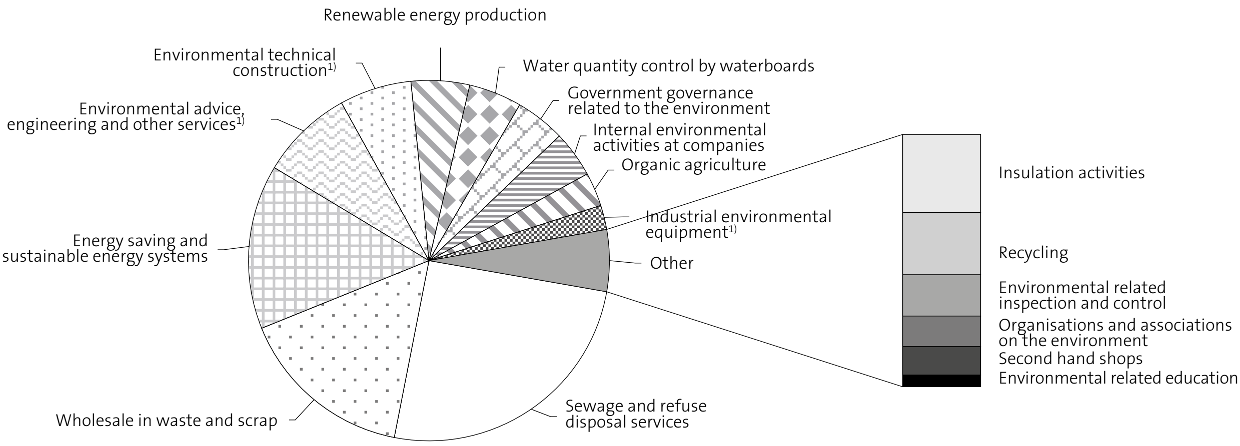
[1] not related to energy saving and sustainable energy systems.

The Dutch EGSS consists of companies and institutions participating in various activities. Traditional environmental activities like sewage and refuse disposal services play a significant role. About 27 percent of all value added of the EGSS is generated in this industry (see Figure 7.5.4). Wholesale trade in waste and scrap is also an important player in the sector. The remainder of total value added is generated by a variety of different activities. For example, recycling companies contributed 2 percent. Environmental activities carried out by government bodies still play an important role. Activities related to water quantity management and other management tasks of the government account for approximately 10 percent of total value added.

A key component of the EGSS is the sustainable energy sector. The sustainable energy sector – which cuts across all industries of the Standard Industrial Classification (NACE) – consists of companies and institutions that physically produce renewable energy, as well as companies active in the value chains that come before it. Apart from renewable energy, the sustainable energy sector also includes companies and institutions that focus on energy saving activities. The sustainable energy sector in 2010 was responsible for 15 percent of the total value added created in the EGSS. Producers active in energy saving and sustainable energy systems (pre-exploitation phase) were responsible for 10 percent of total value added and producers of renewable energy (exploitation phase) for 5 percent. More information on the sustainable energy sector can be found in Statistics Netherlands (2012b).

Slowly but surely the more innovative activities are gaining a more prominent position in the EGSS. The share of traditional environmental activities in total EGSS is diminishing over time.

**7.5.4 Distribution of value added EGSS over different activities, 2010**

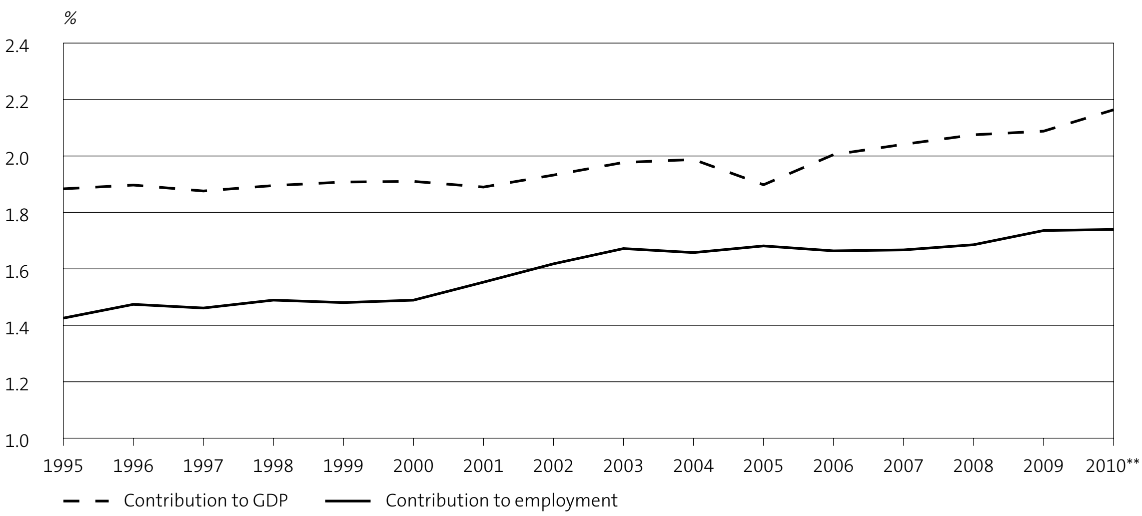



1) Not related to energy saving and sustainable energy systems.

## Relative contribution of EGSS to GDP grew in 2010

With a contribution of 12.7 billion euro to the gross domestic product (GDP) in 2010, the Dutch EGSS accounted for 2.16 percent of total GDP. In 2009 this share was 2.09 percent (see Figure 7.5.5). So relatively the EGSS has become more important for the Dutch economy in 2010 than in 2009. Generally speaking, this share remained more or less stable in the period 1995–2010, ranging from 1.88 to 2.16 percent, although one could discern an upward trend from 2005 onwards. The EGSS had a share of 1.74 percent in total employment in the Netherlands in 2010 in full-time equivalents. The relative contribution of the EGSS to total employment has increased quite convincingly over time (1995–2010).

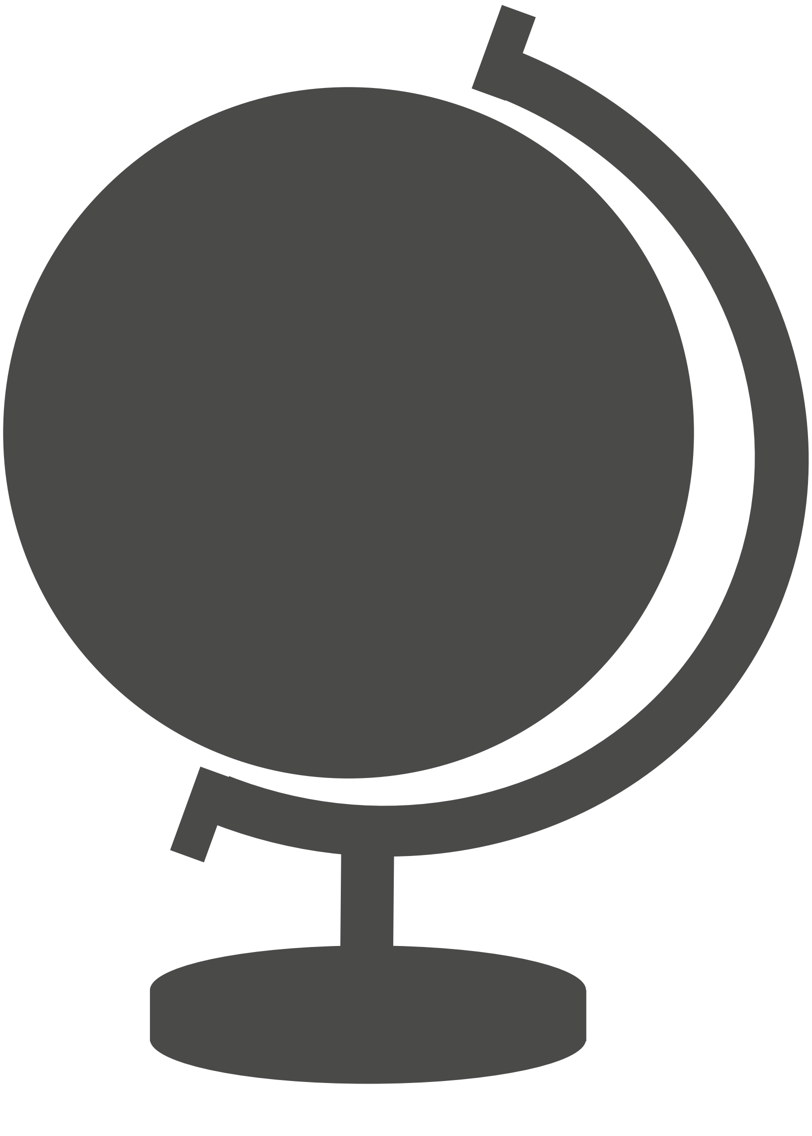
**7.5.5 Contribution of EGSS to GDP and employment**



# Theme articles

# Materials flows

# 8



# Materials flows

# 8.1 Introduction

Worldwide population growth and increasing wealth have lead to an increasing demand of natural resources. As a result some resources are becoming scarce leading in turn to higher prices. So, many countries are now developing a strategy in order to secure a supply of vital resources for their industries in the future (DEFRA, 2012). In 2008 the European Commission launched the "Raw Materials Initiative" which advocates secure, undisturbed access to natural resources on the world market (EC, 2008). Raw materials have been high on the European agenda ever since (see EC, 2010; 2011b). Issues addressed include: more efficient use of resources, sustainable production of European extracted resources, increasing the recycling rate, and containing resource prices and their fluctuations. A flagship initiative for a resource efficient Europe was launched within the Europe 2020 strategy, as a more efficient use of resources is the key to secure economic growth and employment in Europe (EC, 2011a).

In addition to the European initiatives, the Dutch government has drawn up its own resource initiative memorandum (Ministry of Foreign Affairs, 2011). Its primary target is to secure the sustainable supply of natural resources. There are three general methods for this. Firstly, replacing scarce resources by alternative resources (e.g. fossil fuels by wind/solar energy). Secondly, increasing the recycling rate. And thirdly the use of resources can be limited by increasing the resource efficiency. Several studies have been conducted in recent years to support the Dutch resource policy. These were about future scarcity and possible policy measures (M2i, 2009; PBL, 2011; HCSS, 2009; HCSS et al., 2011), the impact of material use on the environment (CE, 2010), the impact of scarce metals on the economy (Statistics Netherlands and TNO, 2010) and the biobased economy (SER, 2010). Statistics Netherlands is conducting a study on material flows to, from and within the Dutch economy, commissioned by the Ministry of Economic Affairs, Agriculture and Innovation.

This chapter shows how the environmental accounts, and especially the module of the economy-wide material flow accounts (EW-MFA), can be used to tackle issues in the current Dutch resource policy. This chapter starts of with a brief description of the methodology. Next, the results section provides analyses of domestic extraction, Dutch trade, dependency on other countries, resource efficiency and the resource footprint for imports expressed in raw material equivalents. The period 2000–2010 is considered, where the 2010 data are preliminary. The final section is on conclusions and discussion.

# 8.2 Methodology

### Economy-Wide Material Flow Accounts (EW-MFA)

Economy-wide material flow accounts (EW-MFA) describe all materials[1] that enter or leave the economy: raw materials, semi-finished and final products. The general purpose of EW-MFA is to describe the interaction of the domestic economy with the natural environment and the rest of the world economy in terms of physical flows of materials (UN et al., 2012). The EW-MFA determines the extraction of domestic natural resources and the imports and exports of products. Re-exports are also included unless stated otherwise. Re-exports are goods which have been imported and then exported again with no (or virtually no) further processing. The goods in question have to be owned by a Dutch resident at some point. If there is no transfer of ownership at any stage, the goods are deemed to be in transit. Transit trade is not included.

At the most detailed level nearly 400 types of traded products and around 30 extracted resources are distinguished in the Dutch system. All goods are assigned to one of five material categories – biomass, metals, non-metallic minerals, fossil fuels and other products – based on their predominant composition. Cars for instance are assigned to the material category metals. The approach used by Statistics Netherlands to determine physical import and export flows guarantees a link between physical and monetary flows. The monetary data of the national accounts are converted to physical data by using price information derived from the international trade statistics. This yields the necessary information on the total amount of trade at the product level. These totals at the product level are subsequently broken down by countries of origin (imported from) and destination (exported to). This is done by using the monetary information from the international trade statistics. For example, if half of the crude oil import comes from Russia and the other half from Norway, the same ratio is used for the physical flows.

Domestic material consumption (DMC) can be determined by subtracting exports from domestic extraction and imports. DMC can be estimated for all materials together, or for a selection of similar kinds of materials like biomass, metals, minerals and energy carriers. Domestic material consumption in combination with an indicator of economic growth provides an indicator for the resource efficiency (or resource productivity) of a country. Gross domestic product (GDP) divided by DMC is one of the major European indicators of the resource productivity of a country (Eurostat, 2011b). The EW-MFA combined with country information and information about the processing stage of products provides more insight in the origin and types of materials used. For a detailed description of the methodology and definitions used to compile the EW-MFA see Delahaye and Nootenboom (2008) and Eurostat (2012). Data on economy-wide materials flows can be found on StatLine, the electronic database of Statistics Netherlands.

[1] Excluding bulk water.

**Beyond EW-MFA: Stage of production and Raw Material Equivalents**

The interpretation of the indicators, such as domestic material consumption, provided by the EW-MFA has been prone to ambiguity because all kinds of materials are added together. Material consumption may change because of a more efficient use of materials but also because of a change in composition of materials, or a substitution of domestic production by importing manufactured products. For example, the DMC indicator of a country will decrease if iron mines are closed and ore-concentrates are imported instead. All materials, and not only the metal concentrates contained in domestically extracted iron ore, add to the DMC of a country. At the same time, the material requirements associated with the provision of imported products may have increased. Also, DMC is determined by the largest material flow. A change in the largest flow will determine DMC while disregarding the composition of smaller flows like scarce materials or materials with a high environmental impact. In the case of the Netherlands, the DMC is determined by the extraction of sand. In 2009 and 2010 the change in DMC is determined by the extension of the Rotterdam harbour (sand was used to reclaim land). Therefore, in this chapter excavated earthen materials are omitted from the results.

Eurostat investigated different approaches to improve the EW-MFA indicators. We present the results of two of these approaches in the second part of the results section. Both approaches are still being developed and experimental, so the results are preliminary and may change in the future as insights progress.

The first approach takes the production stage of traded products into account. Eurostat has provided a conversion table in which products classified by international trade codes are allocated to three different production stages: raw materials, semi finished and final products. Final products are mainly used for consumption, while the others are used in production processes. The conversion table can be linked to the EW-MFA classification. This allows the observation of trade with individual countries at the product level defined by production stage. This approach indicates the resource requirements behind the different kinds of traded products.

In the second approach EW-MFA are converted into so-called raw material equivalents (RME). The RME of a product indicates the amount of raw materials required to manufacture it. For example the raw materials needed to produce tomatoes include seeds, energy and fertilizer. In this analysis the whole production chain is taken into account irrespective of whether the raw materials were extracted from the domestic environment or the rest of the world. To convert products into raw materials, RME coefficients for the imports and exports were estimated for the EU-27 (IFEU, 2012). Eurostat commissioned the project to improve the meaningfulness and interpretability of the existing European material flow indicator “Domestic Material Consumption” (DMC). By expressing all flows in terms of raw material equivalents (RME) it becomes possible to create a mass balance of domestic extraction, imports and exports through a coherent unit of measurement. The “Domestic Raw Material Consumption” (RMC) can be estimated from the flows in raw material equivalents. The RMC is a measure for the natural resource footprint of a country. It would be a more suitable indicator for the European Resource Strategy than the Domestic Material Consumption (DMC).

A mixed Leontief-LCA calculation, using a hybrid Input-Output Tables (HIOTs) approach, is used to estimate the RME coefficients. This mixed method yields results that are significantly more accurate than a “standard” Leontief approach (IFEU, 2012). The output of the calculation consists of RME coefficients for imports and exports at the EU-27 level for 166 product groups and 52 raw material categories. A link between the product classification used for RME and EW-MFA was established. Using EU-27-level RME coefficients at the level of a single country, like the Netherlands, requires some assumptions. The imports of a single country need to be split into intra-EU and extra-EU trade. The country level import coefficients for extra-EU trade are well represented by EU-27 level import coefficients. The detailed breakdown in product groups takes any structural effects into account. The intra-EU trade is better represented by the EU-27 exports coefficients, which reflect the EU average coefficients of final use products. Country specific structural information in the shape of a HIOT is needed to estimate RME for exported products of a single country (IFEU, 2012). An advantage of using an IOT based estimation approach is that the economic link can be established: estimating the domestic economic driving forces of material consumption.

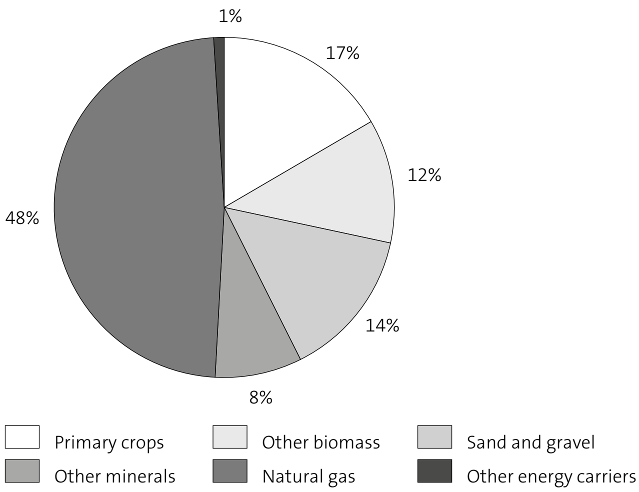
Currently no RME for Dutch exported products are available. Therefore, the RMC for the Netherlands is not presented in this chapter, only the natural resource footprint of imported products is estimated.

# 8.3 Results

### Extraction of natural resources

In 2010 the domestic extraction of natural resources in the Netherlands largely consisted of sand used for the extension of the Port of Rotterdam (2de Maasvlakte). The total amount of excavated earthen materials, also used for infrastructural projects to raise roads and land for the construction of buildings or to strengthen dikes and coastal defences, amounts to 250 billion kilograms. From a resource policy perspective these material flows are not very interesting as they are not lost but merely relocated. Almost half of the remainder of Dutch extractions (142 billion kilograms) comes from the exploitation of natural gas reserves, a quarter consists of biomass and another quarter are non-metallic minerals used for the production of cement and concrete (Figure 8.3.1).

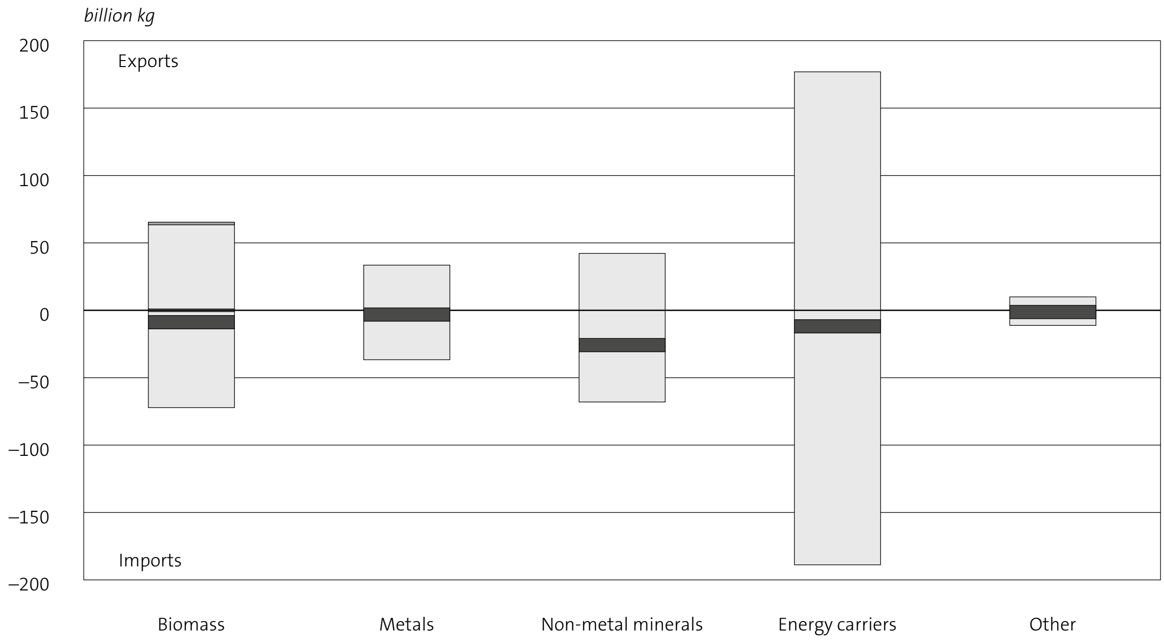
**8.3.1 Domestic extraction (excluding excavated earthen materials) for the Netherlands, 2010.**




## Large trade volumes, small deficit

The extraction of natural resources cannot meet domestic demand for materials, so the Netherlands depends on imports from other countries. At the same time, other countries depend on the Netherlands for their material needs. Energy carriers produce the largest import and export flows. The Netherlands has a great demand of crude oil, which is processed in its refineries. At the same time it exports a substantial part of its natural gas reserves. Total Dutch imports of goods amounted to 377 billion kilograms in 2010 and exports to 326 billion kilograms. These large trade volumes indicate that the Netherlands is a major transit route for Europe. Therefore, an open trading system for goods is important for the Dutch economy. The Netherlands has a total trade deficit (imports minus exports) of 51 billion kilograms. The largest physical trade deficit is in minerals. This can be attributed to the large amount of imported sand and gravel needed for the production of concrete and asphalt. Imports are required because the extraction of sand and gravel in the Netherlands is restricted by spatial and socioeconomic constraints.

