Environmental accounts of the Netherlands 2010

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
2010–2011	2010 to 2011 inclusief
2010/2011	average of 2010 up to and including 2011
2010/'11	crop year, financial year, school year etc. beginning in 2010 and ending in 2011
2008/'09 -2010/'11	crop year, financial year, etc, 2008/'09 to 2010/'11 inclusive
	Due to rounding, some totals may not correspond wit the sum of the separate figures.

Colofon

Publisher
Statistics Netherlands
Henri Faasdreef 312
2492 JP Den Haag

Printed by
Statistics Netherlands – Grafimedia

Prepress
Statistics Netherlands – Grafimedia

Cover
Teldesign, Rotterdam

Information
Telephone +31 88 570 70 70
Telefax +31 70 337 59 94
Via contact form: www.cbs.nl/information

Internet
www.cbs.nl

Price € 22,00 (excluding postage)
ISBN: 978-90-357-1759-6
ISSN: 2210-9749
Print run: 500 copies

60211201101 C-174

Table of contents

Foreword

The economic recovery in 2010 had direct consequences for the pressure on the environment. While in 2009 all environmental indicators showed improvement due to the economic recession, the pressure on the environment from economic activities increased in 2010. For instance, the increase in greenhouse gasses exceeded the rate of economic growth. Also, the use of energy had never been as high as in 2010. This was also due to the relative cold winter, resulting in more use of natural gas for heating purposes. The remaining reserves of natural gas decreased by 6 percent due to high production rates. The impact of economic growth on the emission of acidifying substances and fine dust was reduced by efficiency improvements of production processes.

The *Environmental Accounts of the Netherlands* by Statistics Netherlands (CBS) present a broad quantitative overview of important economic-environmental developments. The environmental accounts provide a systematic description of the relationship between the environment and the economy and can be used for in depth analyses of various types. Key indicators that can be derived from the environmental accounts provide an insight into the interrelation between the environment and the economy, and into the issues of sustainability and green growth. The international interest in environmental accounting has been growing in recent years. In 2012 this will culminate in the adaptation of the System of integrated Environmental and Economic Accounting (SEEA) as an international statistical standard.

The first part of the *Environmental accounts of the Netherlands 2010* provides an overview of the most recent developments in the relationship between the environment and the economy. Part two presents three articles that provide more in-depth analyses of specific topics. In the first article the direct and indirect economic impact of activities related to the North Sea are quantified in terms of employment, production and value added. One of the important outcomes of this study was that almost 250 thousand Dutch employees are dependent on the North Sea economy. The information from this study will be used in the evaluation of the European Union's Marine Strategy Framework Directive. The second article examines the methodology to valuate renewable energy resources and provides a comprehensive overview into the economy behind wind energy production. It shows that wind energy production is not yet profitable without government support schemes. The third article presents the first results of a study on environmental subsidies. The results indicate that environmentally motivated subsidies are used extensively by only few industries, such as agriculture, electricity companies, and the chemical industry. It also shows that environmentally motivated subsidies are predominantly aimed at reducing emissions of greenhouse gases and other air pollutants.