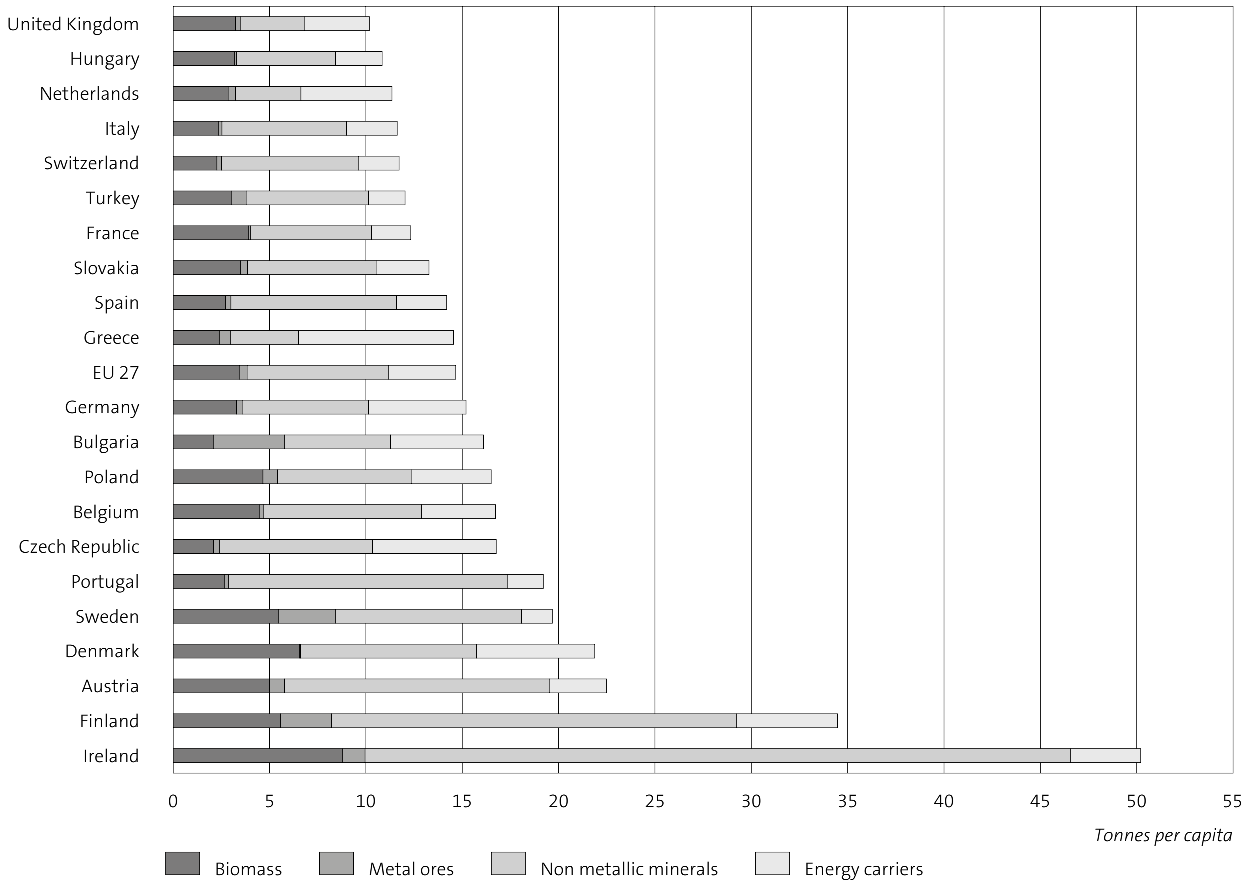
**8.3.2 Physical imports (-) and exports (+) for groups of materials by the Netherlands, 2010.**




## Dutch material consumption per capita one of the lowest in Europe

Domestic material consumption (DMC) is an indicator which expresses the apparent consumption of materials in physical terms by an economy. DMC is estimated by adding the amount of extraction to imports and subtracting exports. Eurostat collects the data for estimating the DMC for most EU-27 countries as part of the EW-MFA, a module of the environmental accounts. The Netherlands has one of the lowest DMC in Europe for all material categories together (excluding excavated earthen materials). Only the Dutch consumption of fossil fuels is above the EU-27 average. This is due to the relative large energy intensive industries like chemistry, refineries and horticulture (greenhouses). The high DMC of fossil fuels in Greece is related to the high domestic consumption of coal, mainly low quality lignite, from domestic production. For the Netherlands, the low DMC for biomass and non-metallic minerals is a consequence of the high population density in the Netherlands. The lack of available land per capita is a limiting factor for domestic extraction of non-metallic minerals and biomass. Also, high population density leads to a lower per capita requirement of infrastructure. The highest DMC is found for sparsely populated Ireland and Finland. In Ireland, the DMC of biomass is determined by grassland based agriculture, e.g. grazing sheep. The low population density also contributes to a higher per capita requirement of infrastructure. A few countries, like Sweden, Finland and Bulgaria have a relatively high DMC for metal ores. These are the countries in which metal ores are both extracted and processed, after which the “metal concentrates” are exported. Therefore, the earthen materials removed from the ores to extract the metallic component, remain in the country, resulting in a large DMC.

**8.3.3 Domestic material consumption per capita per material category for a selection of EU countries, 2009**

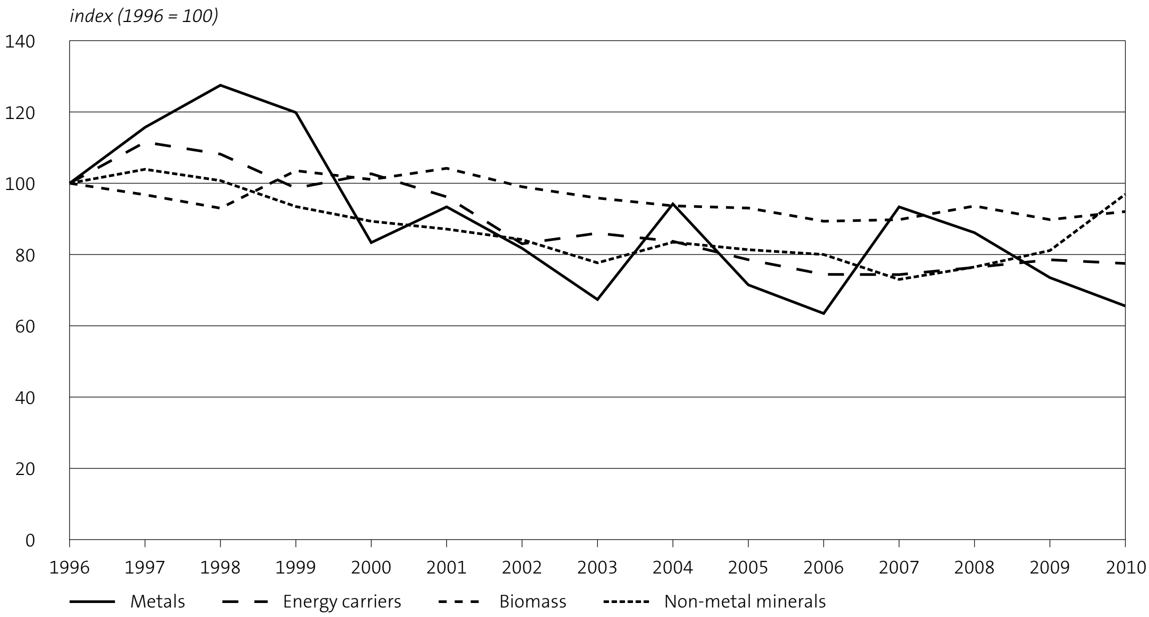



Source: Eurostat database, Domestic material consumption, by material (code tsdpc230)

## Resource efficiency improves

The flagship initiative for a resource-efficient Europe under the Europe 2020 strategy aims at decoupling economic growth from the use of resources. Resource efficiency is defined as the efficiency with which natural resources are used by an industry in order to generate value added. The resource efficiency for four material categories (biomass, metals, non-metallic minerals and fossil fuels) is expressed by the amount of DMC per group of materials per unit of generated value added (in constant prizes) of the largest users of these materials. The largest user of minerals, for example, is the construction industry. In general, the resource efficiency for all four material categories has improved between 1996 and 2010 in the Netherlands. There is a decoupling between material use and value added, which means that fewer natural resources were needed to produce the same value added.

**8.3.4 Development of resource efficiency for four material categories in the Netherlands.**



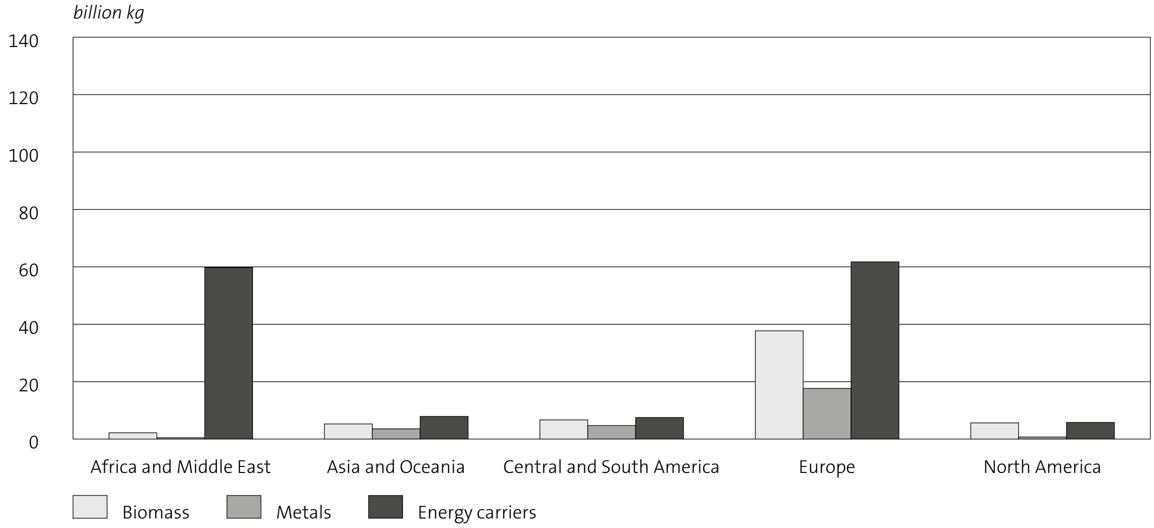

## Shift to importing energy carriers from the Middle East and Africa to Europe

As shown in Figure 8.3.2, the physical amounts of Dutch imports (including re-exports) are dominated by energy carriers. In 2000 the imports of fossil fuels from European countries were almost equal to the imports from the Middle East and Africa. In 2010 energy carriers and their derived products were mainly imported from European countries: Norway (natural gas) and Russia (crude oil)[2]. The import of fossil fuels has shifted from the Middle East to Europe. Between 2000 and 2010 oil extraction in Russia increased due to the development of new oil-wells and improved extraction techniques. Europe is a conveniently located consumer market for Russia. China's increased demand for oil was satisfied by countries in the Middle East.

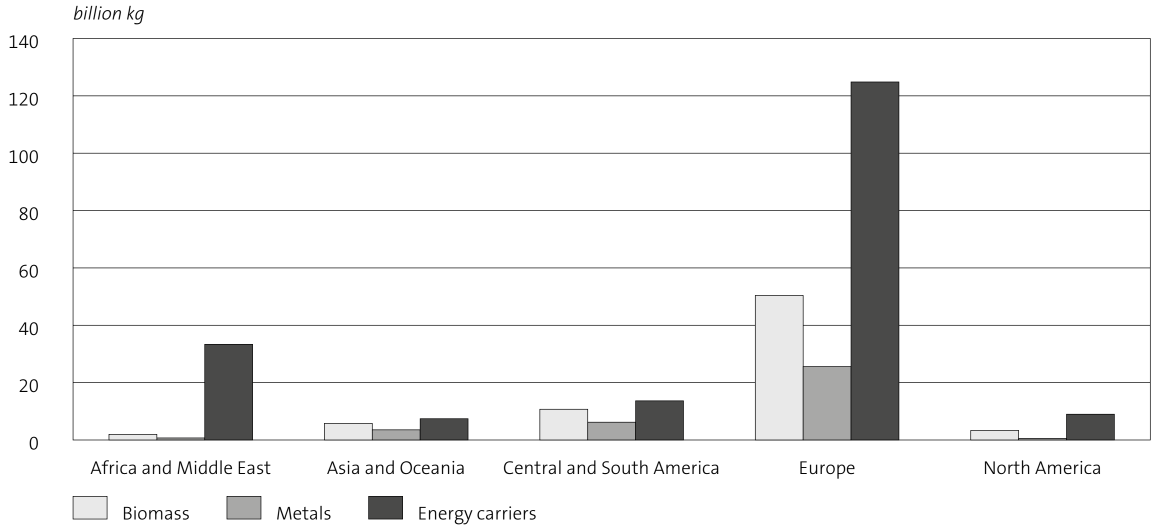
Biomass flows are physically also relatively large. A closer look at the biomass flows reveals that they consist mainly of primary crops (processed and non-processed crops that are not directly used as animal feed). 40 percent of the imported primary crops consist of cereals. Most cereals are imported from France, from where cereal imports went up by about 50 percent between 2000 and 2010. The imports of oil bearing crops, especially soybeans (19 percent), is also relatively large. Soybeans come mostly from Brazil and are mainly processed into animal feed. Imports from other South American countries, Paraguay and Uruguay, increased in recent years at the expense of imports from Brazil.

2) Countries are allocated to regions according to the United Nations classification. According to the UN the Russian Federation is allocated to Eastern Europe.

**8.3.5a Imports (including re-exports) of three types of materials for world regions, 2000.**




**8.3.5b Imports (including re-exports) of three types of materials for world regions, 2010.**



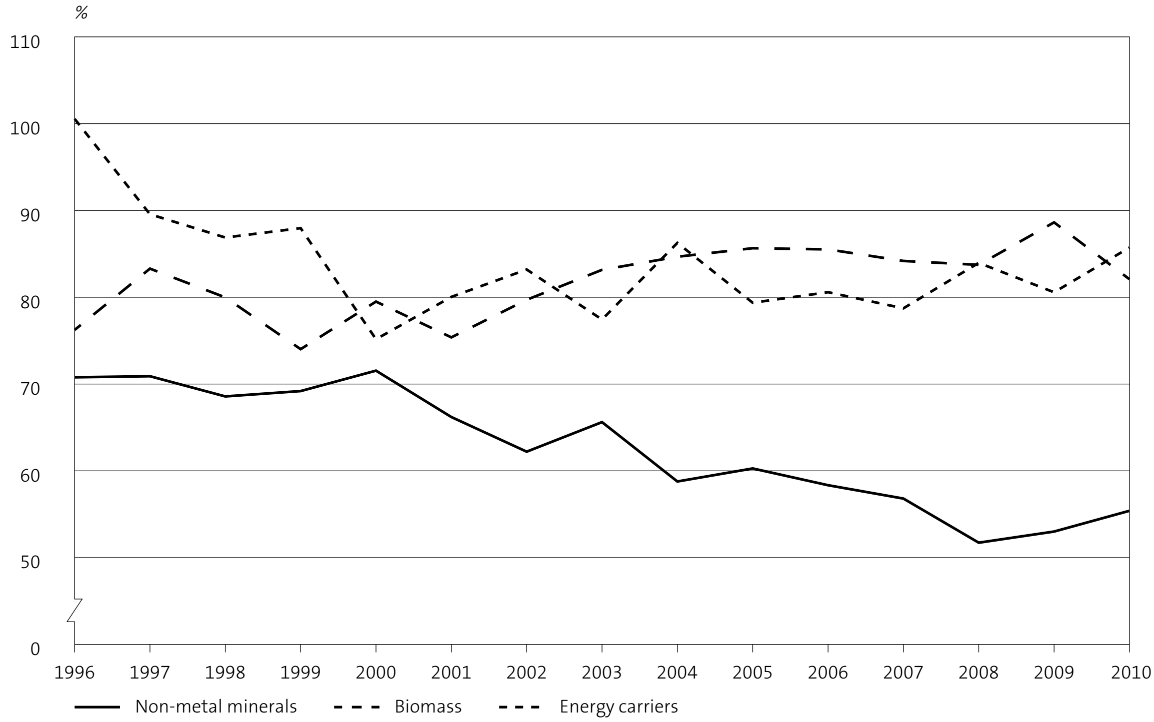

## Extent of self supporting depends on material category

Resource dependency on other countries is a key political issue. The dependency on foreign countries for materials can be indicated by estimating the amount of domestic material consumption that can be covered by domestic extraction of natural resources[3]. No dependency from foreign countries is assumed when Dutch extraction is at least equal to the domestic material consumption. The Netherlands is fully dependent on foreign countries for metals as no metal ore is extracted domestically. The Netherlands is 80–90 percent self supporting in

3) Here it is assumed that all goods within a material category can be substituted by each other. This assumption will not always hold in practise.

biomass and fossil fuels. The Netherlands has become less self supporting for non-metallic minerals, from around 70 percent in 1996 to around 55 percent in 2010. This is mainly due to a decrease of sand and gravel extraction for the production of cement and concrete[4]. The biomass dependency on foreign countries may seem remarkable because of the large agricultural sector in the Netherlands. This is because of the need of specific crops as feed for livestock, like soybeans. The Netherlands is 86 percent dependent for cereals, especially Durum wheat. Durum wheat, used for e.g. bread making, does not thrive very well in the Dutch climate. Furthermore, the Netherlands depends on other countries for wood (85 percent) due to a lack of forests for commercial exploitation. The Netherlands is self supporting in potatoes, sugar beets and fish.

**8.3.6 Percentage self supporting per material category in the Netherlands**



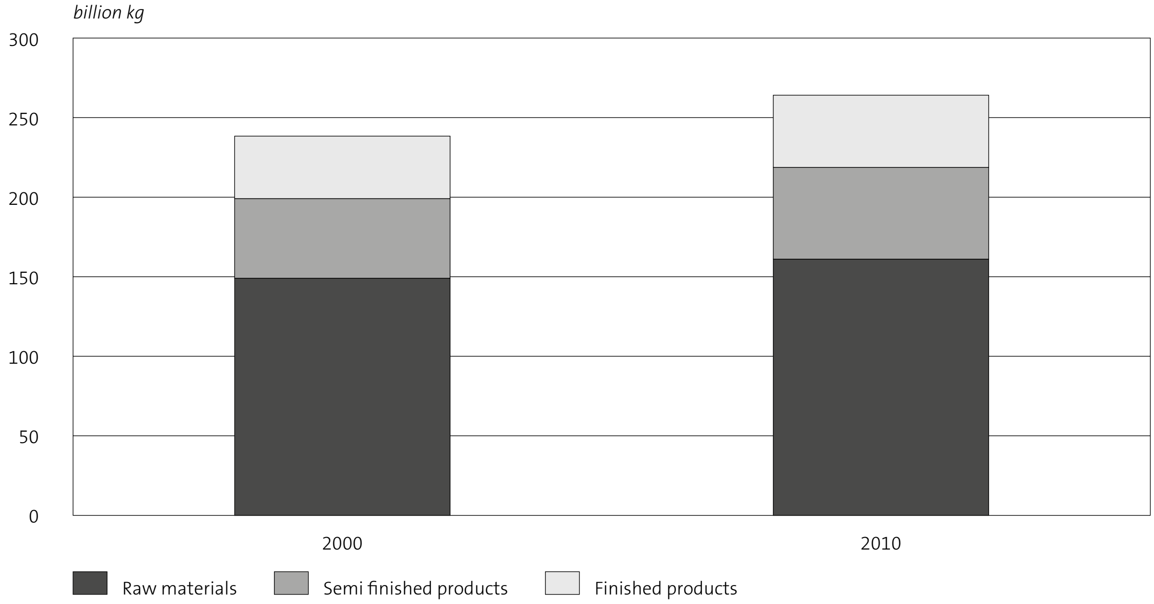

## Shift from raw materials to more processed imports

Imported products can be allocated to different stages of processing such as raw materials, semi finished and final products. Final products are mainly used for consumption while the others are used in the production processes. In 2010, 61 percent of the imports (excluding re-exports) were raw materials. Most raw materials are energy carriers used to produce motor fuels. In physical terms finished products make up only 18 percent of Dutch imports, while representing 59 percent in monetary terms.

[4] Excavated earthen materials used to raise roads, buildings or for the extension of the Rotterdam harbour are not taken into account.

Between 2000 and 2010, the physical amount of imports (excluding re-exports) increased by 11 percent. The products that contributed most to this increase were semi-finished and finished products (around 15 percent). The imports of raw materials increased by only 8 percent. So there appears to be a slight shift towards importing goods at a higher stage of processing. This may be because production processes are now split up due to increasing globalisation. Previously products were produced from start to finish in the Netherlands, whereas now Dutch production often starts with imported semi-finished products. A shift towards the import of goods at a higher stage of processing decreases the DMC and therefore increases the resource efficiency of a country. However, an increase in domestic resource efficiency does not necessary imply an increase in resource efficiency on a global scale.

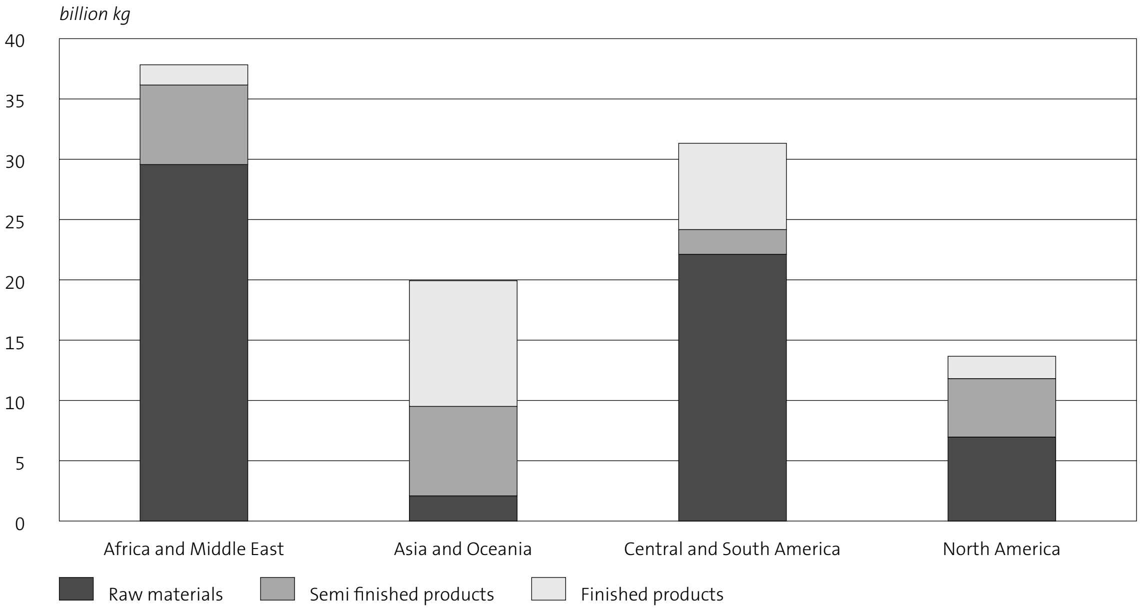
**8.3.7 Developments in Dutch imports (excluding re-exports) by level of processing for 2000 and 2010.**




## Importing raw materials from Africa, the Middle East and South-America

Most of the raw materials are imported (including re-exports) from European countries (including Russia). Among the imports from outside Europe, the largest amounts of raw materials come from Africa, the Middle East and Central and South America. The main raw materials imported from South and Central America are coal and iron ore. Crude oil is imported from the Middle East and Africa. Disregarding Europe, 49 percent of the finished products are imported from Asia. Animal feed and palm oil are imported from Malaysia and Indonesia while electronics are imported from China.

**8.3.8 Imports (including re-exports) from outside the EU by level of processing, 2010.**

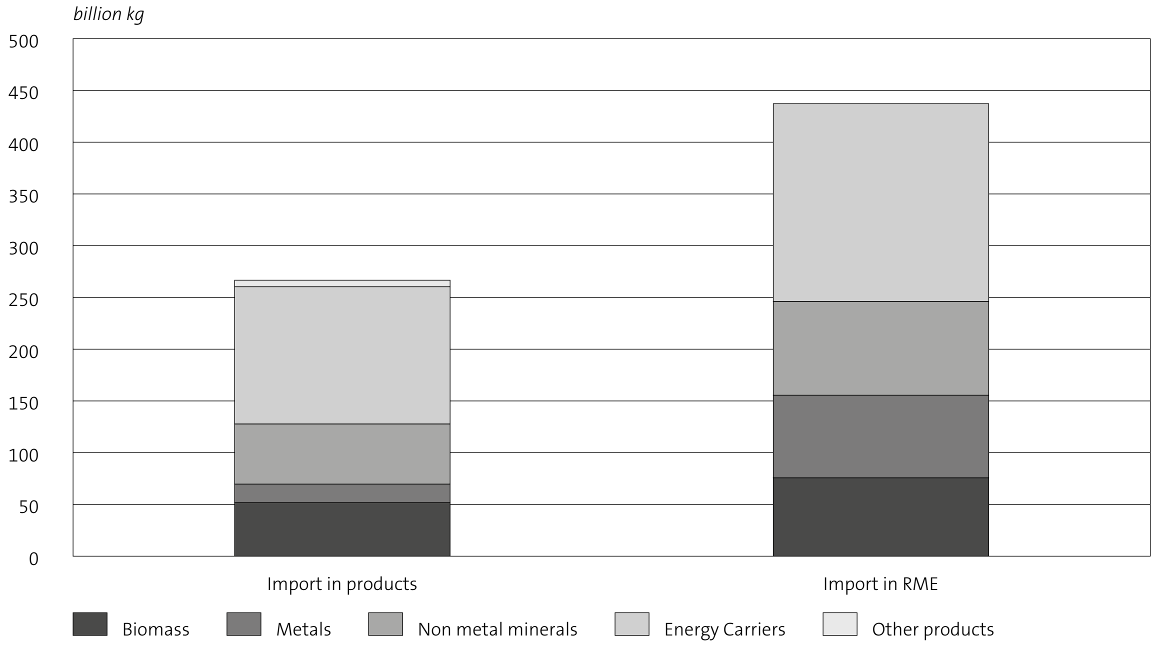



## Metallic products have the highest raw material equivalent

Instead of assigning imported products to different stages of processing, imported product can also be converted into raw material equivalents (RME)[5]. The RME of a product indicates the amount of raw materials needed to produce the product. The imports of products converted to raw material are 1.6 times higher than the imports of actual products. For metals the RME are even 4.5 times higher because the production of metallic products requires a large amount of metal ores[6]. The imports in raw material equivalents are a measure of the natural resource footprint of Dutch imports. Unfortunately the footprint of Dutch consumption could not be estimated as RME for exports are not yet available.

5) Water is not taken into account as a raw material.
6) The import of gold products is excluded because the import seems very erratic and, at the same time, have a large influence on the amount of metal ores needed.

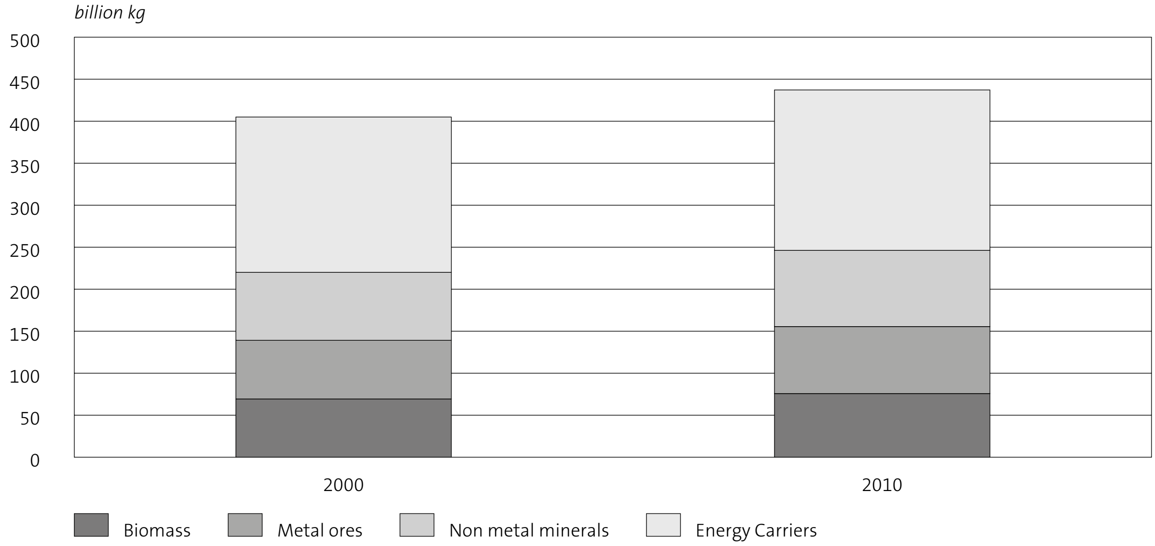
**8.3.9 Imports (excluding re-exports) in actual products and products converted to RME, 2010**




## Natural resource footprint of imports increases over time

Over the period 2000–2010 the Dutch import expressed in RME has increased by 8 percent while total physical imports has increased by 12 percent. This indicates an increased efficiency in the production of the imported goods. In 2010, around 15 percent more metal ores and non-metallic minerals were needed to produce Dutch imported products. Fossil fuels increased only by 3 percent. For all raw material categories except metals, the increase in RME was less than the increase in imported products of the corresponding product categories. One reason why this trend was not observed for metals (a 14 percent increase in RME was observed despite a 7 percent decrease in metal product imports) is a shift in imports towards metallic products (like tin products) with higher raw material equivalents.

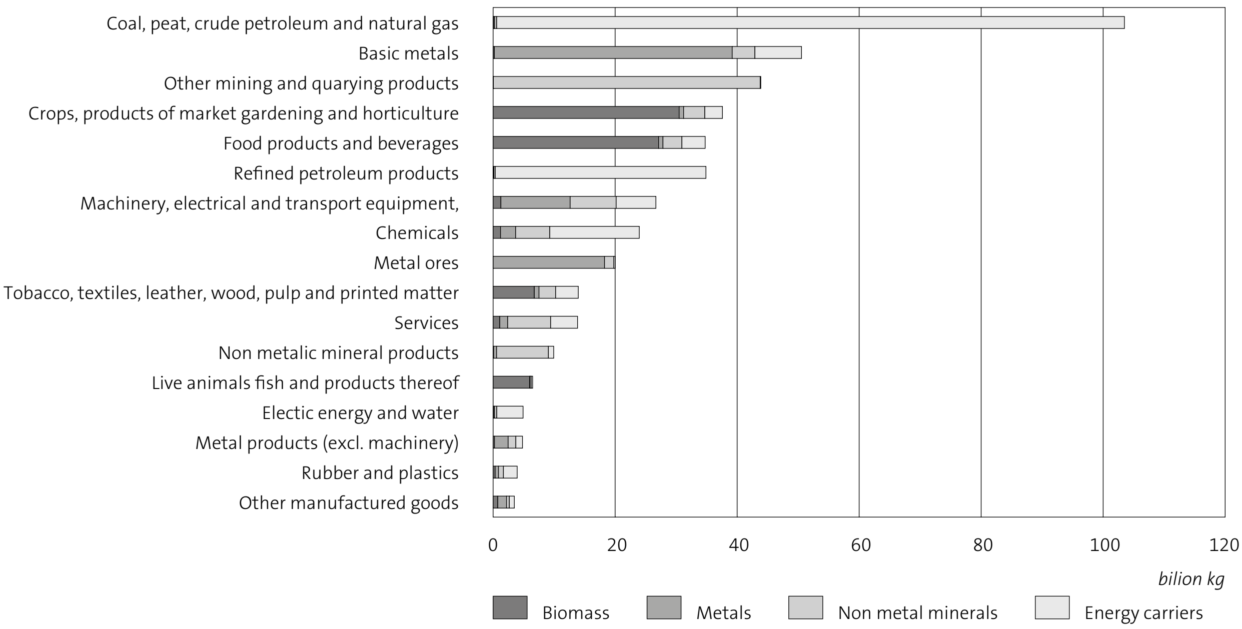
**8.3.10 Imports (excluding re-exports) in raw material equivalents, 2000– 2010**




### Fossil fuels part of the footprint of most products

Figure 8.3.11 shows imported products expressed in RME, broken down by the types of raw materials required in the production chain. Obviously, a particular type of raw material (e.g. metals) is used most for a product that consists mainly of this raw material (e.g. basic metals). Fossil fuels, and to a lesser extent non-metallic minerals, are used in the production of most products.

**8.3.11 Imports (excluding re-exports) of products expressed in RME for different types of natural resources, 2010**



# 8.4 Conclusions and discussion

Economy-wide material flow accounts (EW-MFA) provide insight in the origin and use of natural resources. In physical terms the Netherlands is a net importer of materials. The large amounts of imports and exports show that the Netherlands is a major transit route and underline the importance of an open trading system.

Dutch domestic material consumption (DMC) per capita is below the EU average. The high population density in the Netherlands limits the amount land available for domestic extraction and leads to a lower per capita requirement of infrastructure. Over time the consumption of materials is decoupled with the value added of key industries indicating an improvement of the resource efficiency.

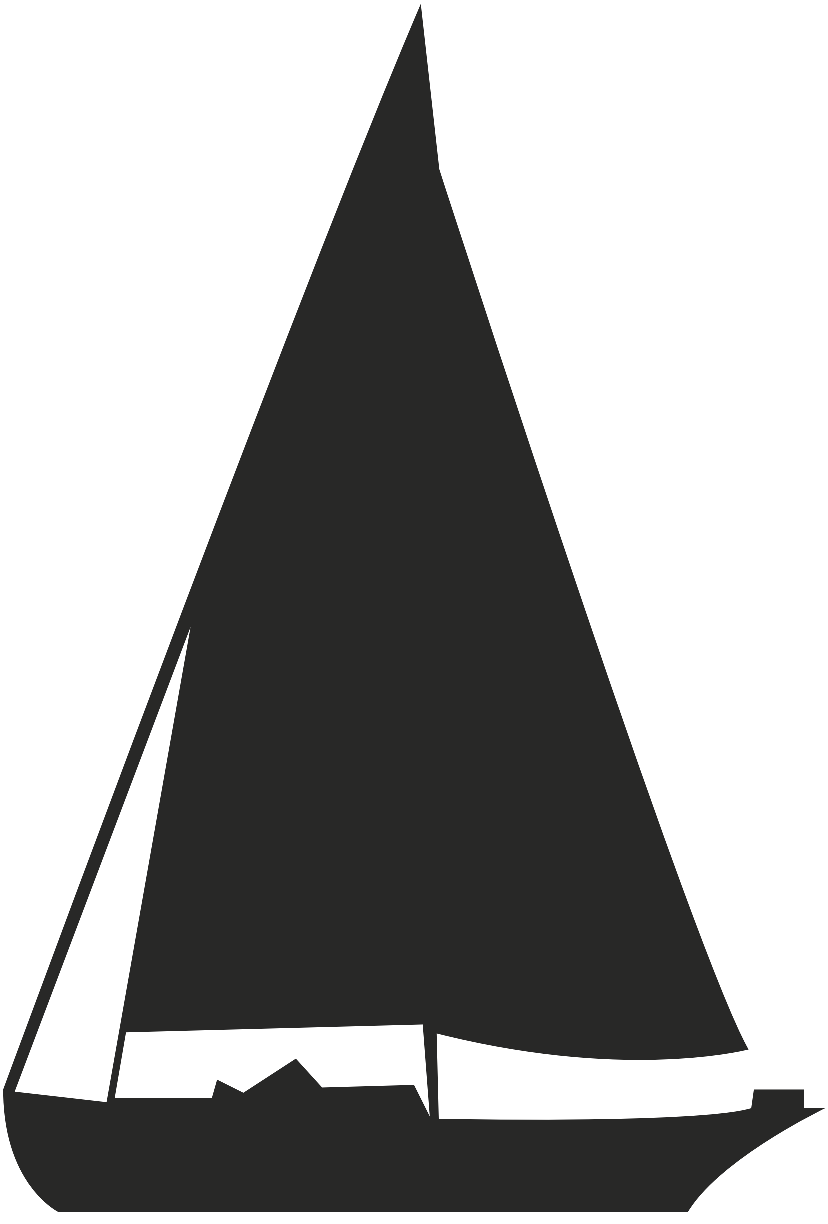
The consumption of fossil energy carriers is relative high compared to other European countries due to the energy intensive industries in the Netherlands. Taking all fossil fuels together, the Netherlands is largely self supporting. However, at a more detailed level, it shows that a large amount of natural gas is extracted domestically while a large amount of crude oil and oil products are imported. Over the period 2000–2010 fossil fuel imports have shifted from the Middle East and Africa to other European countries. Beside Europe, the main providers of Dutch imported raw materials are Africa, the Middle East, South and Central America. The Dutch economy is very dependent on these raw materials. 61 percent of Dutch imports excluding re-exports consist of raw materials (i.e. only raw materials used in the domestic production process). From the non-European imports, 49 percent of the finished products are imported from Asia.

The physical amount of natural resources required to produce Dutch imports is 1.6 times higher than the actual amount of imported products. Metal products require large quantities of metal ores. Between 2000 and 2010 the Dutch natural resource footprint for imports has increased by 8 percent as more raw materials were needed for the increasing imports of products. However, the increase in RME is low compared to the 12 percent increase in total physical imports. This indicates an increase in efficiency in the production of Dutch imports. However, an exception to this trend concerns the 14 percent increase in RME of metal products despite a 7 percent decrease in metal product imports. This is due to the imports of specific types of metals which have a large footprint. Metal resources are mostly used in metal products while fossil fuels, and to a lesser extent non-metallic minerals, are used in the production of all kinds of products.

The EW-MFA statistics described here consider the economy as a black box. Currently Statistics Netherlands is conducting a study that establishes the material flows within the economy. This study will provide insight in the resources use and the resource efficiency of different industrial branches and households. Waste flows are also part of this study. Having waste flows next to product flows provides insight in the relation between the use of natural resources and recovered material resources. Furthermore, an estimate of the raw material equivalents of Dutch exports is foreseen. This information would allow an estimate of the natural resource footprint with regard to consumption requirements in the Netherlands.

# Improvement of the National water balance

# 9



# Improvement of the National water balance

## 9.1 Introduction

## 9.2 Context
- SEEA-Water
- Water Framework Directive

## 9.3 Sources and methods of the water balance
- Precipitation
- Actual evapotranspiration
- Actual external inflow of surface water from foreign territory
- Actual outflow of surface water
- Regionalized inflows and outflows of surface water
- Flows of groundwater to and from the Dutch territory

## 9.4 Results for the main elements of the water balance
- Precipitation
- Actual evapotranspiration
- Actual external inflow of surface water from foreign territory
- Actual outflow of surface water
- Regionalized inflows and outflows of surface water

## 9.5 Synthesis

# 9.1 Introduction

In hydrology, a water balance describes the flows of water in and out of a system, which can be a country, a river basin or a more localised area. Important items of the water balance are the exchanges with the atmosphere, namely precipitation and evapotranspiration. In addition, the inland fresh water resource system exchanges water with other territories by importing or exporting water (exchanges of water between economies) and through inflows from upstream territories and outflows to downstream territories or the sea. Finally, there are flows between the inland water system and the economy, namely extractions of surface and groundwater, the use of water by agriculture and the reuse and discharge of waste water. Water resources provide inputs and services to the economy, but they are also essential for the survival and wellbeing of ecosystems. Monitoring and understanding the water balance, which include both flows in the environment and flows between the economy and the environment, is therefore important for all kinds of water related policies.

In 2011 and 2012, Statistics Netherlands conducted a research project about improving the national water balance as well as compiling water balance data per river basin (Graveland and Baas, 2012)[1)]. The regionalisation of water statistics is listed as an international priority, parallel to further improving national data on water flows. This priority setting came from the growing need for national and regional water data within international bodies such as the European Commission, the European Environmental Agency (EEA) and the United Nations (UN). In recent years Statistics Netherlands had already compiled national and regional figures on abstraction of groundwater and surface water, on water use by households and by the different industries of the economy (Statistics Netherlands, 2011d; Baas and Graveland, 2011). However, water data required for compiling a water balance for the national territory, as well as for the four river basins, was by no means complete and could be improved in several respects. This chapter describes the project activities, data, and methods to achieve this.

The scope of the research encompassed all incoming and outgoing flows of fresh water and an assessment of the fresh water stocks in the Dutch territory. The objectives of the research were:

1. Starting from existing data, to compile a national water balance for the Dutch national territory for a single year (2009). For that purpose missing parts should be filled in, while improving the quality of the data underlying the different parts of the balance.
2. To collect data at disaggregated level and attempt to compile water balance data for the country's four river basins districts or the seven (sub) river basins, for the year 2009.
3. When data would prove to be sufficient, to develop a method for and make assessment of existing stocks (resources) of freshwater in the country for groundwater, surface water and soil water. For that purpose we have elaborated on a compilation methodology and parameterisations of these stocks. This assessment, however, is not reported in this chapter.

This chapter is structured as follows. Section 9.2 provides contextual information about the objective of the research undertaken and the issues summarised in this chapter. Section 9.3

1) This project was assigned to Statistics Netherlands as part of the Eurostat Water Statistics Grants program 2010.

describes the methodologies applied in order to makes a quantitative assessment of the different elements of the water balance in the Netherlands. Section 9.4 describes the main results while section 9.5 makes a synthesis, draws some conclusions, and ends with discussion.

# 9.2 Context

### SEEA-Water

Water accounts provide a description of water flows and stocks in quantitative terms for a country and regionally at (sub-) river basin level. The SEEAW (UN et al. 2012) contains chapters on physical water flow accounts and on water asset accounts. As such it provides a solid conceptual framework and a format to enable compilation of a full set of tables. Although we used these formats conceptually in the compilation process of the water balance, the results are not necessarily fully compatible with the prescribed formats. Various statistics exist and are used for compiling the different flows of the water balance. Statistics Netherlands has a more than 40 year long tradition of water statistics and over 20 year long tradition in water accounting. Water accounts consists of different types of accounts, namely water flow accounts for water use and water abstraction, water emission accounts, and (sub) regional water accounts (see also chapter 4).

### Water Framework Directive

In order to compile a water balance with elements that provide a relevant source of information for policy makers, the Water Framework Directive (WFD) is taken as the point of departure for the project. The European WFD was adopted in October 2000 and entered into force in December 2000 (EP, 2000). The WFD is an important and leading directive for water policy in Europe. The WFD considers groundwater and surface water (fresh, marine and brackish). EU member states are required to send in reports on water status once every three years (EEA, 2010). For surface water the WFD divides areas into ‘river basin districts’ and ‘sub river basin districts’. In the Netherlands four river basin districts are identified: Ems, Rhine, Scheldt and Meuse. All Dutch river basin districts are part of international river districts, which means that the policies for the river basin districts also need to be coordinated on an international level. In the Netherlands, the Rhine district is divided into four sub river basin districts.

# 9.3 Sources and methods of the water balance

For this study we made an inventory of the available data sources for the water balance for the year 2009, starting with the four main elements precipitation, evapotranspiration, actual external inflow and total actual outflow. In the Netherlands data for the main elements of the water balance stem from the Ministry of Infrastructure and the Environment[2)] and the Dutch water boards. Furthermore, in the context of this study, WaterWatch[3)] as a third party calculated and provided data on both precipitation and actual evapotranspiration for the Netherlands with the requested level of detail i.e. by use of remote sensing technology.

### Precipitation

WaterWatch quantified precipitation (rainfall) for the country. The applied method calculates the amount of water from precipitation measured every 5 minutes by the precipitation radar network of the KNMI (Royal Dutch Meteorological Institute). The raw images are calibrated using dozens of precipitation gauges in the country. The resolution of the precipitation radar is 1 x 1 kilometre, implying that the precipitation volume is determined for every square kilometre (Voogt et al., 2011). Precipitation is calculated for the 2009 annual total and for both the 2009 summer period (April-September) and the 2009 winter periods (January – March and October – December). By using a map overlay in GIS (geographic information system), precipitation could also be broken down by (sub-) river basins. In order to calculate the total precipitation (in $m^3$), the average precipitation in millimetres for each area (country or river basin) is multiplied with the area of concern.

### Actual evapotranspiration

Until now, data on evapotranspiration, either evaporation and transpiration for the country as a whole, was limited and based on the so-called ‘reference crop evapotranspiration’, which only show the evapotranspiration under somewhat hypothetical conditions with constantly sufficient water supply / water availability for crops and other vegetation. A major goal of this project was to significantly improve the quantification of the ‘actual evapotranspiration’. The detailed assessment of the actual evapotranspiration in the Netherlands is based on spatial and temporal explicit data obtained from WaterWatch. WaterWatch uses remote sensing and related techniques to compile and calculate this data.

2) The new ministry is the result of the 2010 merger of the Netherlands Ministry of Transport, PublicWorks and Water Management with the Netherlands Ministry of the Environment actually called the Dutch Ministry of Infrastructure and the Environment.

3) WaterWatch recently has become part of eLEAF, a company based in the Netherlands active worldwide that supplies quantitative data on water and vegetation on any land surface to support sustainable water use, increase food production, and protect environmental systems.

While standard evapotranspiration models are based on a water balance, WaterWatch exclusively uses so-called energy balance models. The model 'ET-Look' determines the energy available per pixel each day and calculates how the energy is distributed over the physical processes (Pelgum et al., 2010). This procedure allows for the calculation of evaporation (soil evaporation) and transpiration (crop transpiration) separately (Voogt et al., 2011). The input parameters of the 'ET-Look' model include the meteorological conditions observable, such as cloud cover, air temperature, wind speed and relative humidity. The assessment of 'actual evapotranspiration' was done for the national territory and for the (sub-) river basins.