The Director General of Statistics Netherlands

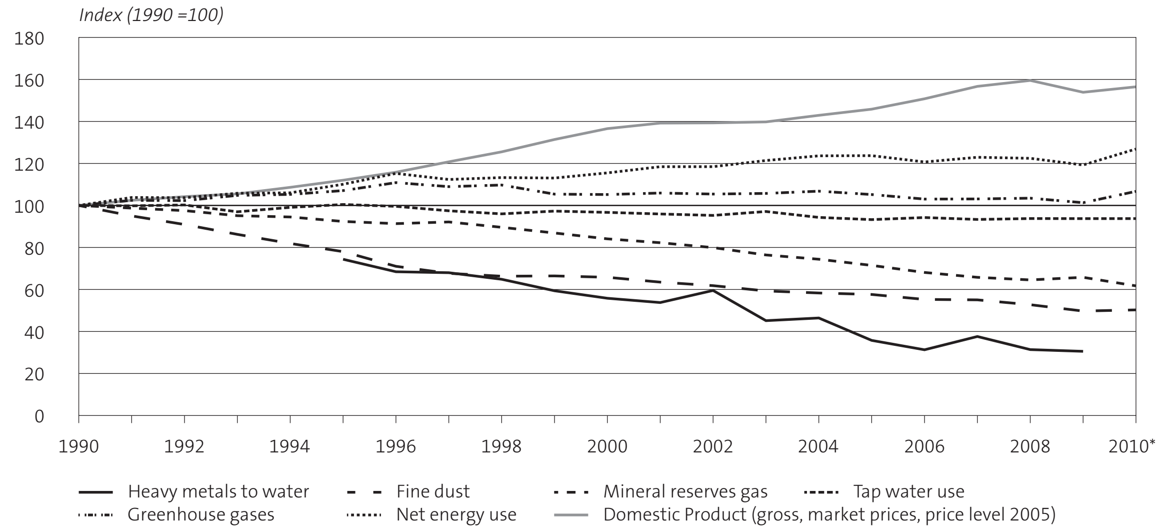
G. van der Veen

Heerlen/The Hague, November 2011

Summary

Economic developments have a major impact on the environment. Environmental accounts describe the relationship between the economy and the environment. Because the environmental accounts are integrated with concepts from the national accounts, developments in the field of the environment and macro-economic developments in the Netherlands can be compared directly (see Statline and the CBS website). Key indicators can be derived from the environmental accounts that provide an insight into sustainability with respect to environmental and economic developments. The integrated system makes it possible to quantify and analyse the underlying causes of changes in environmental indicators. The effects of changes in such aspects as economic growth, environmental efficiency and international trade can therefore be expressed in figures. This publication presents the results of the environmental accounts developed by Statistics Netherlands.

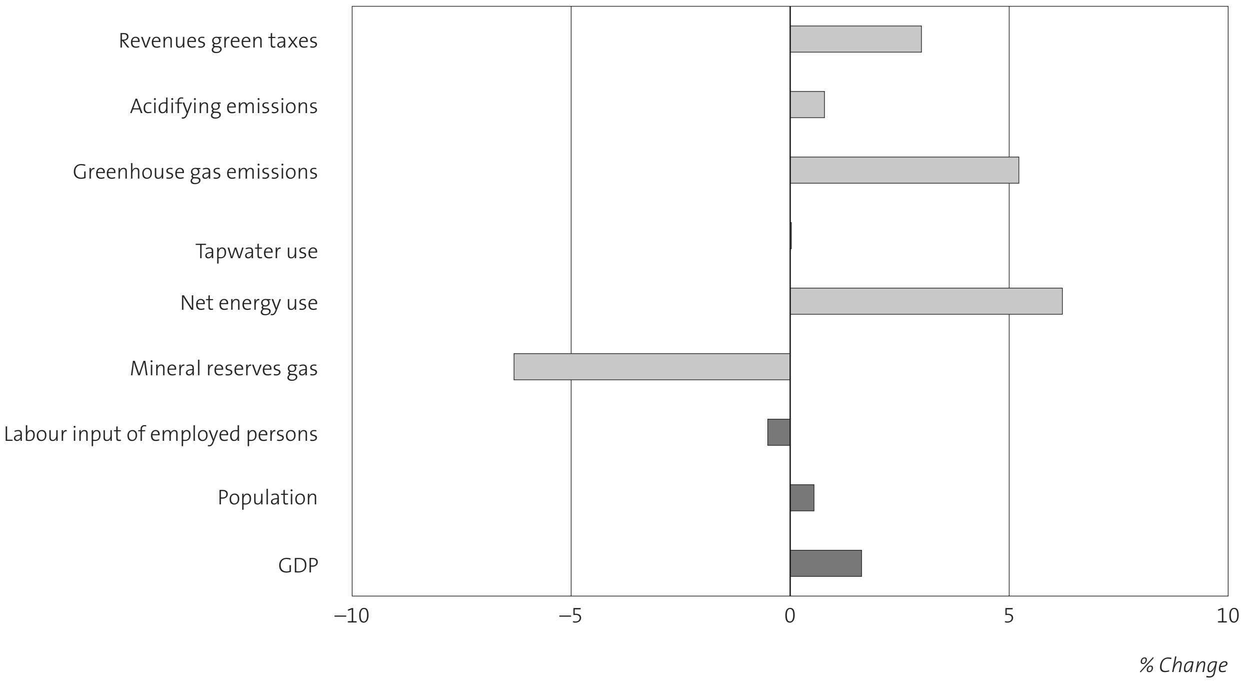
1 Development GDP and environmental indicators