**Actual external inflow of surface water from foreign territory**

The Netherlands is situated downstream of the large rivers Rhine, Meuse and Scheldt. In practice it means that nearly all cross-border fresh surface waters bodies flow into the country. The existing data on external inflow of surface water was solely based on data of yearly flows ($m^3$/year) of the river Rhine (gauging station Lobith) and river Meuse (gauging station Eysden). In order to extend and further improve the data on the external inflow of surface waters, two actions were undertaken. First, the identification of all smaller rivers and canals those contribute to the external inflow of surface water and influential to (sub) river basin allocation. This is done by exploring relevant information (reports, websites, etc.) of the water boards in charge. Secondly, the collection of all available data of the relevant river flows ($m^3$/sec, $m^3$/day) measured at gauging stations situated at or near the border. Due to the marine conditions in the mouth of the river Scheldt, this inflow is not regarded as fresh water and consequently is not taken into account in the nation's fresh water balance.

**Actual outflow of surface water**

Outflow of surface water includes outflow to the sea that is the North Sea, Wadden Sea, Ems-Dollard and the Scheldt estuary. As the Netherlands is situated downstream in all the river basins relevant for the country, the outflow particularly reflects the large quantities of inflow of fresh surface water from the incoming rivers in the South-Eastern part of the country. Outflow of surface water to neighbouring countries doesn't occur, except for one small river, the Dinkel, that crosses the Dutch-German border twice. For surface water, the current outflow figures to the sea are produced on an annual basis and taken from the OSPAR RID report on riverine inputs to the North Sea catchment area (OSPAR Commission, 2011).

Besides the large outflow points of the Rhine and Meuse delta, pumping stations were also included. They evacuate excess water from polders and waterways directly into the sea, and contribute to the total external outflow of fresh surface water from the territory as well. The improvements of the data on external outflow of surface waters, stem from a single additional action in the project namely the collection of all available data of water flows ($m^3$/sec, $m^3$/day) measured at gauging stations situated at or near the outflow points at rivers, canals, dams or pumping stations.

### Regionalized inflows and outflows of surface water

The previous section described the assessment activities to determine fresh water inflow from neighbouring countries and outflow to the sea at the national level. As a next step, we had to determine the domestic transfers of surface water between the four river basins, but also between the seven sub-river basins. Therefore data had to be collected on the so-called intermediate gauging stations, which consider the relevant domestic flows too.

The rather complex hydrological situation requires quite an exhaustive analysis of all the surface water transfers between the seven sub-river basins. Making an inventory and processing this data would go far beyond the resources and time of the project. We therefore decided to determine just the flows of surface water between the four main river basins. Among the four sub-river basins of the river Rhine, numerous flows could be observed and quantified, ones that take place either via pumping stations, canals, drains etc. Essentially, these flows capture the distribution of water in the Rhine-Meuse-Scheldt delta area.

For the assessment of flows between the four river basins, we collected the available data on surface water flows ($m^3$/sec, $m^3$/day) measured at gauging stations situated at or near rivers, canals, dams or pumping stations, which transfer water from one river basin to another. This has been achieved via a limited inventory of data for the entire 2009 period among the responsible water authorities. The main flows of fresh water between the river basins were compiled by aggregating daily average flow rates of several stations that represent a particular area.

### Flows of groundwater to and from the Dutch territory

The groundwater stock is affected by several flows, including groundwater flows that run in underground layers/aquifers. Groundwater is exchanged with neighbouring countries Belgium and Germany but no clear data were found in the existing literature or databases to quantify the cross-border groundwater flows, net or gross.

## 9.4 Results for the main elements of the water balance

In this section we present the main results. The first few paragraphs give the results for precipitation, actual evapotranspiration, actual external inflow and of actual outflow of surface water and regionalisation. The later paragraphs look at the quantification of some remaining balance items like imports and exports and after abstractions. The last sections describe the production and discharge of waste water, cooling water and water reuse.

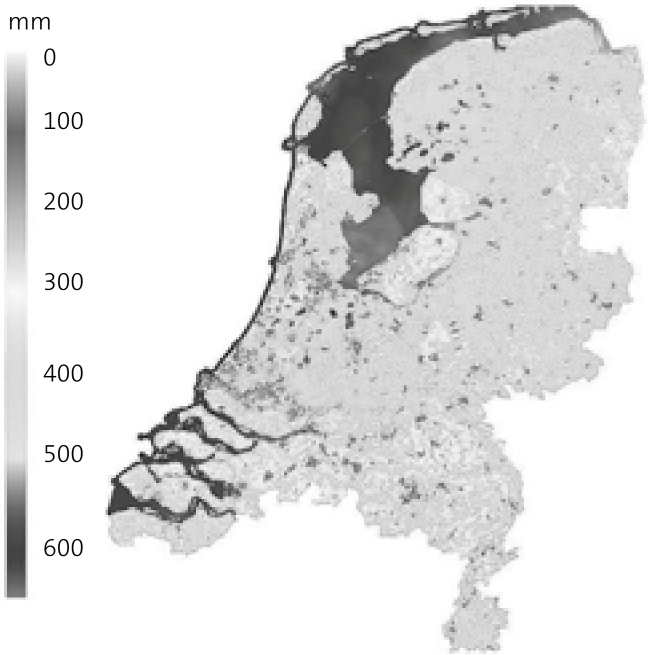
**Precipitation**

In the Netherlands precipitation is caught by the inland land surface and the fresh surface waters. Most of the precipitation for the inland falls on land. In the project, maps have been produced for the Netherlands with a spatial distribution of 1 x 1 km for precipitation during the six months summer period and the three plus three months winter period for 2009. For 2009 the annual precipitation averaged 761 mm over the whole area: 328 mm in summer and 433 mm in the winter periods, a 43 – 57 percent distribution. Such precipitation at an area of 3.72 million hectares, gives an annual incoming (internal) flow of 28.3 billion $m^3$ fresh water for the summer and winter of 2009 for the country as a whole.

**Actual evapotranspiration**

The result of the requested assessment of 'actual evapotranspiration' instead of a quantification partially based upon 'reference crop evapotranspiration' is shown in Figure 9.4.1. It shows a map with spatial distribution of evapotranspiration over the country, during April – September for 2009 based on the remote sensing data. For the winter a similar figure can be generated though with much smaller quantities.

**9.4.1 Actual evapotranspiration in the summer of 2009 (mm/half year)**

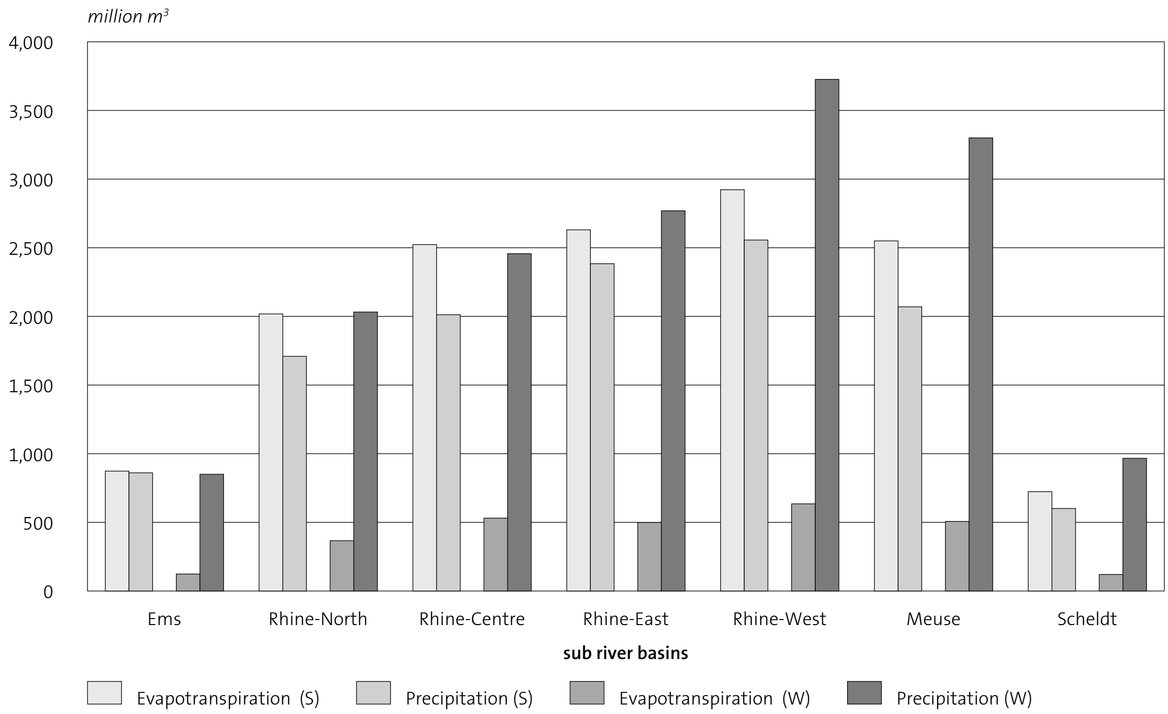



Source: Voogt et al. (2011).

The average annual evaporation that covers both the summer and winter periods, amounted to 142 mm. As transpiration ran up to 316 mm, an average evapotranspiration of 458 mm for 2009 was calculated for the country as a whole. A summer – winter distribution of 383 mm to 75 mm means 84 percent of the 2009 evapotranspiration took place in the six summer months.

An actual evapotranspiration of 458 mm at an area of 3.72 million hectare led to 17.0 billion $m^3$ of fresh water diverted from the country's inland water system in 2009. This compares to 60 percent of the total amount of precipitation in 2009. The remaining 40 percent is principally available for groundwater replenishment. However, in the summer period, the country's evapotranspiration exceeds precipitation by around 17 percent. The volume of evapotranspired fresh water taken from the territory is also allocated to the seven sub river basins (Figure 9.4.2).

**9.4.2 Precipitation and evapotranspiration in winter and summer, 2009**

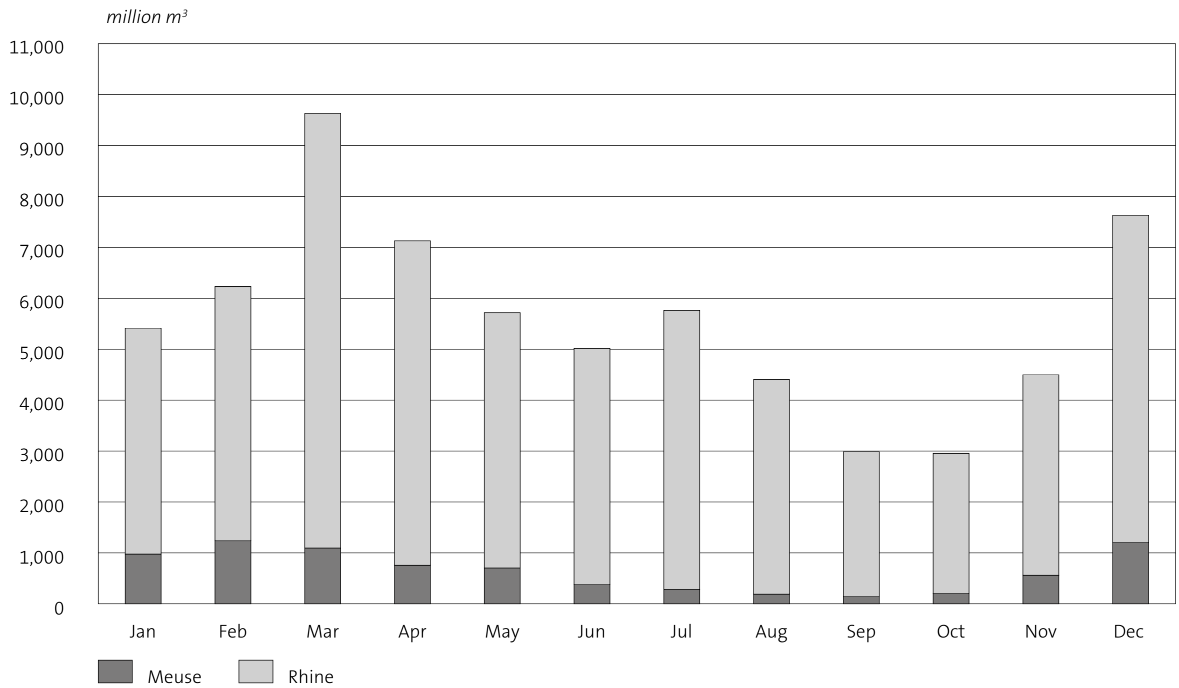



Source: Voogt et al. (2011).

### Actual external inflow of surface water from foreign territory

In the framework of the project, we received data files with daily flow rates of the rivers Meuse and Rhine as well as daily flow rates from 26 small border-crossing waterways, of which 17 situated in the Meuse River Basin and 9 in the Rhine River Basin. As explained, the availability of daily flow rates (in $m^3$/sec) allowed us to make several aggregations. One example is elaborated in Figure 9.4.3. It shows the monthly inflow (in million $m^3$) for the Meuse and the Rhine River Basins. The graph illustrates that from August to November the flow drops sharply due to less rainfall and to less melting water, particularly from the Alps. The flow rate of the river Meuse heavily depends on the rainfall upstream, while the smaller rivers in the Meuse RB district are less sensitive.

### 9.4.3 Monthly riverine inflow into the Netherlands territory, per river basin area, 2009

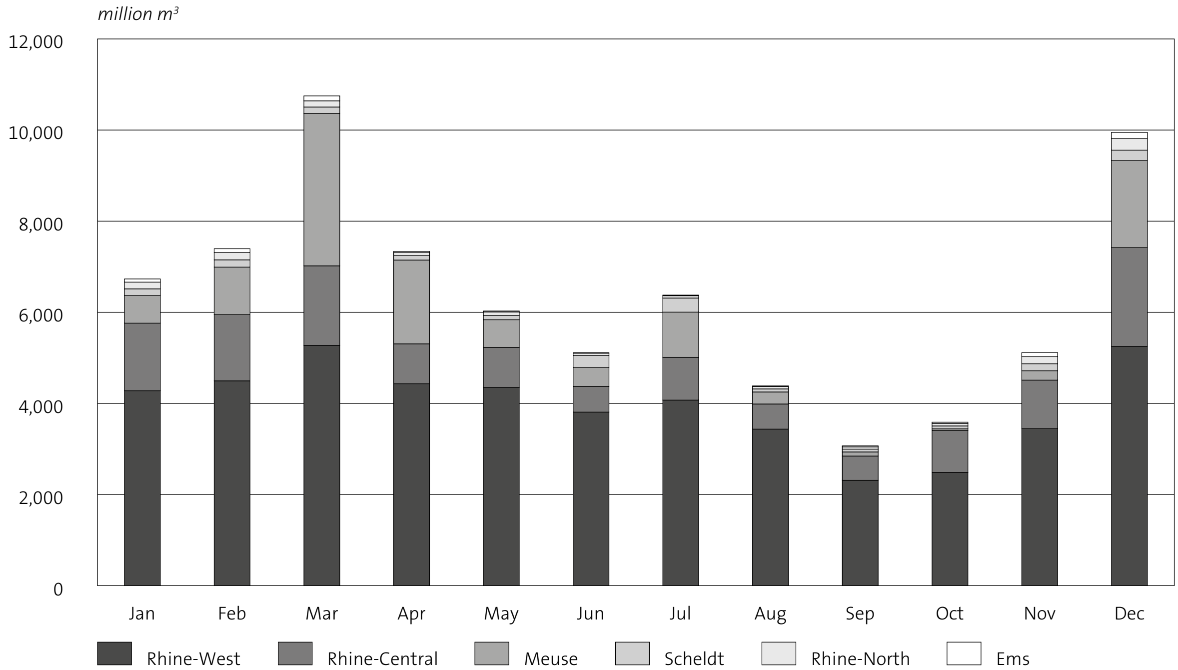



The available data also tells that in 2009, 20 percent of total annual inflow in the Meuse river basin can be attributed to inflow of small rivers. In the summer season from April-September the share of small rivers was nearly 30 percent. The contribution of small rivers in the Rhine river basin is quite limited, as it was just 1 percent.

## Actual outflow of surface water

For the total actual outflow, we also received data files with daily or monthly flow rates from the water management authorities. In total, data on 28 outflow stations were processed. Figure 9.4.4 summarizes the resulting monthly outflow data with a breakdown into (sub-) river basins. The Rhine (-West) delta has by far the largest outflow volume of all (sub-) river basins.

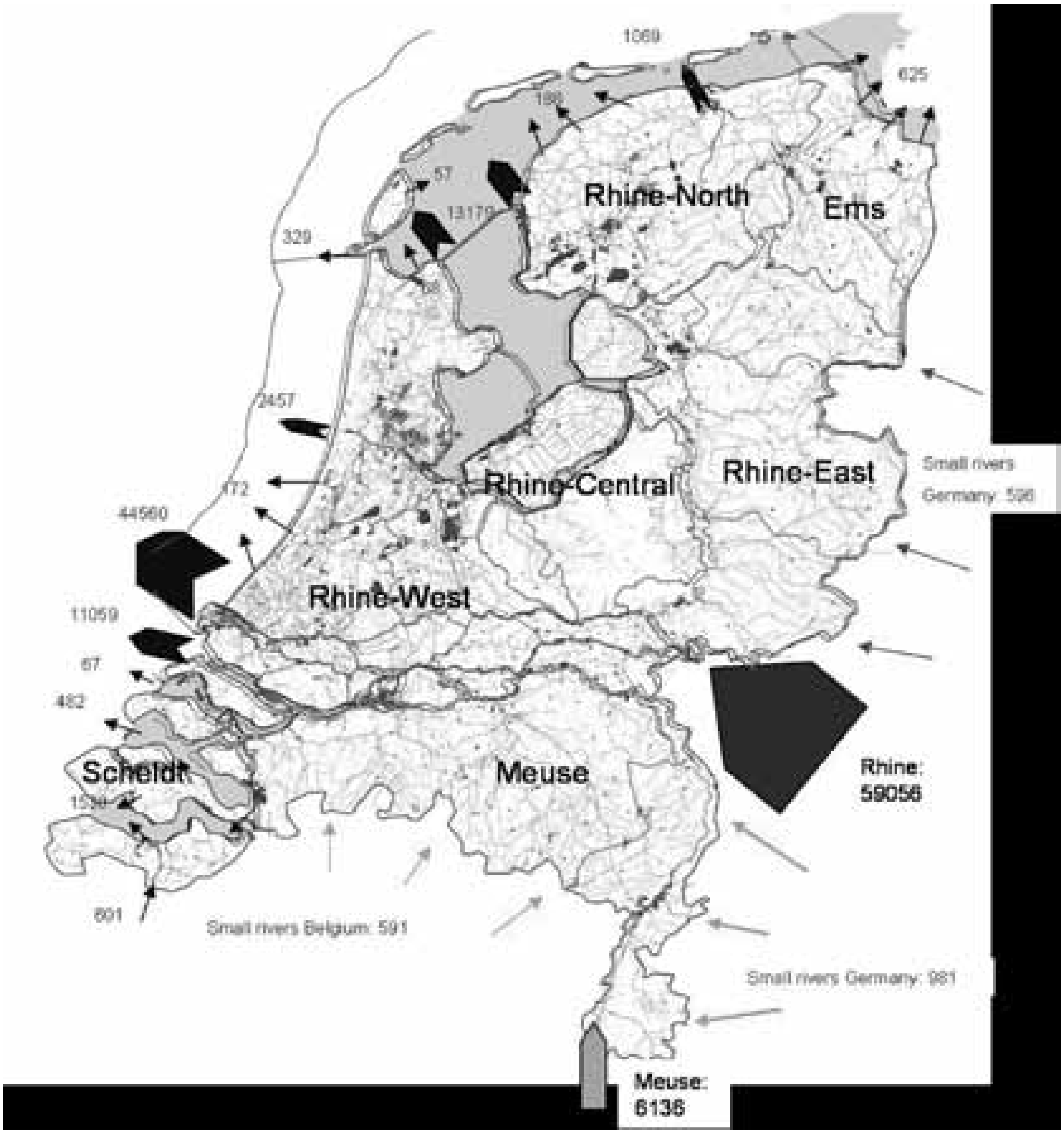
### 9.4.4 Total monthly outflow to sea per (sub-) river basin, 2009




The Dutch delta area is formed by the tail of the large rivers Rhine and Meuse, where specific outlets to the sea can be designated to either one of the sub river basins. The largest outflow is via the 'Nieuwe Waterweg', which is in fact the 'natural outflow' of the River Rhine. The "key" waterworks for managing the outflow of the water that has entered the Dutch territory are the Haringvliet drain-sluices. When opened, all Meuse water is discharged via the Haringvliet sluices, together with a part of the river Rhine flow. When closed, the Meuse river flow is redirected to the Nieuwe Waterweg where it is added to the large 'natural riverine outflow' of the Rhine. These sluices principally enable the water managers to regulate the amounts of water in the whole delta area, with a possibility to redirect Meuse water to the Rhine River Basin or vice versa or to redirect Meuse and Rhine water to the Scheldt region. This facility is designed to protect the south-western part of the Netherlands against salination. This is relevant as salt intrusion is becoming a major concern, particularly in the south-west part of the country.

The two regulated drains of the Lake IJsselmeer (Rhine-Central) form the second largest outflow point of fresh surface water. The outflow from the other sub river basins is limited and consists mainly of small draining sluices or pumping stations which function to evacuate excess water from the polders and the waterways situated on the landside of the dikes. Figure 9.4.5 shows a map of the Netherlands with a synthesis of actual inflow and outflow to and from the Netherlands territory.

### 9.4.5 Actual exernal inflow of surface water and outflow to sea, 2009

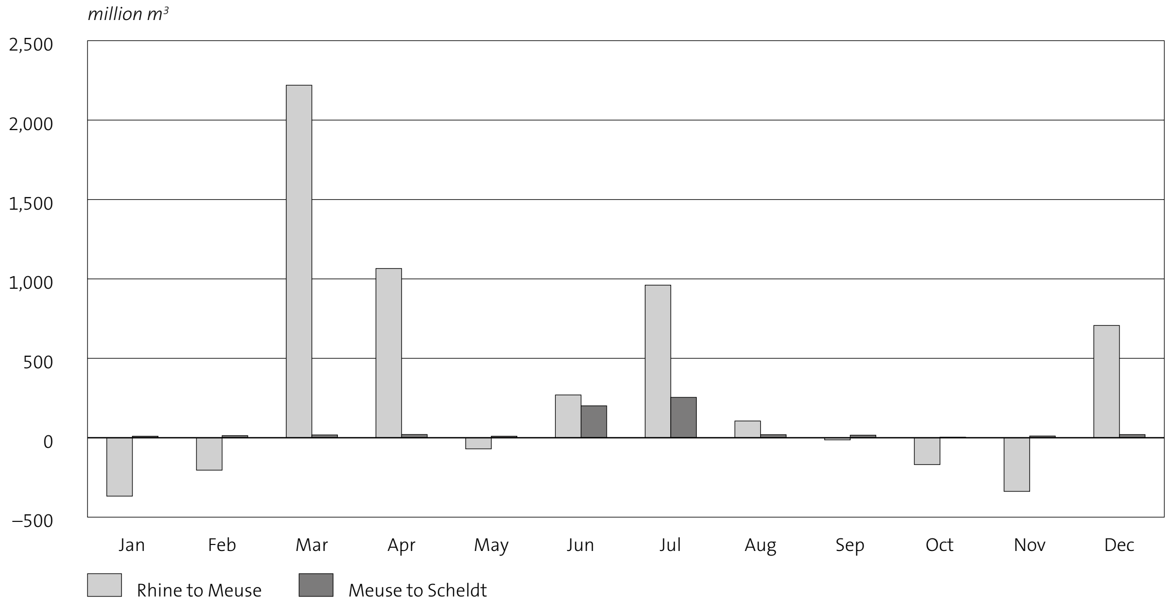



Source: Graveland and Baas (2012).

## Regionalized inflows and outflows of surface water

Figure 9.4.6 visualises the monthly variation in transfers between the river basins of the Rhine and Meuse and between the Meuse and the Scheldt. In some months, when the Haringvliet sluices are mainly closed, water is diverted from the Meuse to the Rhine (the negative values). In months with high river flows, the Haringvliet sluices are opened, allowing more water to flow from the Rhine to the Meuse. Annually a net flow results from Rhine to Meuse. In the summer, more water is diverted from the Meuse region to the Scheldt region in order to combat the salt intrusion into the fresh water system of the Scheldt region.

**9.4.6 Monthly regional flows of fresh surface water, per RBD, 2009**




# 9.5 Synthesis

Table 9.5.1 provides the national water balance for 2009 in terms of annual totals as well as for the summer and winter season separately. The water balance includes the four main flows (precipitation, evapotranspiration, actual inflow and actual outflow), but also calculated values for several indicators[4)], namely:

a) The 'Internal flow', defined as the total volume of river runoff and groundwater generated, in natural conditions, exclusively by precipitation into a territory. The internal flow is equal to precipitation less actual evapotranspiration
b) The 'Total freshwater resources'. According to the definition of the Joint Questionnaire Inland Waters, this is calculated as the 'Internal flow' plus the 'Actual external inflow' into the territory.
c) The 'Recharge into the aquifer', calculated as the total freshwater resources minus the actual outflow to sea.
d) The 'Groundwater available for annual abstraction'. Here the theoretical maximum is given, which is equal to the total recharge (item c).

In addition to the main items of the water balance, Table 9.5.1 provides information on total abstractions and discharges as well as imports and exports of tap water and water contained in products, as calculations and methods explained in section 9.3 and results showed in section 9.4. The purpose of presenting these items is to facilitate comparison with the main items of

4) For definitions of the several balance items and indicators see Graveland and Baas, 2012.

the water balance so as to indicate the relative importance of abstractions, discharges and imports and exports.

In the summer season, actual evapotranspiration exceeds precipitation, with a negative value for internal flow as a result. This is caused by i) excess evaporation from large surface waters, like the Lake IJsselmeer and ii) uptake and transpiration of soil water by vegetation. A negative value for internal flow means that either the existing stocks of surface and ground water at the territory are being used or the stocks will have to be maintained or replenished by external inflow. During the winter season, the internal flow is positive due to higher precipitation volumes and a low level of evapotranspiration. This allows for replenishing the stocks.

### 9.5.1 Water balance for the Netherlands, 2009

| | Year | Summer | Winter |
|---|---|---|---|
| | *million m³* | | |
| 1. Precipitation | 28,294 | 12,193 | 16,101 |
| 2. Actual evapotranspiration | 17,022 | 14,240 | 2,782 |
| **3. Internal Flow = 1 – 2** | **11,273** | **–2,047** | **13,319** |
| 4. Actual external inflow from foreign territory | 67,962 | 31,231 | 36,731 |
| 5. Total actual outflow to sea | 75,839 | 32,311 | 43,530 |
| **6. Total freshwater resources = 3 + 4** | **79,235** | **29,184** | **50,050** |
| 7. Recharge into the Aquifer = 6 – 5 | 3,396 | –3,127 | 6,521 |
| 8. Groundwater available for annual abstraction = 7 (max) | 3,396 | | |
| | | | |
| Abstraction of ground water | 1,011 | | |
| Abstraction of fresh surface water | 10,654 | | |
| Discharges to fresh water | 11,478 | | |
| Discharges to sea | 175 | | |
| Balance abstraction - discharges | 13 | | |
| | | | |
| Imports of tapwater and water in product | 54 | | |
| Exports of tapwater and water in products | 33 | | |

Source: Graveland and Baas (2012).

The outcomes of this balance perfectly illustrate the need to compile not only annual data but also data per season. Annual totals do not explicitly show the precipitation deficit in the summer months and the resulting negative internal flow. Of course, monthly data are even more accurate for identifying water stress situations, but within the scope of the project it was not possible to have monthly data on evapotranspiration. For the country as a whole it can be concluded that in 2009 the annual ground water abstraction is approximately one third of the maximum recharge. This means that in 2009 the use of ground water resources did not exceed the maximum replenishment. Furthermore, total abstractions are somewhat higher than total discharges which is according to expectations. A portion of the abstracted water is consumed or used, for instance in products.

Table 9.5.2 provides a comparison of the data resulting from this study with data compiled in 2010 for the (Eurostat/OECD, 2010) Joint Questionnaire on inland waters. The main differences are the higher precipitation, lower evapotranspiration and higher external inflow. These are mainly because:

1. The total precipitation is calculated more accurately by making use of radar images calibrated by data of numerous precipitation gauging stations. In the old method for the

whole country the average precipitation was used as published by the KNMI (Royal Dutch Meteorological Institute).
2. In this study a reliable estimate is made of the actual evapotranspiration, while in the previous data compilations, data on the ‘reference crop evapotranspiration’ (source: KNMI) were used. The latter value was significantly higher, because the reference crop evapotranspiration is a maximum value for evapotranspiration under circumstances for which the available water does not hamper evapotranspiration. It more or less reflected potential evapotranspiration.
3. For actual external inflow, the quantification of the small contributing rivers is more accurate, resulting in a higher value for the actual external inflow for the country as a whole.

#### 9.5.2 Comparison of results from newly developed method with former methods

| | This study | Reported in ES-JQ 2010 |
|---|---|---|
| | *million m$^3$* | |
| 1. Precipitation | 28,294 | 27,568 |
| 2. Actual evapotranspiration | 17,022 | 23,270 |
| **3. Internal Flow = 1 – 2** | **11,273** | **4,293** |
| 4. Actual external inflow from foreign territory | 67,962 | 65,192 |
| 5. Total actual outflow to sea | 75,839 | 75,839 |
| **6. Total freshwater resources = 3 + 4** | **79,235** | **69,485** |
| 7. Recharge into the Aquifer = 6 – 5 | 3,396 | not reported |
| 8. Groundwater available for annual abstraction = 7 (max) | 3,396 | not reported |

Tables 9.5.3 to 9.5.6 provide the water balance data for the four river basins. The gross exchange of surface water between the national river basins is included in these tables. A few conclusions can be drawn from these tables:
- In the summer, the precipitation deficit varies between the regions: In the Ems regions the deficit is just small (1 percent), while in the Meuse region the deficit is almost 19 percent.
- Actual outflow is relatively large in the Rhine RB, which means that a larger share of the total freshwater resources is evacuated via outflow of surface water, leaving less water for replenishment of ground water resources.
- Within the Scheldt region the internal flow plays an important role in the water balance during the summer season. It shows that precipitation in summer isn’t sufficient to keep fresh water stocks intact. Water managers in such cases will act by operating sluices and drains in such a way that water is transported from the Meuse RB to the Scheldt RB where stocks can be replenished still.
- In the Netherlands and particularly in the western part, ‘polders’ play a major role in water management. The water system in these polders is managed by the water boards. In summer these polders principally rely on the available water (internal flow) generated within the polder via precipitation. However, once evapotranspiration exceeds the water collected from precipitation, there will be a deficit once it isn’t replenished from either the available stock of ground and soil water or via external inflow. All four river basins, though, show such shortages for the whole summer period. For brief periods the deficit may even be severe. Replenishment from external inflowing sources is not always preferred due to a lack of quality, or else cannot be organised.
- In the Meuse RB the seasonal differences in actual external inflow are larger than in the Rhine RB. This can partly be explained by the fact that the Meuse is more rain-fed, while the

Rhine also depends on melting snow and glaciers in the Alps, processes that result in a more continuous water flow even during summer and autumn.

### 9.5.3 Water balance for the Rhine river Basin, 2009

| | Year | Summer | Winter |
|---|---|---|---|
| | *million $m^3$* | | |
| 1. Precipitation | 19,646 | 8,661 | 10,984 |
| 2. Actual evapotranspiration | 12,124 | 10,094 | 2,031 |
| **3. Internal Flow = 1 – 2** | **7,521** | **–1,432** | **8,953** |
| 4. Total actual external inflow | 60,814 | 28,652 | 32,161 |
| 4.1 from foreign territory | 59,652 | 28,569 | 31,083 |
| 4.2 from other national river basin (gross) | 1,161 | 83 | 1,078 |
| 5. Total actual outflow | 67,405 | 29,507 | 37,897 |
| 5.1 to foreign territory | 62,077 | 27,105 | 34,971 |
| 5.2 to other national river basin (gross) | 5,328 | 2,402 | 2,926 |
| **6. Total freshwater resources = 3 + 4** | **68,335** | **27,220** | **41,115** |
| 7. Recharge into the Aquifer = 6 – 5 | 930 | –2,286 | 3,217 |
| 8. Groundwater available for annual abstraction = 7 (max) | 930 | | |
| | | | |
| Abstraction of ground water | 611 | | |
| Abstraction of fresh surface water | 6,252 | | |
| Discharges to fresh water | 6,915 | | |
| Discharges to sea | 114 | | |
| Balance abstraction - discharges | –166 | | |

### 9.5.4 Water balance for the Ems River Basin, 2009

| | Year | Summer | Winter |
|---|---|---|---|
| | *million $m^3$* | | |
| 1. Precipitation | 1,711 | 861 | 850 |
| 2. Actual evapotranspiration | 997 | 873 | 124 |
| **3. Internal Flow = 1 – 2** | **714** | **–13** | **726** |
| 4. Total actual external inflow | 0 | 0 | 0 |
| 4.1 from foreign territory | 0 | 0 | 0 |
| 4.2 from other national river basin (gross) | 0 | 0 | 0 |
| 5. Total actual outflow | 625 | 111 | 516 |
| 5.1 to foreign territory | 625 | 111 | 516 |
| 5.2 to other national river basin (gross) | 0 | 0 | 0 |
| **6. Total freshwater resources = 3 + 4** | **714** | **–13** | **726** |
| 7. Recharge into the Aquifer = 6 – 5 | 89 | –124 | 211 |
| 8. Groundwater available for annual abstraction = 7 (max) | 89 | | |
| | | | |
| Abstraction of ground water | 42 | | |
| Abstraction of fresh surface water | 49 | | |
| Discharges to fresh water | 106 | | |
| Discharges to sea | 1 | | |
| Balance abstraction - discharges | –16 | | |

### 9.5.5 Water balance for the Meuse River Basin, 2009

| | Year | Summer | Winter |
|---|---|---|---|
| | *million m³* | | |
| 1. Precipitation | 5,370 | 2,070 | 3,300 |
| 2. Actual evapotranspiration | 3,057 | 2,550 | 507 |
| **3. Internal Flow = 1 – 2** | **2,314** | **–480** | **2,793** |
| 4. Total actual external inflow | 13,037 | 4,843 | 8,194 |
| 4.1 from foreign territory | 7,709 | 2,441 | 5,268 |
| 4.2 from other national river basin (gross) | 5,328 | 2,402 | 2,926 |
| 5. Total actual outflow | 13,109 | 4,809 | 8,300 |
| 5.1 to foreign territory | 11,351 | 4,205 | 7,146 |
| 5.2 to other national river basin (gross) | 1,758 | 604 | 1,154 |
| **6. Total freshwater resources = 3 + 4** | **15,351** | **4,363** | **10,988** |
| 7. Recharge into the Aquifer = 6 – 5 | 2,241 | –446 | 2,688 |
| 8. Groundwater available for annual abstraction = 7 (max) | 2,241 | | |
| | | | |
| Abstraction of ground water | 334 | | |
| Abstraction of fresh surface water | 3,901 | | |
| Discharges to fresh water | 3,942 | | |
| Discharges to sea | 0 | | |
| Balance abstraction - discharges | 293 | | |

### 9.5.6 Water balance for the Scheldt River Basin, 2009

| | Year | Summer | Winter |
|---|---|---|---|
| | *million m³* | | |
| 1. Precipitation | 1,568 | 601 | 967 |
| 2. Actual evapotranspiration | 844 | 723 | 120 |
| **3. Internal Flow = 1 – 2** | **724** | **–122** | **846** |
| 4. Total actual external inflow | 1,198 | 742 | 456 |
| 4.1 from foreign territory | 601 | 221 | 380 |
| 4.2 from other national river basin (gross) | 597 | 521 | 76 |
| 5. Total actual outflow | 1,787 | 890 | 897 |
| 5.1 to foreign territory | 1,787 | 890 | 897 |
| 5.2 to other national river basin (gross) | 0 | 0 | 0 |
| **6. Total freshwater resources = 3 + 4** | **1,922** | **620** | **1,302** |
| 7. Recharge into the Aquifer = 6 – 5 | 135 | –270 | 405 |
| 8. Groundwater available for annual abstraction = 7 (max) | 135 | | |
| | | | |
| Abstraction of ground water | 24 | | |
| Abstraction of fresh surface water | 453 | | |
| Discharges to fresh water | 515 | | |
| Discharges to sea | 60 | | |
| Balance abstraction - discharges | –98 | | |

# Climate change expenditure of Dutch government

# 10

# Climate change expenditure of Dutch government

# 10.1 Introduction

Nowadays climate change is widely recognized to be a major global problem that requires internationally coordinated anticipation. This recognition is supported within the scientific community, where there is consensus on the significant impact on the environment of economic and socio-economic factors. Since the beginning of the 20th century there have been accelerating emissions of carbon dioxide, methane, and other greenhouse gases. This has caused both an increase in average global temperature by about 0.8°C and altered global precipitation patterns (IPCC, 2007). Furthermore, there are indications that since 1950, around the globe, weather patterns have become more extreme (IPCC, 2011). These developments are also affecting economic activities throughout the world. Moreover, the impact of climate change on society, the economy and the environment is likely to increase further, while it remains difficult to measure the impact of policy measures. Therefore, there is a high demand for statistics that allow policymakers to both monitor climate change developments and observe the effectiveness of their policy measures (UNEP, 2008; Parry et al., 2009).

An important statistic that gives policymakers an indication of progress in climate change measures is the expenditure on climate change mitigation and adaptation. Moreover, countries are required to report government expenditures for adaptation to climate change as part of the country level reporting to the United Nations Framework Convention on Climate Change (UNFCCC), in compliance with the Kyoto Protocol. However, data on climate change mitigation and adaptation expenditures are currently missing in the set of basic (environmental) statistics (i.e. emission inventories, energy balances, business statistics etc.), government finance statistics and in the environmental accounts. A couple of studies present estimates on the costs of climate change adaptation. However, more quantified information on the costs and benefits of adaptation based on a more harmonized methodology is necessary (UNFCCC, 2007;2010; UN et. al., 2009). Therefore, in this chapter we explore and assess the possibilities of constructing these statistics further while keeping aspects like statistical harmonisation and standardisation in mind. The outline is as follows. Section 10.2 contains definitions of adaptation and mitigation, and discusses some practical problems in the measurement of adaptation expenditures. This section further discusses the ensuing choice of flood control expenditure as a valid proxy. Section 10.3 provides an inventarisation of possible data sources for adaptation/flood control and mitigation measures and related expenditures. The results of the study are described in section 10.4. The report ends up with conclusions in section 10.5. This chapter is the summary of a more extensive report on climate change expenditure by Statistics Netherlands (Geloof and de Kruik, 2012).

# 10.2 Definitions

**Definition of adaptation and of mitigation measures**

In this study, the following definitions for mitigation and adaptation measures related to climate change are applied (UNEP, 2008):

*Mitigation measures are anthropogenic interventions to reduce the sources or enhance the sinks of greenhouse gases.*

*Adaptation measures that deal with the consequences of climate change are responses to actual or expected climatic stimuli or responses to the effects of these stimuli, and they can both be adjustments to natural as well as human systems.*

When addressing the consequences of climate change only the anthropogenic adaptations are taken into account. We do not account for animals and plants that change their habits in response to climate change, unless humans adapt to these changes in animal behaviour, than we do take these human adaptations into account. Apart from negative consequences like floods and hurricanes, climate change can also create beneficial opportunities for technological innovation, investments in infrastructure, agriculture and tourism. However, assessing these benefits is outside the scope of this research.

**Expenditure definition**

As defined in the IPCC Fourth Assessment Report, adaptation and mitigation costs are the costs of planning, preparing, facilitating, and implementing adaptation and mitigation measures, including transition costs. This study only considers the monetary aspect (within a budgetary framework) of adaptation and mitigation measures. In a next step of (economic) assessments it could be desirable to consider non-monetary costs, such as reduced biodiversity, to the national economy as a whole (UNFCCC, 2010). In this paragraph we will first define expenditure within a SNA and SEEA context.

According to SEEA environmental protection expenditure (EPE) is the sum of capital and current expenditure carried out in order to protect the environment (Eurostat, 2008; UN et al., 2012). In a national account perspective, economic activities and their related transactions are analysed from both the supply and use side, while it is placed in a monetary context. Environmental protection accounts (EPEA) are strictly conforming to the national accounts and describe environmental protection expenditures according to all their sub-costs. This implies the aggregation of EPE on services, total EPE and the EPE per institutional sector.

EPE includes:

- The domestic use of environmental protection products (goods and services). These environmental protection products are either services or connected or adapted products. The use is either final use or intermediate consumption.

- The domestic gross capital formation for environmental protection.
- Those transfers for EP that are not reflected in the expenditure recorded under the two previous categories.

The focus in this research is on operational costs, investments in fixed tangible assets and environmental transfers. The operational costs will be split into operating expenses and personnel costs where possible. To prevent double counting, subsidies that flow between government agencies are not included in the total expenditure. This is because government agencies that transfer money among themselves do not spend it directly on climate change measures. Only governmental subsidies that flow towards individuals and companies are included in the study.

**Primary purpose criterion and climatic share, a practical solution**

Mitigation and especially adaptation expenditures can have multiple purposes. For instance, expenditures on climate-proof houses (that float when water fluctuates) can be considered adaptation expenditures, but their only real goal is to provide housing services, while the climate change adaptation is a mere side-effect. It therefore provides a biased picture when we would appoint all such expenditures to climate change mitigation and adaptation. Therefore, we choose to apply a slightly alternative version of the primary purpose criterion. Under the 'pure' primary purpose criterion, only expenditures for which the main goal is climate change mitigation or adaptation is considered a valid expenditure. However, as it is not always clear what the main purpose of an expenditure is, we choose to include all expenditures that have as part of their legal considerations the adaptation or mitigation to climate change. Here the legal considerations are part of the documents that accompany and motivate the expenditures. Similar solutions are applied in the compilation of statistics such as environmental protection expenditure and resource use and management expenditure (e.g. Graveland et al., 2011).

This approach has an important implication, namely all flood protection expenditures for which part is regular maintenance, are fully assigned as mitigation and adaptation expenditure. In practice this implies that (in the Netherlands) all adaptation expenditure is determined by expenditure on flood control. However, climate change adaptation expenditures should ideally also include other areas such as health, agriculture, tourism, nature preservation etc., but for these categories we have no data and are therefore beyond the scope of this research.

# 10.3 Methods and data sources

**Main data sources**

The annual governmental financial report contains all government expenditure on climate change measures. The level of aggregation differs between government agencies. Therefore, in order to zoom in on the details of these expenditures, we consult the various types of budget reports, provided by both the central and local governments. Additionally, for some details, data from a set of standard questionnaires that Statistics Netherlands sends to various government agencies are consulted. Data on flood control expenditure by water boards are provided by the Dutch Association of Water Boards and are available over the period 2007–2010. The same period holds for central government mitigation data. Mitigation data as provided by provinces are available over the period 2008–2010, while municipalities provide data over 2009 and 2010.

#### State government

As a first step, we examined the annual reports of relevant ministries, and assigned each policy article to flood control or mitigation. When it was not possible to regard an item as flood control or mitigation specifically, the expenditure is divided fifty-fifty Furthermore, the aim is to construct data that are consistent with the national accounts. Therefore, data from the annual reports are reconstructed such that they are consistent with the data on governmental spending as presented in the national accounts.

#### Water boards

The Dutch water boards provide publicly available data on a highly aggregated level. Unfortunately, with this data it is not possible to construct adaptation expenditure data that are consistent with the national accounts. Therefore, The Association of Water Boards was so kind to provide Statistics Netherlands with a more detailed set of data on operational costs. Unfortunately, they defined the operational costs as total costs minus subsidies, which implies that detailed subsidy data are not available. Moreover, this way the data does not provide us with the total flood control expenditure.

#### Provinces

Statistics Netherlands receives data from the Dutch provinces on a regular base. This data is also used in the construction of the national accounts and therefore, in the light of consistency, well suited for this study. Most important, the Dutch provinces provide monetary data on the operating costs of dikes, which serve as (under)estimation of flood control expenditures. Data on 2007 are sparse but from 2008 onwards it was possible to obtain and analyze all annual reports that contained data on flood control expenditure. These reports do not only contain the expenditure on dikes, but also, for instance, the expenditure on control of muskrat and water storage. Combining these reports with national accounts data provides flood control data that are consistent with the national accounts. However, for mitigation expenditures data are retrieved directly from the annual provincial reports and are not consistent with the national accounts.

#### Municipalities

Because flood control is mainly conducted by provinces and water boards, the registration of flood control expenditure has a low priority in municipalities. However, at Statistics Netherlands some data on operational costs for dikes are available over the period 2007–2009. For 2010, budget estimates are available. From these data we can construct estimates on the amount of joint spending by municipalities on flood control.

Data on climate change mitigation expenditures by municipalities are not directly available at Statistics Netherlands. However, as of 2009 there is the Stimulating Local Climate Initiatives (SLOK) scheme. This scheme implies that municipals can apply for state funds to finance mitigation projects. The annual report of the municipal fund provides the total expenditure in SLOK funded mitigation projects. According to AgentschapNL (www.agentschapnl.nl), about fifty percent (at most) of the mitigations costs on the municipal level is paid for by a SLOK subsidy. Unfortunately, there are no data sources for the remaining spending on mitigation by municipalities.

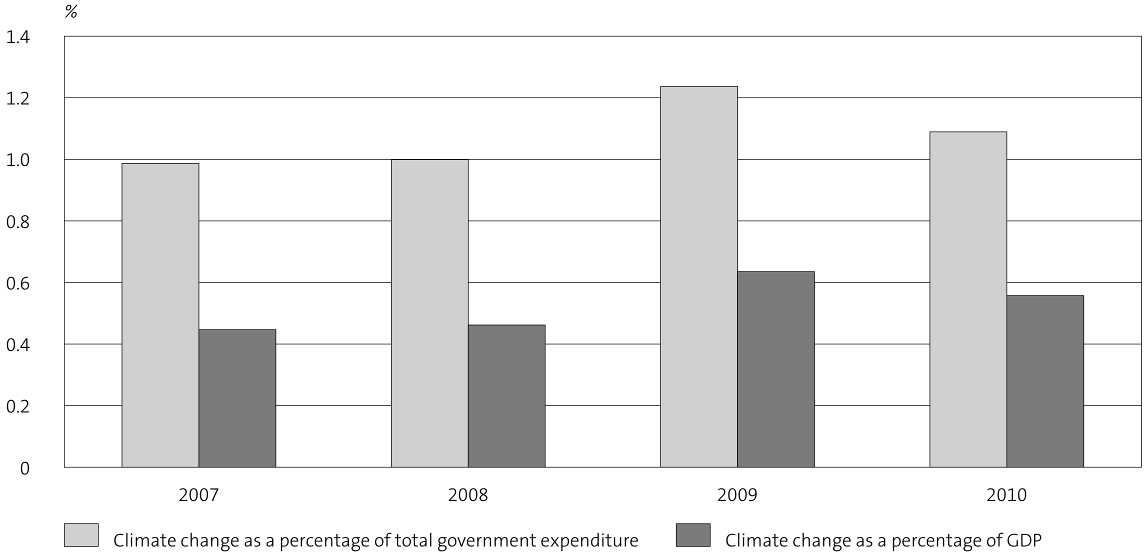
# 10.4 Results

**Overview**

The expenditure on climate change measures has increased from 2.5 billion euro in 2007 to almost 3.3 billion euro in 2010. As percentage of government spending (State government and local), there is an increase from 0.99 percent in 2007 to 1.09 percent in 2010. Compared to the Dutch GDP, in 2007 it was 0.45 percent while in 2010 this increased to 0.56 percent. The two main institutional players are the State government and the water boards. Together, they are responsible for more than 90 percent of total spending on flood control and mitigation. The focus of the State government is on mitigation, while the water boards focus on flood control. The most important State government actors are the Ministries of Economic Affairs (EZ), Agriculture, Nature and Food Quality (LNV), Housing, Spatial ordering and Environment (VROM), Transport and Water Management (V&W), the Infrastructure Fund and the Wadden Fund.[1)]

[1)] From January 2011 there has been a change in the composition of the ministries. EZ and LNV form the new Ministry of Economy, Agriculture & Innovation (EL & I). VROM and V&W are covered by the new Department Infrastructure & Environment (I & M). The most recent year in this research is 2010, therefore, use is made of the old nomenclature.

### 10.4.1 Development of climate expenditure




Source: annual reports ministries, provinces and municipal fund, Association of water boards.

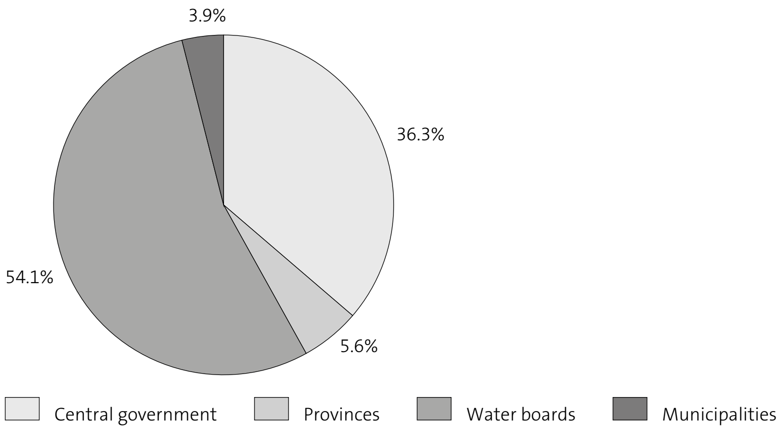
Total climate change expenditure as a percentage of GDP (current prices) showed a strong increase in 2009. However, this provides a deceiving signal, as the reason for this increase is twofold. First, there has been an amended registration in 2009, thereafter an increased number of expenditures became part of the definition of mitigation and adaptation expenditures. Second, due to the global economic crisis, the Dutch GDP decreased significantly, leading to a denominator effect.

## Flood Control

Based on the annual reports, flood control expenditure can roughly be classified into three categories[2]. These categories are 1) maintenance of dikes and coastal defense, 2) general programs and research and 3) other expenditures related to water safety. The latter category includes costs such as muskrat control and water storage spending. In 2010, 0.34 percent of GDP, or nearly 2 billion euro, was spent on flood control.

2) These categories are not based on an official classification.

**10.4.2 Allocation of costs for flood control to different government organizations, 2010**




Source: annual reports ministries, provinces and municipal fund, Association of water boards.

The State government spent over 726 million euro on flood control in 2010. About two third was designated to the maintenance of dikes and coastal defense, including the Delta Works. Another major category is "research and projects". Only 0.5 percent of the money was spent on personnel costs.

A large amount of money in the category "research and projects" is spent on the programs 'Room for the River' (in Dutch: Ruimte voor de Rivier) and 'River Meuse' (in Dutch: Maaswerken). The first program focuses on facilitating the outflow of rivers in order to increase security to protect nearly four million people against flooding. In about thirty sub-projects different locations are addressed. The program 'River Meuse' focuses on a natural and better navigable Meuse and protection against flooding of this river. In about 52 sub-projects, nearly 222 km Meuse has been secured. A third important and well-known program that falls under this category of expenditure is the program 'Knowledge for Climate Research' (formerly Climate and Space). 'Knowledge for Climate Research' is a research program for the development of knowledge and services that makes it possible to climate proof the Netherlands. This program has the aim to develop knowledge that is useful in the assessment of investments in spatial planning and infrastructure over the coming twenty years, both in terms of their resistance to climate change, and for making changes where necessary. (Source: http://knowledgeforclimate.climateresearchnetherlands.nl/). There are also several other programs included in this category, such as the 'High Water Protection Program' (Hoogwaterbeschermingsprogramma), 'Weak Links of the Coast' (Zwakke schakels kust) and 'Living with water' (Leven met water).

The provinces also have the focus on dikes and coastal defense. Like the State government, they also have a lot of expenditure for other measures of water safety than dikes, but research is considerably less important than it is for the State government. The provinces have especially expenditures for practical measures. Most of these expenditures go to the personnel costs of muskrat control. Collectively, the provinces spent almost 113 million euro on flood control in 2010. In the same year municipalities spent 79 million on dikes and water safety.[3] There are no data

[3] This is a preliminary figure based on the municipal budgets for 2010.

available on other measures of flood control by the municipalities, but these expenditures are likely to be low, as flood control is not core business for municipalities.

The water boards are the main actors in the field of flood control. In total they spent nearly 1.1 billion euro in 2010. This amount goes entirely to the maintenance of dikes and flood protection.[4] Water boards are responsible for the upkeep of regional barriers. Slightly more than half of the budget was spent on investments in reinforcements of dikes and pumps. The rest of the budget consisted of operating costs, including personnel costs.

### Mitigation

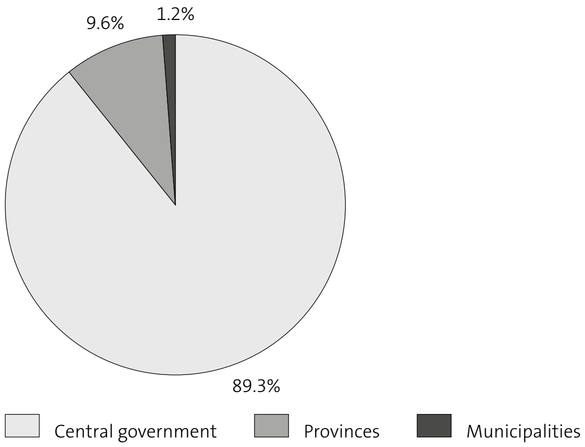
Mitigation in the Netherlands represents a smaller part of total expenditures on climate change, as compared to flood control. In 2010, 0.22 percent of GDP was spent on mitigation, which equates to almost 1.3 billion euro. Like with flood control, the State government is responsible for nearly 90 percent of all mitigation expenditure. The measures are diverse, i.e.:

- General climate policy. This is a very wide area. The most important expenditures are for stimulating energy saving and environment-friendly building.
- International / Kyoto: These are expenditures related to joint implementation and the clean development mechanism projects which are financed by the State government in order to comply with the agreements from the Kyoto protocol.
- Projects / programs / research: This category includes the financing of the Dutch research center for renewable energy (ECN) and projects of AgentschapNL (formerly SenterNovem) as well as projects for underground storage of $CO_2$ for example.
- Horticulture: stimulation programs for horticulture to invest in renewable energy.
- Subsidies: subsidies and schemes to promote energy saving and reduce greenhouse gas emissions, such as the $CO_2$ reduction plan and the renewable energy subsidies (MEP, SDE[5]). Subsidy flows from one government agency to another to finance climate costs are excluded, only the flows towards households and companies are included.
- Mobility: examples in the context of mitigation are stimulation the use of natural gas as fuel instead of petrol, green seats in the aviation and 'New Driving' (in Dutch: Het Nieuwe Rijden).
- Renewable energy sources. This includes, for instance, expenditures on wind and solar energy.

The category 'subsidies' includes measures that provide fiscal advantages for individuals and companies. These fiscal investment grants imply there is a reduction in government revenues. This reduction could be considered as costs, but these are not included here. The amounts of subsidies in this project are only the sum of actual government expenditures.

4) The figures of the water boards are difficult to classify. For this reason, everything is allocated to flood protection and dikes.
5) The subsidy SDE (In Dutch: stimulering duurzame energie) has been ended in December 2010 and replaced in 2011 by the subsidy SDE+.

**10.4.3 Allocation mitigation expenditure to government agencies, 2010**




Source: annual reports ministries, provinces and municipal fund.

In 2010, nearly three-quarter of the mitigation State government budget was spent on subsidies. This is almost 836 million euro. By far the largest part went to the Ministerial Regulation Environmental Quality Electricity Production (MEP), but also the contribution to the Dutch Energy Research Foundation (ECN) and the Energy Research Grants scheme (EOS) were significant expenditures.[6)] This latter scheme was discontinued in 2011. The remaining quarter of the mitigation budget was mainly spent within the categories of general climate policy and mobility. Note that expenditures directly related to European and international climate policies are rather low in spite of the legislation, policy objectives and international agreements the Netherlands should fulfill. Just less than 2 percent was spent on personnel costs.

Provinces spent their 122 million mitigation budget in 2010 almost entirely on 'general climate policy'. The picture here is probably biased because of aggregated reporting of some provinces. Costs are quickly justified under items such as climate policy or energy policy without specifying them. This does not alter the fact that provinces indeed spend a large sum of money on general climate policy. Additionally, provinces spend a considerable amount of money on projects and research in the area of mitigation. It is not possible to specify these projects, because in the annual reports all the provinces call this 'projects related to climate change'. Personnel costs are often hidden in the items totals and therefore difficult to determine.

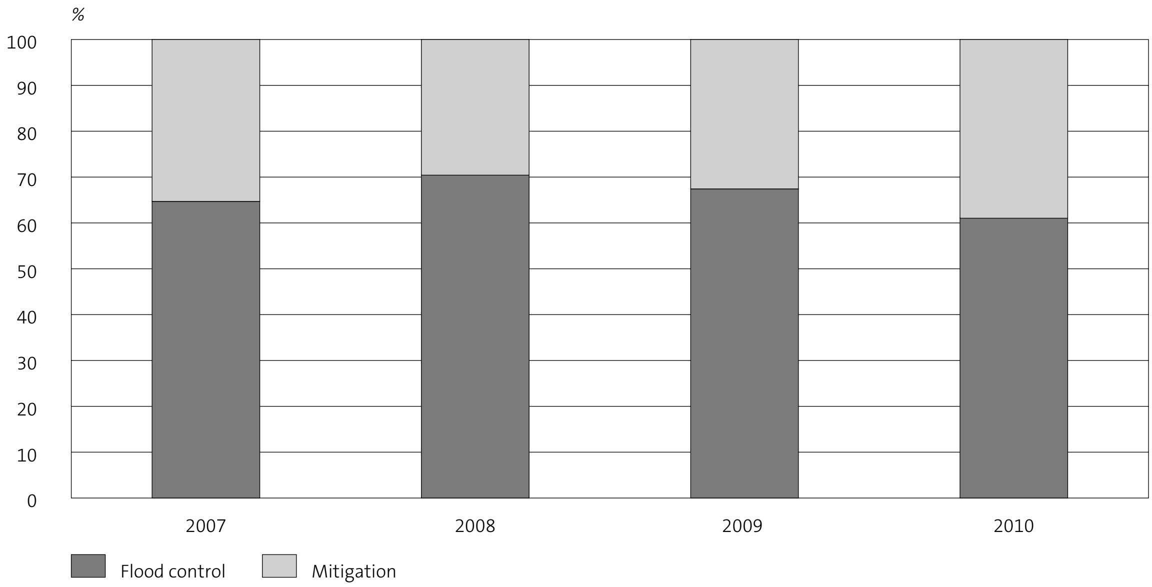
The mitigation expenditures of municipalities are based on data from the Municipal Fund. Under the SLOK scheme in 2010 over 15 million euro was spent out of the Municipal Fund. This is less than half of all municipal mitigation costs, as fifty percent is the maximum coverage of the SLOK scheme. Further information on mitigation expenditures of municipalities is not available. Therefore, the overall picture is incomplete.

6) These flows of money exist already for a long time, even before climate change was a hot topic. In this study energy policy is taken into account in a broader sense, so the expenditures of mitigation include these two flows.

### Comparison of flood control and mitigation expenditure

In the Netherlands the government expenditures on flood control are higher than spending on climate mitigation. Nearly sixty percent of expenditure in the context of climate change is spent on flood control. Water boards are the main contributor. Both the State government and provinces focus on mitigation. Yet a shift in flood control responsibilities is visible. Water boards are becoming relatively less dominant, as the provinces took over some of their tasks. This is due to the political desire for less administrative layers. Nevertheless, the proportion of the water boards in the total spending on flood control in 2010 is still over 54 percent, while in 2007 this was over 61 percent. Over the years, mitigation expenditure of local government agencies have become more important, although this has partly an administrative cause, as over the years more extensive data on the local level has become available. However, this effect of additional data in later years is marginal. The main reason of the increased spending is the increased effort by local government agencies to reduce greenhouse gas emissions.

**10.4.4 Ratio of flood control and mitigation**




Source: annual reports ministries, provinces and municipal fund, Association of water boards.

The expenditures on climate change measures can be divided into a number of different types. Table 10.4.5 to Table 10.4.7 below present the different types of measures, both for the central as well as the local government agencies. The personnel costs of the State government are listed separately, while for local government agencies this category is not available, so personnel costs are included in the other types.

## 10.4.5 State government expenditure by measure

| | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|
| | *million euro* | | | |
| **Flood control** | | | | |
| Dikes/Flood protection | 289.6 | 406.1 | 587.3 | 492.4 |
| Other measures of water safety | 10.1 | 13.2 | 13.1 | 16.6 |
| Projects / programs / research flood control | 162.0 | 160.6 | 207.3 | 207.6 |
| Other measures of flood control | 6.1 | 6.4 | 10.2 | 6.3 |
| Personnel costs | 7.8 | 2.8 | 3.1 | 3.9 |
| Flood control total | **475.6** | **589.1** | **821.0** | **726.8** |
| **Mitigation** | | | | |
| Climate policy / Energy saving | 52.3 | 51.4 | 63.7 | 97.5 |
| International / Kyoto | 35.1 | 49.5 | 61.2 | 28.6 |
| Projects / programs / research mitigation | 22.2 | 22.5 | 18.3 | 16.6 |
| Horticulture | 9.6 | 20.1 | 24.1 | 19.1 |
| Subsidies | 602.2 | 496.2 | 810.6 | 835.8 |
| Mobility | 163.1 | 96.5 | 75.9 | 85.7 |
| Alternative energy sources | – | 1.1 | 2.1 | 33.0 |
| Temporarily measures | – | – | – | 3.4 |
| Personnel costs | 17.4 | 19.4 | 20.8 | 21.8 |
| Mitigation total | **901.9** | **756.6** | **1,076.7** | **1,141.6** |

Source: annual reports of ministries.

## 10.4.6 Provincial expenditure by measure

| | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|
| | *million euro* | | | |
| **Flood control** | | | | |
| Dikes/Flood protection | 85.8 | 71.5 | 85.6 | 87.4 |
| Coastal Vision | – | 1.3 | 1.4 | 1.8 |
| Other measures of water safety | – | 22.9 | 27.8 | 22.6 |
| Projects / programs / research flood control | – | 2.9 | 3.5 | 1.1 |
| Flood control total | **85.8** | **98.6** | **118.3** | **112.9** |
| **Mitigation** | – | 0.0 | 0.0 | 0.0 |
| Climate policy / Energy saving | – | 52.9 | 86.8 | 107.9 |
| Projects / programs / research mitigation | – | 2.9 | 4.5 | 10.9 |
| Horticulture | – | – | 0.1 | 0.6 |
| Subsidies | – | 0.5 | 0.8 | 2.4 |
| Mobility | – | 0.2 | 0.1 | 0.2 |
| Alternative energy sources | – | 0.1 | 0.2 | 0.3 |
| Mitigation total | **0.0** | **56.6** | **92.5** | **122.2** |

Source: annual reports of provinces.

### 10.4.7 Expenditure of municipalities and water boards

| | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|
| | *million euro* | | | |
| **Flood control municipalities** | | | | |
| Dikes/Water protection | 77.0 | 80.0 | 89.0 | 79.0 |
| **Flood control water boards** | | | | |
| Dikes/Water protection | 1,014.1 | 1,166.0 | 1,426.8 | 1,083.8 |
| Flood control total | **1,091.1** | **1,246.0** | **1,515.8** | **1,162.8** |
| **Mitigation municipalities** | | | | |
| Climate policy / Energy saving | – | – | 15.9 | 15.2 |
| Mitigation total | **–** | **–** | **15.9** | **15.2** |

Source: annual reports of municipal fund, data of Association of water boards.

# 10.5 Conclusions

In the Netherlands, policy and decision makers desire an annual overview of the expenditures on climate change measures on a high level of detail, preferably as soon as possible. This is illustrated by questions in the Dutch parliament and discussions between Statistics Netherlands and the National Audit Office. We conclude that in current times, Statistics Netherlands is able to provide part of this desired information. However, in order to exalt the full picture, more detailed data is required. For instance, beside measures of expenditure on the maintenance of dikes and muskrat control, more of such detailed expenditure information would allow for improvements. Finally, the use of investment data on the level of State government and provinces, such as investment in windmills, might lead to improved statistics.

On the positive side, Statistics Netherlands is able to provide some decent quality data on climate change expenditure, albeit on an aggregated level. Altogether we conclude that in order to collect better statistics on Dutch climate change expenditure, it is important to improve the level of detail in the available data sources.

Finally, it should be emphasized that the data that are currently available does not allow us to distinct expenditure that is aimed solely at climate change from expenditure that is aimed at climate change only for a small bit. Nevertheless, many policy makers (e.g. political parties, National Audit Office) have already indicated that the results of this study are a welcome supplement to their own research activities and decision making.

# Towards water quality accounts

# 11

# Towards water quality accounts

# 11.1 Introduction

Water quality accounts provide a description of water resources in quantitative and qualitative terms for a country as a whole or at a sub-national level, in such a way that different types of water resources (rivers, lakes, etc.) can be compared, for instance in terms of volume or surface area. Water quality accounting is a relatively undeveloped area of environmental accounting. The SEEAW (System of Environmental-Economic Accounting for Water) (UN, 2012a) contains a chapter on water quality accounts, but considers these accounts experimental as few internationally accepted best practices have emerged so far. Although there are various statistics on water quality[1], water quality accounts i.e. the integration of such data with economic and social statistics, would allow for a comprehensive understanding of the interaction between the economy and the environment.

Statistics Netherlands has a long tradition in water accounting. The NAMWA (National Accounting Matrix including Water Accounts) (Van Rossum et al, 2010) consists of three types of accounts: water use, emissions to water, and regional water accounts. Water use includes abstraction of ground and surface water, (tap) water use and (tap) water use intensity. Emissions to water include heavy metals and nutrients. The regional water accounts show the regional differences in water use and emissions for the different river basins. Recently a water balance has been developed (Graveland and Baas, 2012). Eventually, water quality accounts could be an addition to the Dutch water accounts.

This feasibility study was undertaken in the context of the CREEA (Compiling and Refining Environmental and Economic Accounts) project, which has a work package on water accounts. It entailed a stock-taking of possible data sources, an articulation of methodology, and compilation of pilot accounts. The results presented in this chapter should be considered experimental, but will hopefully facilitate a dialogue with policy makers and interested parties.

In order to compile accounts that may be a relevant source of information for policy makers, we have decided to take the Water Framework Directive (WFD) as a point of departure for this research. This has the additional advantage that it provides an answer to various contentious issues in water quality accounting, most importantly the definition of quality classes. The scope of the research was restricted to surface water.

The outline of this chapter is as follows. In Section 11.2 we will provide background information about the WFD and water quality accounts in relation to environmental accounting. Section 11.3. discusses sources and methods, followed by experimental results in Section 11.4. Section 11.5 provides the conclusions.

[1] http://www.compendiumvoordeleefomgeving.nl/

# 11.2 Context

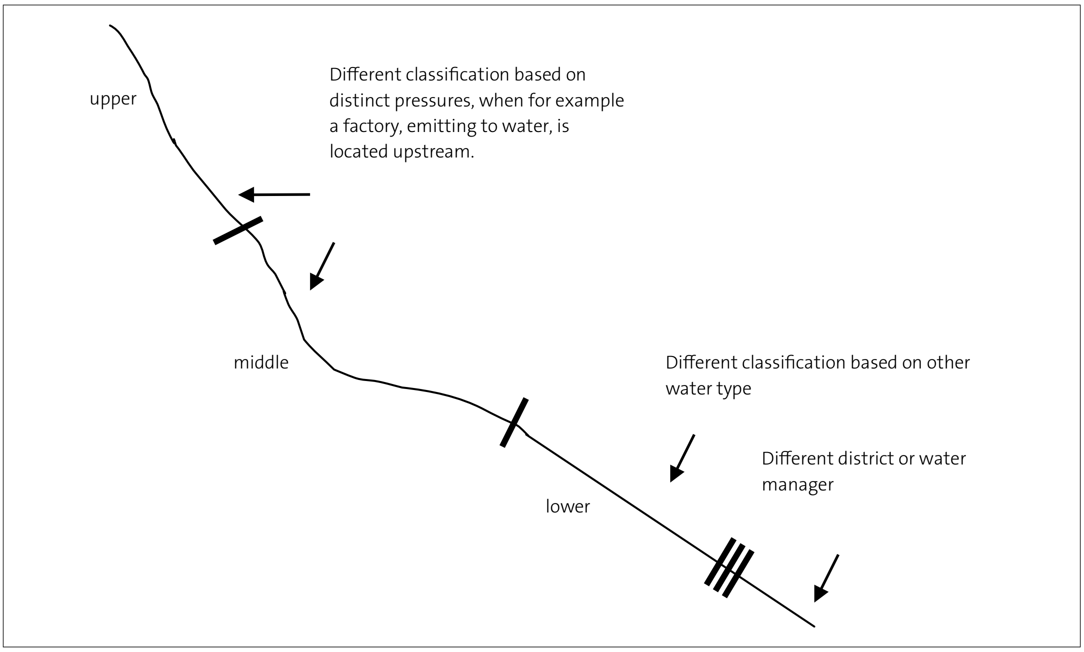
### Water Framework Directive

The European WFD was adopted in October 2000 and entered into force in December of that year (EP, 2000). The WFD is an important and leading environmental policy directive in Europe. European waters must meet good quality requirements by the year 2015. The WFD includes surface water (marine, brackish and sweet) and groundwater. EU member states are required to send in reports on water quality once every three years (EEA, 2010).

For surface water the WFD divides areas into 'river basin districts' and 'sub river basin districts'. In the Netherlands four river basin districts are identified: Ems, Rhine, Scheldt and Meuse. All Dutch river basin districts are part of international river districts, which means that the policies for the river basin districts also need to be coordinated on an international level. In the Netherlands, the Rhine district is divided into four sub river basin districts.

A key element of the WFD is the identification of water bodies (EC, 2003). The WFD classifies water bodies based on their 'status' and 'type'. The status indicates the degree to which water bodies have been modified: natural, artificial or strongly modified. Most Dutch water bodies fall under the classification of 'artificial' or 'strongly modified'. Water 'type' describes the water debit (rate of flow), the kind of water (river, lake, coastal or transitional) and soil type (sand, clay, etc.). Based on these characteristics a classification scheme of 50 different water types has been developed for the Netherlands (Elbersen et al., 2003). See for an example Figure 11.2.1. A river can be divided in several WFD water bodies because it flows through multiple water manager districts. Another reason can be the water status or type. For example a section of a river that is modified into a canal can be a separate water body. Distinct pressures, like a factory emitting to water, can be another reason to divide a river into multiple WFD water bodies. In this way 724 water bodies have been identified by water managers in the Netherlands. The 724 Dutch WFD water bodies represent 36 of the water types identified by Elbersen et al. (2003). The water managers do not assign a WFD status to small waters like creeks and ponds. In addition, there are 23 groundwater bodies in the Netherlands that are assessed for quantity and quality by the WFD.

### 11.2.1 Allocation of WFD water bodies



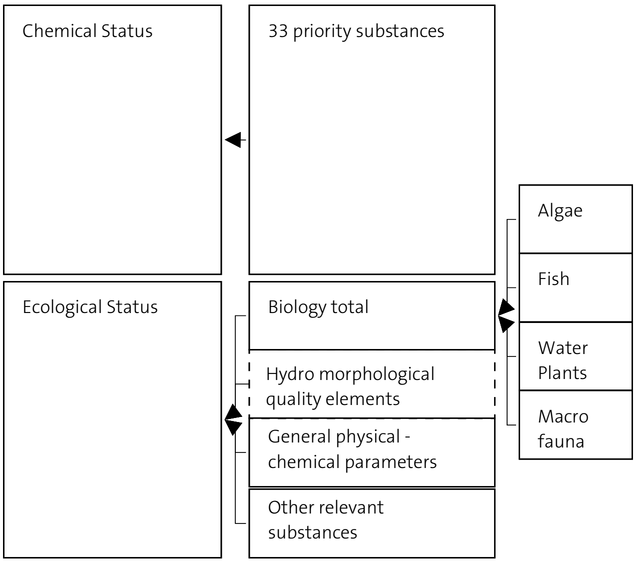

Source: Based upon EC (2003).

In terms of reporting requirements, the WFD makes a distinction between obligatory and optional factors (EP, 2000). These factors differ from one water type to another. For example; obligatory factors for coastal waters are: longitude, latitude, tidal range and salinity. Optional factors are current velocity, wave exposure, mean water temperature, mixing characteristics, turbidity, retention time (of enclosed bays), mean substratum composition, water temperature range. It is mandatory to report whether a water body is part of a protected area.

In the Netherlands there are 243 water bodies with a 'protected area' status. Four sorts of protected area types are reported in the Netherlands: Bathing water, Drinking water, Shellfish water and Natura 2000 areas. The Natura 2000 areas consist of areas that either fall under the 'habitat directive', the 'bird directive' or under both (EP, 2000). The Netherlands has two shellfish areas; one in the Wadden Sea (North East of the country), and one in the Oosterschelde (South West).

In terms of quality, the WFD determines the status of a water body in terms of ecological and chemical assessments. How these assessments are constructed is illustrated in Figure 11.2.2.

### 11.2.2 Derivation of status of water bodies




The chemical status is determined on the basis of 33 priority substances listed in the Directive (EP, 2000). The ecological status is determined by four sub indicators. The first indicator of biological conditions in turn is determined by four indicators on fish, algae, water plants and macro fauna. The second indicator 'hydro morphological quality elements', concerns the physical system of water bodies (like appearance of banks, soil/substrate etc.). This indicator is not fully developed yet. The third physical-chemical indicator reflects aspects like water debit and temperature. The fourth group of indicators 'other relevant substances' are those that are not part of the 33 internationally determined substances yet thought to be important.

Chemical status is classified into the two classes: good and bad. The ecological status is assessed in five classes: high, good, moderate, poor, and bad. How the measurements for the parameters are translated to the final assessment is described in more detail for the Netherlands in Rijkswaterstaat (2011).

The WFD follows the 'one out, all out' or 'worst of the worst' assessment system: the lowest assessments for a parameter of a (sub) indicator determines the final outcome. This means that when one of the 33 chemical substances fails to achieve a good status, the chemical status is 'bad'. Reporting for the WFD is required every three years. The most recent reporting year is 2009 and the next reporting year is 2012.

#### Quality accounts in relation to environmental accounting

To position quality accounts in the DPSIR (Driving forces-Pressures-States-Impacts-Responses) framework, quality accounts would describe the resulting States of water resources. Environmental accounting is traditionally mostly concerned with analysing the Driving forces and Pressures (e.g. in water use accounts or water emission accounts). The quality accounts could be used as a starting point to analyse Impacts (e.g. in terms of environmental quality of life) and Responses, for instance by assessing the effectiveness of policy instruments such as environmental taxes, subsidies or regulations.

Technically speaking, water quality accounting is a form of physical asset accounting, in which the state of water resources is described in both quantitative and qualitative terms. An important aspect of developing water quality accounts is aggregation across various types of water resources (e.g. in terms of volume, surface area or standard river units). Quality accounts could be used to further disaggregate water asset accounts and provide a description of water resources of a country or at the sub-national level.

Water quality accounting could also be instrumental in the emerging area of ecosystem accounting, where the environment is described in terms of ecosystems that provide various ecosystem services.
In this feasibility study, we have therefore investigated to what extent a classification of water bodies by functions or uses is available for the Netherlands.

# 11.3 Sources and methods

**Data sources**

For this feasibility study a stock-taking exercise was made of the available data sources for the year 2009, the most recent reporting year of the WFD. We chose 2009 because the data of the first reporting year, 2006, is not as reliable. This initial year was used as a base year to set up the monitoring system.

The most important data sources that we have used are:

- Aquatic Base Map *(in Dutch: Map Basiskaart Aquatisch Top10NL – Kadaster)*
  The Base Map was developed by Wageningen University and PBL (PBL, 2010). The Aquatic Base Map is a GIS (Geospatial Information System) map that indicates the location of all Dutch surface water bodies. The water bodies are classified according to the WFD water types. The map provides a classification into water types for the whole country and a clear link to the WFD. Three databases form the core of this source: (1) a polygone map, (2) a polyline map, (3) a database including a classification of water types. The map was published in 2010. The TOP10NL data is based on the year 2006 (most recent Kadaster map) and has a scale of 1:10.000. The WFD water bodies division is based on the most recent reporting year i.e. 2009.
- WFD Portal *(In Dutch: KRW Portaal[2])*
  This website is administered by the 'Information House Water[3]' and online since February 2012. The WFD Portal provides a large number of databases for public use. The website contains data for surface water and groundwater, the data is reported in the

[2] http://krwportaal.nl/portaal/
[3] The Information House Water intends to gather and manage water data and to implement a uniform coding system known as the 'Aquo Standaard' which is accessible via the following link: http://www.aquo.nl/aquo-standaard/aquo-domeintabellen/.

year 2009 and measurements are done in previous years. For our project several databases proved relevant:

- Theme 1: databases with a description of surface water bodies;
- Theme 2: databases with information on type of protected area;
- Theme 3: databases with surface water quality assessments.

### Integration of data sources

The Aquatic Base Map consists of two maps that do not overlap: the polygone map includes areas of the larger water bodies and the polyline map is one-dimensional and consists of lines, showing for example rivers and canals with a width of six meter or less. In the Aquatic Base Map one WFD water body can be split up into several polygone and/or polyline parts. There are 724 WFD water bodies, of which 696 appear in the polygone map and 507 in the polyline map. The two sources together cover all 724 WFD water bodies. The total surface area of Dutch water resources in the polygone map is 16.259 square kilometres. The WFD water bodies make up almost 95 percent of this area. As the actual surface area of water bodies listed in the polyline map is unknown, and in either case very small compared to the surface of the polygone map, the analyses have been done on the polygone map only.[4)]

The WFD, or actually the water managers, assign unique codes to water bodies. This code is called 'OWMIDENT' and all 724 water bodies in the Netherlands have an OWMIDENT code. These unique codes have been used to link the various data sources. In order to link water data with economic and social statistics, the Aquatic Base Map was intersected with a grid of Dutch zip codes. The zip codes used are the 'PC4' areas, which are formed by the four numbers of the zip codes in the Netherlands. There are 4221 PC4 codes in the Netherlands (1 January 2008). This is approximately the level of a neighbourhood.

### Functions

Functions can be attributed to water bodies in several ways. One key question in water accounting is whether the functions of a water body determine its quality, or whether it is the other way around, where functions are derived from the water quality of water resources. In theory, there are several ways to attribute functions to water bodies: (1) based on characteristics such as concentrations of pollutants in combination with reference benchmarks, (2) based on functions 'assigned' by water managers, (3) based on actual or desired uses.

Arguably, with the introduction of the WFD, the policy focus has shifted from the second approach towards the first.[5)] There are still function maps which can be found in the provincial environment plans. However, we found that the classification schemes often differ per province. Moreover, it is not always clear how useful they are: in the province Drenthe, 80 percent of the assigned functions falls under the category 'other'. Data is difficult to gather because

4) The Basiskaart and the Basiskaart enriched with PC4 codes give slightly different totals for total surface (polygone) and length (polyline). The difference is within 50 square kilometres. This is caused by numerical difference because of a technology used to assign 'empty' areas to one of the joining area types. The analyses in the first three sections are based on the 'original' maps, while the analysis including population is based on the enriched maps, which differ slightly.

5) Based on a conversation with F. Kragt of PBL (May 2012).

since 2009 the provinces are no longer required to document the main functions of water. Even before 2009 the classification was not standardised, which led to a large variety of water functions.[6)] Combining these provincial databases is a labour intensive process, but this was undertaken by RIVM in 2002, and resulted in a map that assigns one function per water body (RIVM, 2002). Given that for our base year 2009 most provincial plans were no longer valid, we decided that this would not be a viable approach for our project.

For the WFD, the desired water quality is not based on an analysis of water functions but on benchmark conditions. Indirectly functions are still part of the Dutch WFD, but this is not part of the mandatory reporting requirements. The way functions are introduced is as follows: only those functions that are negatively affected by a proposed measure are included (article 5). This means that this list of functions is not complete for two reasons. One: when functions are not affected, or not negatively affected, they are not included in this dataset. Two: when there are no proposed measures for a specific water body, this water body is not part of the dataset.

The approach that we have eventually chosen is to relate functions to protected area type, as is documented in the WFD. The protected area type ‘bathing water’ could be interpreted as a proxy for the function ‘recreation’; the ‘Natura 2000’ and ‘Shellfish water’ areas may serve as a proxy for the function ‘nature’ and the protected areas for ‘drinking water’ would be a proxy for the function drinking water. This method has the advantages that it is directly linked to the WFD coding and that these indications of protected areas are mandatory for WFD registration. A drawback is that it need not align with reality: people can swim in water even though it does not have an official ‘protected’ area status. However, these functions are the ones with the most stringent water quality requirements. Another drawback is that it only results in a limited set of functions.

# 11.4 Results

In this section we present our main experimental results. The first paragraph gives a general description of Dutch water bodies, the second paragraph looks at the chemical and ecological status of water bodies according to water type. The third paragraph describes the quality of the different types of protected areas. The fourth paragraph discusses the results of an analysis, in which the Dutch population (by province) is classified according to the quality of water resources in their neighbourhood.

### Dutch surface water types

The 724 water bodies in the WFD can be divided into water types. First, we look at the division of water bodies over all WFD water types. As shown by Table 11.4.1 counting the number of water

[6)] For example the province Zuid-Holland distinguishes the following functions: water nature, provincial waterways, (reconsidering) bathing water location, surface water for preparing drinking water, urban area, other water. The province Groningen uses however a list of much more detailed functions.

bodies belonging to a water type gives a somewhat different picture, compared to looking at the surface area of those water bodies belonging to one water type. While the majority of WFD water bodies consists of lakes (450 out of 724), they have a joint area of only 18 percent. Rivers make up only 2.7 percent of total water surface area. The coastal water areas account for 75.5 percent of the total WFD water area. This means that the quality assessments based on surface are largely determined by the quality of these coastal areas.

### 11.4.1 Water bodies disaggregated by water type

| Water type | Description | Number | Area | |
|---|---|---|---|---|
| | | | *km²* | % |
| **Lakes** | | **450** | **2,808** | 18.2% |
| M1a | Freshwater ditches (well buffered) | 46 | 3 | |
| M1b | Non-freshwater ditches (well buffered) | 1 | 0 | |
| M2 | Ditches (weak buffered) | 2 | 0 | |
| M3 | Buffer zone (regional) canals | 99 | 44 | |
| M6a | Large shallow canals without shipping | 22 | 7 | |
| M6b | Large shallows canals with shipping | 16 | 36 | |
| M7a | Large deep canals without shipping | 1 | 0 | |
| M7b | Large deep canals with shipping | 17 | 52 | |
| M8 | Buffer zone (low) fen/marsh/bog ditches | 18 | 3 | |
| M10 | Weak buffer zones (high moorland) ditches | 31 | 38 | |
| M12 | (Low) fen waterways and canals | 1 | 0 | |
| M14 | Small very shallow weakly ponds (buffer zone) | 51 | 334 | |
| M20 | Very Shallow ponds(buffer zone) | 29 | 112 | |
| M21 | Moderately large deep lakes (buffer zone) | 2 | 1,834 | |
| M23 | Large deep lakes (buffer zone) | 6 | 4 | |
| M27 | Large shallow lime-rich ponds | 25 | 107 | |
| M30 | Moderately large very shallow low fen ponds | 61 | 93 | |
| M31 | Moderately brackish waters | 20 | 6 | |
| M32 | Small brackish till saline waters | 2 | 135 | |
| **Rivers** | | **254** | **413** | 2.7% |
| R4 | Permanent slow flowing upper course on sand | 47 | 1 | |
| R5 | Slow flowing middle/lower course on sand | 133 | 17 | |
| R6 | Slow flowing small river on sand/clay | 30 | 21 | |
| R7 | Slow flowing river/side channel on sand/clay | 11 | 157 | |
| R8 | Fresh tidal water ( river) on sand/clay | 10 | 205 | |
| R12 | Slow flowing middle/lower course on peat | 6 | 1 | |
| R13 | Rapid flowing upper course on sand | 2 | 0 | |
| R14 | Rapid flowing middle/lower course on sand | 3 | 0 | |
| R15 | Rapid flowing river (siliceous soil) | 1 | 1 | |
| R16 | Rapid flowing river/ side channel (siliceous or sandy soil) | 1 | 9 | |
| R17 | Rapid flowing upper course on lime rich soil | 6 | 0 | |
| R18 | Rapid flowing middle/lower course on lime rich soil | 4 | 1 | |
| **Coastal water types** | | **15** | **11,653** | 75.5% |
| K0 | Coastal water, open and polyhaline | 5 | 7,760 | |
| K1 | Coastal water, sheltered and polyhaline | 3 | 499 | |
| K2 | Coastal water, open and euhaline | 5 | 2,621 | |
| K3 | Coastal water, open and polyhaline | 2 | 773 | |
| **Transitional water** | | **5** | **555** | 3.6% |
| O2 | Estuarium with moderate tidal movement | 5 | 555 | |
| | **Total** | **724** | **15,429** | 100% |

Source: Calculation of area is based on the polygone map only; water types are based on Elbersen et al. (2003) and Marcel van den Berg (RIVM) assisted with the translation.

## Surface water quality

Water quality is presented in chemical and in ecological status separately.[7)] Chemical status can be classified as 'good' or 'bad', while ecological status can be classified as 'high', 'good', 'moderate', 'poor' and 'bad'. High quality does not occur in the Netherlands, and is for that reason left out of this analysis. These results concern water bodies that have both a surface in the polygone map and a WFD assessment. For the chemical status there are 685 water bodies in total, and for the ecological status there are 716 water bodies. As Table 11.4.2 shows, the assessment presented in surface area gives a very different picture compared to the number of water bodies: while 506 water bodies have a good chemical status, together these only form 7 percent of total surface area.

### 11.4.2 Quality judgements of water bodies

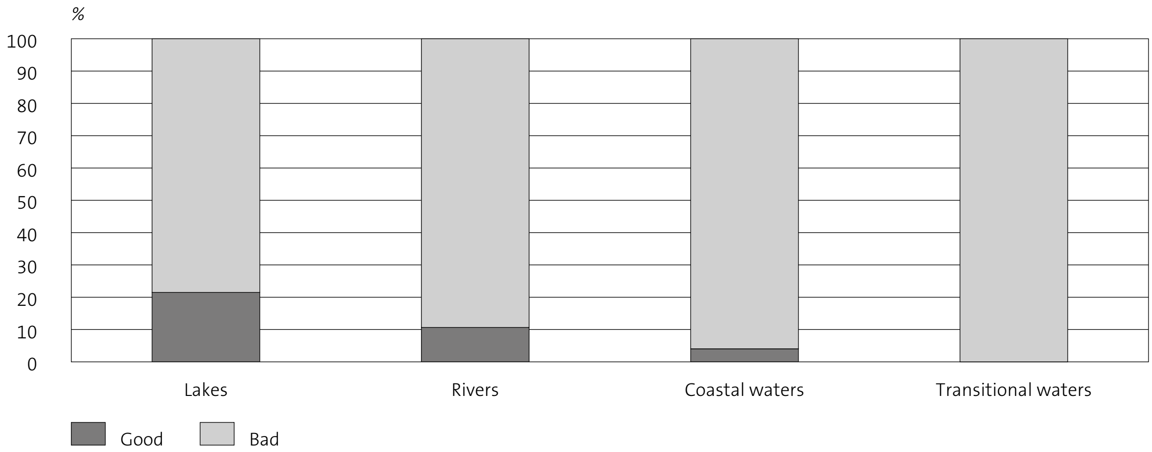
| Status | Number | Surface area | Surface area |
|---|---|---|---|
| | | *km²* | *percentage* |
| **Chemical status** | 685 | | |
| Good | 506 | 1,137 | 7% |
| Bad | 179 | 14,275 | 93% |
| **Ecological status** | 716 | | |
| Good | 3 | 2 | 0% |
| Moderate | 249 | 4,707 | 61% |
| Poor | 315 | 2,689 | 35% |
| Bad | 149 | 270 | 4% |

Table 11.4.2 also demonstrates the weak relation between chemical status of water bodies and their ecological status, as is also indicated in the report of RIVM (2004). While most water bodies (±74 percent) have a good chemical status, the majority also has a bad or poor ecological status (±65 percent).

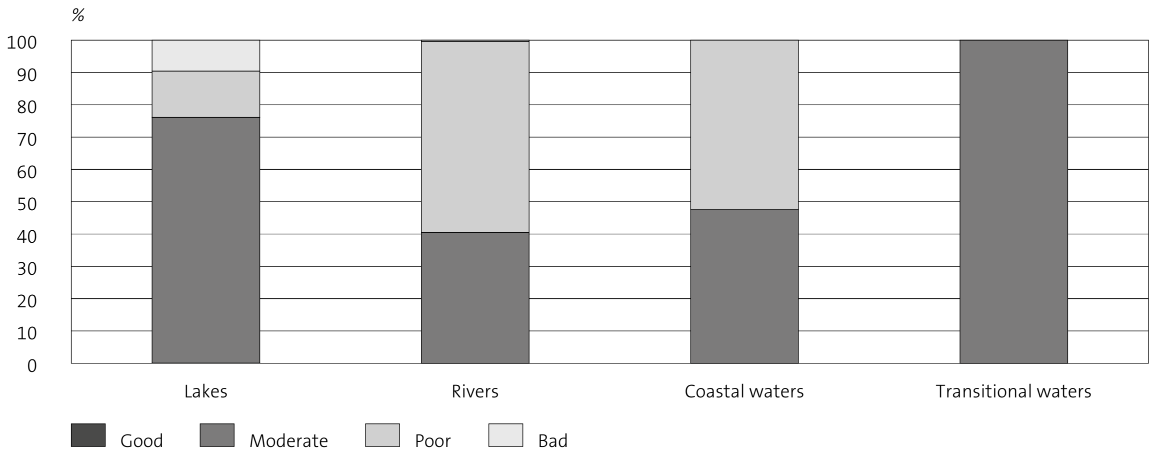
Figures 11.4.3 and 11.4.4 depict water quality by water type, based on surface area. It demonstrates that the inland water bodies are of a relatively better chemical status than the coastal and transitional waters. Again, the chemical status does not translate directly to good ecological status. Lakes and rivers have relatively more 'bad' and 'poor' water bodies. The coastal and transitional water bodies on the other hand have high percentages of 'moderate' ecological status. The reason for this 'mismatch' could be the use of the 'one out, all out' assessment system. Transitional and coastal waters might not meet the standards for one or two chemical parameters that have little or no influence on the ecological status.

7) For the results the combined indicators 'chemtc' and 'ecoltc' are used for the chemical and ecological assessments respectively. These data follow the same pattern as the EEA surface water viewer (EEA, 2012).

11.4.3 Chemical status of main water types




11.4.4 Ecological status of main water types

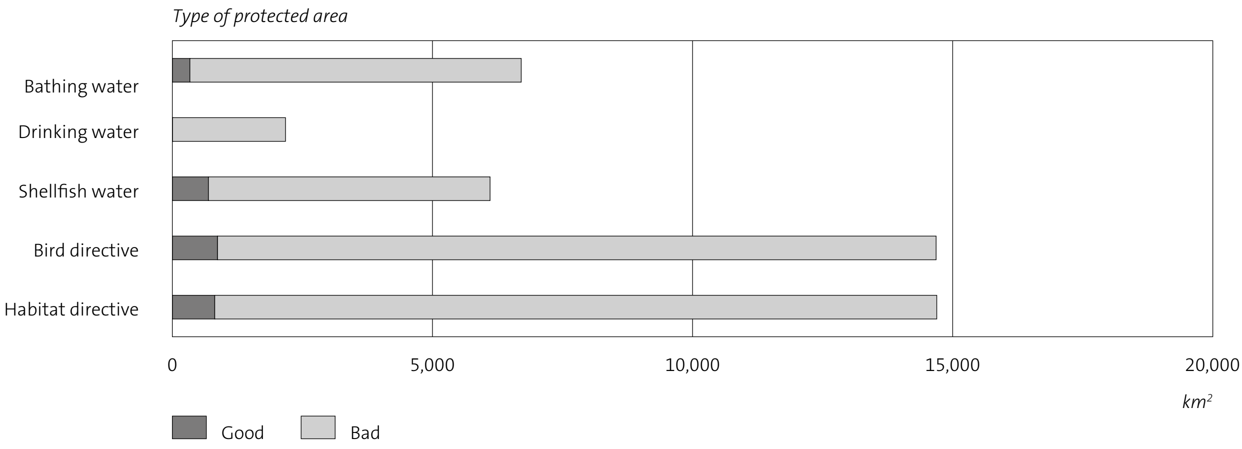



## Functions

There are 243 water bodies with one or more 'protected area type'. This means that a water body (partly) intersects or overlaps with a protected area like a 'Natura 2000' area or includes a bathing water location. When multiple protected areas of one type are linked to a water body, this is counted as 'having a protected area type' status. The 243 water bodies with a protected area status have on average 1.8 types of protected area assigned to them.

Figure 11.4.5 provides an overview of the chemical status of various protected areas, where we have disaggregated the Nature 2000 areas into those that fall under the Bird Directive and/or the Habitat directive. It should be noted, however, that because most of the water bodies have multiple protected area types (and the larger the water body, the more likely it becomes that multiple protected areas are assigned), there is a large degree of double counting involved. We observe that the chemical status for the majority of types is 'bad'.

**11.4.5 Chemical status of protected area types (square km)**




## Population and water quality

Table 11.4.6 contains the results of intersecting the Aquatic Base Map with a stratification of zip codes. We see that about one percent of the Dutch population does not live in zip codes that contain water. Nearly 21 percent of the population (3.4 million people) live in zip codes with water that is not classified as a WFD water body. The remaining 12.7 million lives in a zip code with at least one WFD water body. It is for this last category that we make an analysis of the quality of the water bodies in their neighbourhood.

**11.4.6 Population (provinces) by presence of water bodies in their neighboorhood**

| Provinces | Population | Not near water | Not near WFD water | Near WFD water |
|---|---|---|---|---|
| Groningen | 573,245 | 100 | 64,225 | 508,920 |
| Friesland | 643,110 | 95 | 63,655 | 579,360 |
| Drenthe | 487,700 | 220 | 98,925 | 388,555 |
| Overijssel | 1,119,405 | 8,690 | 224,235 | 886,480 |
| Flevoland | 378,660 | 0 | 60,395 | 318,265 |
| Gelderland | 1,983,125 | 32,990 | 606,400 | 1,343,735 |
| Utrecht | 1,200,530 | 6,725 | 299,975 | 893,830 |
| Noord-Holland | 2,625,285 | 23,945 | 354,380 | 2,246,960 |
| Zuid-Holland | 3,460,835 | 18,810 | 699,275 | 2,742,750 |
| Zeeland | 380,565 | 0 | 43,865 | 336,700 |
| Noord-Brabant | 2,424,700 | 52,015 | 563,330 | 1,809,355 |
| Limburg | 1,123,385 | 43,930 | 399,660 | 679,795 |
| **Total** | **16,400,545** | **187,520** | **3,478,320** | **12,734,705** |
| | | | | |
| Percentage (total population) | | 1% | 21% | 78% |

To be able to say which share of the population lives in zip codes that contain water of a certain quality, we made the following assumptions:

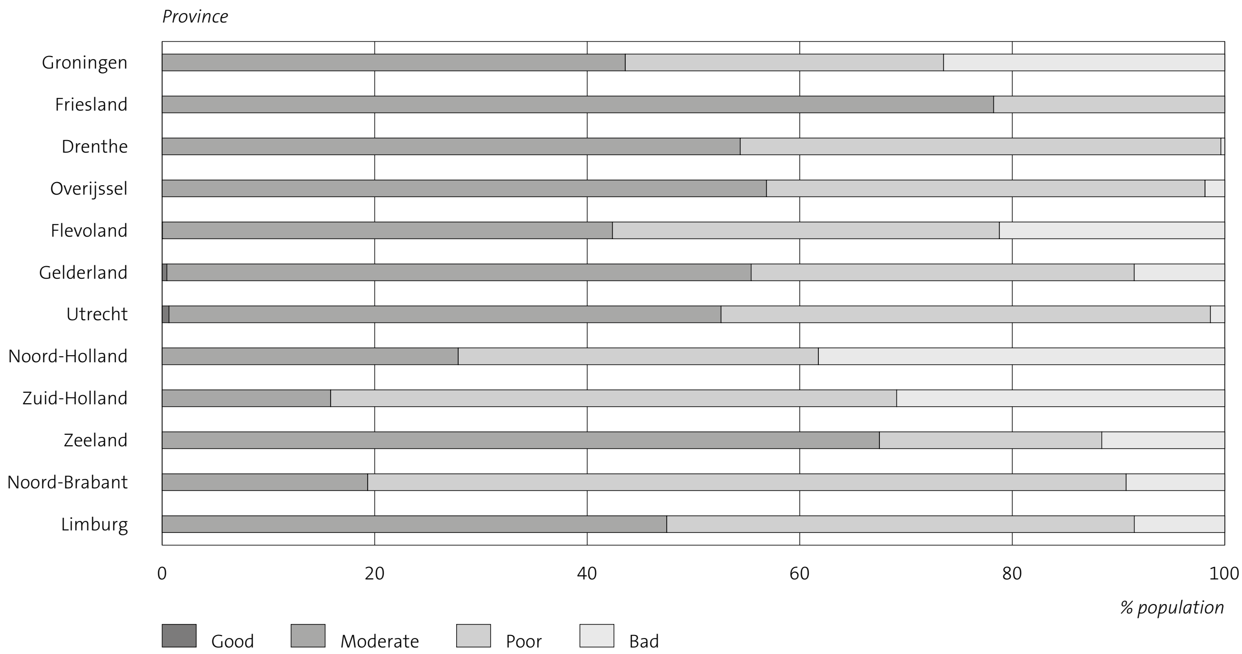
- The WFD water body or bodies in a PC4 area determine the water quality assessment for the entire area. This means that even when part of the water within such an area is not WFD water, the water body, or water bodies that are WFD water bodies determine the assessment.

- When two or more WFD water bodies of differing water quality intersect a single zip code, its inhabitants are assigned to different quality classes based on the respective surface areas of these water bodies.

This approach is chosen because it allows for more differentiation than following the 'worst of the worst' rule. Otherwise all people within a PC4 code that intersects with a part of a water body with 'bad' water quality would be listed as living near water of 'bad' chemical status.

Figure 11.4.7 provides a further breakdown of the 12.7 million people who live in neighborhoods with WFD water bodies, disaggregated by ecological status. We find that 18 percent of the population lives near surface water of bad ecological quality, followed by 45 percent with poor ecological quality. In Utrecht, Overijssel, Drenthe and Friesland there is a relatively large share of 'moderate' ecological status combined with a small share of 'bad'. The three water bodies with a 'good' ecological status are located in Utrecht, Gelderland and Flevoland.

**11.4.7 Population (by province) by ecological quality of water bodies in their neighbourhood**




# 11.5 Conclusions and discussion

There are a number of outstanding issues in the area of water quality accounting as described in SEEAW (UN, 2012a). One of the most important issues, the definition of quality classes, is overcome by taking the WFD as point of departure. The Directive defines water quality classes and contains an elaborate system to measure and assess the water quality of water bodies. Another advantage

of the WFD is that it serves as a standard for Europe. While using the WFD has many advantages, the system is not exhaustive because small water areas are excluded from the analysis. However, in terms of surface area, 95 percent of Dutch water bodies are covered by the system.
The one-out-all-out assessment method for water quality is considered too restrictive by some (Hering et al., 2010). Related to this is the concern that policy makers accept the assessments without investigating the underlying strategy. This is especially true for the ecological assessment because not every user is aware of the strengths and weaknesses of the underlying system (Hatton-Ellis, 2008). Therefore, it might be useful to account for quality with respect to specific substances (like heavy metals).

The search for available classifications of water resources into functions resulted in the following insights. Provinces are no longer required to report water functions. This makes it difficult to assign functions based on policy. The WFD assigns quality based on reference conditions of water bodies. This is not directly based on functions, but it does provide information on 'functions negatively affected by proposed measures'. However, this set is not complete because the functions that are positively or not affected by proposed measures are left out, just like water bodies not considered for measures. The WFD does provide a dataset that links protected area types to water bodies. In this project, we have used the different protected area types as proxies for 'drinking water', 'recreation' and 'nature'. However, due to the limited number of functions that result, this is not considered a fruitful direction for future research.

The method used for the analysis of the population living near water of a specific quality should be further improved, especially taking issues such as the treatment of coastal areas into account. There is also a need to develop a more refined method to link population to presence of water of a certain quality (e.g. using weighted distances of population to water bodies).

A key accounting issue, which is also discussed at length in the SEEAW, is how to aggregate across water resources of certain quality. One of the conclusions of our feasibility study is that information about the volume of water bodies is not generally available for the Netherlands. The integration of the Aquatic Base Map with WFD databases allowed us to aggregate results using surface areas. Aggregation using surface area gives a more nuanced image than mere counting the number of water bodies. It could be a first step towards volume based aggregation. It should be possible to provide a rough estimate of average depth for different water types based on the disaggregated water types developed for the Netherlands (Table 11.4.1). As a result, volume estimates of opening and closing stocks of surface water bodies may be obtained. This would complement work on the 'Water Balance', recently developed by Statistics Netherlands (Graveland and Baas, 2012). However, the variation of water levels throughout the year (large seasonal variation) will remain a key issue (Graveland and Baas, 2012). This issue will need to be further investigated in future work.

Another area for future research is the relationship between economic data and water quality. For example, information about the location of industries which underlies the Dutch emission inventory could be linked to spatial water quality data. This could potentially be a first step towards relating pressures as described in the water emission accounts to water quality, although we should be cautious as there could be numerous non-economic factors involved. Furthermore, when additional data with reports to the WFD will become available in 2012, we can also assess changes in water quality over time. This would allow us to develop a comprehensive water quality account in which we could assess changes in water quality over time, disaggregated into different types of water.

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# Glossary

**Acidification**

Process by which soil or water becomes more acid (i.e. decreases in pH) as the result of the deposition of polluting substances ($NO_X$, $SO_2$, $NH_3$ and VOS (volatile organic substances)).

**Acid equivalents**

Measure used to determine to what degree a substance contributes to the acidification of the environment. One acidification equivalent is equal to one mole $H^+$.

**Asset**

a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another.

**Basic prices**

The basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale; it excludes any transport charges invoiced separately by the producer. Value added can be expressed in basic prices.

**Bunkering**

Deliveries of oil products to ships and aircraft engaged in international traffic.

**$CO_2$-equivalents**

measure that describes how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide ($CO_2$) as the reference. The emissions of 1 kg methane is equal to 21 $CO_2$-equivalents and the emission of 1 kg nitrous oxides is equal to 310 $CO_2$-equivalents.

**Climate change**

The United Nations Framework Convention on Climate Change (UNFCCC) defines 'climate change' as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

**Consumption of fixed capital**

Consumption of fixed capital represents the depreciation of the stock of produced fixed assets, as a result of normal technical and economical ageing and insurable accidental damage. Losses due to catastrophes and unforeseen ageing are seen as a capital loss.

**Current transfers**

transactions in which one institutional unit provides a good, service or asset to another unit without receiving from the latter any good, service or asset directly in return as counterpart and does not oblige one or both parties to acquire, or dispose of, an asset.

**Decoupling**

Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving force (e.g. GDP) over a given period. Decoupling can be either absolute or relative. Absolute decoupling is said to occur when the environmentally relevant variable is stable or decreasing while the economic driving force is growing. Decoupling is said to be relative when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable.

**Depletion**

In physical terms, is the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the extraction of the natural resource by economic units occurring at a level greater than that of regeneration.

**Domestic Material Consumption, DMC**

Domestic material consumption in kg, defined as extraction plus imports minus exports.

**Economic growth**

The change in volume of gross domestic product (GDP) with respect to the previous year in market prices.

**Effluent**

Treated waste water flowing from the waste water treatment plant to the surface water.

**End use (of energy)**

The final energy use for energetic and non-energetic purposes (for example the use of lubricants) plus conversion losses (for example energy losses that occur at the transformation of coal into electricity by electricity companies).

**Emissions**

Polluting substances that are released from a source. Emissions can be divided into direct and indirect emissions. Direct emissions are directly discharged into the environment. Indirect emissions reach the environment by a roundabout way. For example, discharges into the sewer system that partially reach the surface water after purification by the sewage plants. In the context of IO analysis, indirect emissions refer to all emissions embedded in the production of goods and services. i.e. all emissions that have accrued over the supply chain.

**Emission factor**

A measure of the emissions per unit of energy use.

**Emission-intensity**

The emission intensity is measure for the efficiency by which polluting substances are emitted in production processes. The emission intensity is equal to the total emission (in kg or equivalents) divided by a monetary unit either value added (in euro) or output (in euro). It can be calculated for both individual economic processes as for the economy as a whole.

**Energy-intensity**

The energy intensity is measure for the efficiency by which energy is used in production processes. The energy intensity is equal to the net energy use (in PJ) divided by a monetary unit either value added (in euro) or output. It can be calculated for both individual economic processes as for the economy as a whole.

**Environmental costs**

The annual costs of environment-related activities which companies carry out themselves (interest and depreciation of environment-related investment and current costs such as operation, maintenance and supervision of environmental provisions).

**Environmental fees**

Fees that are levied to finance specific environmental measures, like the sanitation of waste water or the collection and processing of waste.

**Environmental services**

Industry that is occupied with collection and treatment of wastewater and waste and the clean-up of soil (NACE 90). Environmental services are part of the Environmental goods and service sector.

**Environmental investments**

Extra investment in capital goods intended to protect, restore or improve the environment.

**Environmental goods and services sector**

A heterogeneous set of producers of technologies, goods and services that measure, control, restore, prevent, treat, minimise, research and sensitise environmental damages to air, water and soil as well as resource depletion. This includes 'cleaner' technologies, goods and services that prevent or minimise pollution.

**Environmental subsidies and similar transfers**

transfers intended to support activities which protect the environment or reduce the use and extraction of natural resources.

**Environmental taxes**

Taxes whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment.

**Eutrophication**

Excessive enrichment of waters with nutrients and the associated adverse biological effects.

**Expected reserve**

The amount of crude oil or natural gas that can be extracted according to a predefined expectation.

**Fine dust (PM10)**

Air-borne solid particles, originating from human activity and natural sources, such as wind-blown soil and fires, that eventually settle through the force of gravity, and can cause injury to human and other animal respiratory systems through excessive inhalation.

**Final use of energy**

Use after which no useful energy carriers remain.

**Fixed capital formation**

Expenditure for produced tangible or intangible assets that are used in the production process for more than one year.

**Green growth**

Green growth is about fostering economic growth and development while ensuring that the quality and quantity of natural assets can continue to provide the environmental services on which our well-being relies. It is also about fostering investment, competition and innovation which will underpin sustained growth and give rise to new economic opportunities (OECD definition).

**Greenhouse gases**

gases in the atmosphere that absorb and emit radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The most important greenhouse gases are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), HFK's, PFK's en $SF_6$.

**Gross domestic product (GDP)**

value of all the goods and services produced in an economy, plus the value of the goods and services imported, less the goods and services exported.

**Heavy metal equivalents**

Emissions of copper, chromium, zinc, lead, cadmium, mercury and arsenic can be converted into heavy metal equivalents and can subsequently be added up. The conversion into equivalents takes into account the harmfulness of the metal for the environment. Mercury and cadmium, for example, are more harmful than cupper and zinc and therefore get a higher weight in the conversion calculation.

**Industry**

used synonymously with economic activity. Industries are distinguished in general at the 2-digit ISIC/NACE level (divisions). NB: manufacturing (in Dutch: industrie) is considered an economic sector.

**Influent**

Waste water transported to a waste water treatment plant (for treatment).

**Intermediate consumption (purchasers' prices)**

includes all goods and services used up in the production process in the accounting period, regardless the date of purchase. This includes for example fuel, raw materials, semi manufactured goods, communication services, cleansing services and audits by accountants. Intermediate consumption is valued at purchasers' prices, excluding deductible VAT.

**Mobile sources**

sources for emissions such as vehicles that are not stationary.

**NACE code**

Code identifying economic activities following the Nomenclature of Activities in the European Union (NACE).

**Net environmental costs**

Environmental costs plus environmental related taxes minus environmental subsidies.

**Net energy use**

End use of energy plus export of energy

**Non-residents**

All persons and businesses that do not belong to the Dutch economy.

**Nutrient-equivalents**

Emissions of phosphorus and nitrogen can be can be converted into nutrient-equivalents and can subsequently be added up. The conversion into equivalents takes into account the harmfulness of the nutrients for the environment.

**Operating surplus / mixed income**

Gross operating surplus by industry is the balance that remains after deducting from the value added (basic prices) the compensation of employees and the balance of other taxes and subsidies on production. The operating surplus of family enterprises is called mixed income, because it also contains compensation for work by the owners and their family members.

**Output (basic prices)**

Output covers the value of all goods produced for sale, including unsold goods, and all receipts for services rendered. Output furthermore covers the market equivalent of goods and services produced for own use, such as own account capital formation, services of owner-occupied dwellings and agricultural products produced by farmers for own consumption. The output of such goods is estimated by valuing the quantities produced against the price that the producer would have received if these goods had been sold.

**Products**

Materials with an economic value.

**Re-exports**

Imported goods that are destined for use abroad. These goods must leave the country in (almost) unaltered condition and must change ownership to a Dutch resident.

**Renewable energy**

Energy from the following sources: hydropower, geothermal energy, solar
energy, wind energy, tide/wave/ocean energy, solid biomass, wood, wood waste, other solid waste, charcoal, biogas, liquid biofuels and biodegradable material combusted from municipal waste.

**Reserves**

The expected reserve is the remaining amount of gas or oil based on geological surveys which is supposed to be extractable with existing technology. The expected reserve includes the probable reserves, and is therefore larger than the mere proven reserves. Inventories are also included.

**Residents**

All persons and businesses that belong to the (Dutch) economy These are persons that stay in the Netherlands for longer than one year and businesses that are established in the Netherlands, including companies from foreign enterprises that are located in the Netherlands.

**Resident principle**

According to the resident principle all emissions caused by residents or all energy or raw materials that are used by residents are accounted for.

**Resource rent**

income that accrues to the owner of a natural resource through it use in production. It is derived residually by deducting from output all the costs of production.

**River basin**

The land area drained by a river and its tributaries.

**SEEA 2012**

System of Integrated Economic Environmental Accounting 2012.

**Sector**

a distinction is made between institutional sectors and economic sectors. Institutional sectors group together residents into five mutually exclusive sectors composed of the following types of units: a. Non-financial corporations; b. Financial corporations; c. Government units, including social security funds; d. NPIs serving households (NPISHs); e. Households. Economic sector is defined as a grouping of industries e.g. the agricultural sector.

**Short-cyclic $CO_2$**

$CO_2$-emissions that are released during the combustion of biological degradation of biomass (i.e. combustion of wood in furnaces and burning of biomass in electricity plants). These $CO_2$-emissions are not part of the emissions as calculated by the IPCC guidelines.

**Stationary sources**

Sources for emissions from fixed point sources such as installations ,power plants or other point sources. Includes all emissions not related to mobile sources.

**TOFP**

Tropospheric ozone forming potential. Indicator for the formation of tropospheric ozone (local air pollution). The formation of tropospheric ozone causes smog pollution.

**Value added**

The income created during the production process. Value added at basic prices by industry is equal to the difference between output (basic prices) and intermediate consumption (purchasers' prices).

**Waste**

Materials for which the generator has no further use for own purpose of production, transformation or consumption, and which he discards, or intends or is required to discard. Not included are materials that are directly re-used at their place of origin.

**Waste product**
Waste with an economic value to the generator.

**Waste residual**
Waste with no economic value to the generator.

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