Strong increase net energy use and greenhouse gas emissions Dutch economy in 2010

Energy use by Dutch economic activities has never been as high as in 2010. Overall, net energy consumption (including households) increased by 6.4 percent in 2009. This means that economic growth increased far less (1.7 percent) than energy consumption. Particularly the use of natural gas increased, while the use of other energy products increased only slightly (oil products, coal and coal products). The total greenhouse gas emissions by economic activities equalled 245.8 Mton CO_2 eq. in 2010, which was 5.3 percent higher than the previous year. There are two main reasons for the increase in energy consumption and greenhouse gas emissions: the low average temperatures during the winter months and the economic recovery. In agriculture, greenhouse gas emissions rose 4 percent, primarily due to higher combustion of natural gas in horticulture. In manufacturing, emissions increased in most industries. Particularly in the chemical industry, basic metal and the refineries, where the production processes are very emission intensive, emissions rose fast. In the transport sector the increased emissions closely follow the higher transport activities.

2 Change of key economic and environmental indicators, 2009–2010



Highest natural gas production since 1996

In 2010, the production of natural gas from the Dutch gas fields amounted to 86 billion standard cubic metres (Sm^3) compared to 74 billion Sm^3 in 2009. The last time the annual production of natural gas was this high was in 1996. The increase is due to the cold winter and the large supply in spring. At the same time, the export of gas increased by about 7 percent compared to 2009, while imports remained more or less constant. At the end of 2010, the remaining expected reserves of natural gas in the Netherlands were estimated at 1 304 billion Sm^3. Assuming that the net annual production remains constant at its 2010 level, Dutch natural gas will last about another 15 years. The value of the reserves of natural gas amounted to 152 billion euro. This is a decrease of 6 percent compared to 2010 when the reserves were estimated at 161 billion euro. The decrease in value is caused by the decrease in the expected reserves due to extraction and revaluation due to lower prices for natural gas and oil.

Tap water use intensity slightly increased in 2009

The tap water use intensity decreased from 1.04 litres in 2003 to 0.88 litres in 2009 (excluding households). Compared to 2008, however, the intensity slightly increased in 2009. The contraction of the economy was not accompanied by a corresponding reduction of water use. The electricity industry more than tripled its use of tap water, due to the establishment of a new plant for steam production in a combined heat and power plant. A disaggregation of water abstraction by river basins showed that abstraction of surface water is largest in the Rhine-West (sub-) river basin (46 percent of total). In the Rhine-West river basin, electricity supply is responsible for 50 percent, while the second largest user, the chemical industry together with refineries, uses 30 percent.

Reduced water emissions in 2009 due to the economic crisis

The net discharge of heavy metals and nutrients to water by the Dutch economy decreased in 2009 compared to 2008. Emissions to surface water and sewer systems decreased as a result of production cuts due to the economic crisis. In 2009 the environmental performance of the Dutch economy (including households) improved with regard to the emission of nutrients to water, since the nutrient emissions to water decreased more than the economy shrank. But with regard to the emission of heavy metals in 2009 the environmental performance of the Dutch economy got worse. Although emission of heavy metals by producers and other domestic sources decreased, the economic decline exceeded the reduction in emission of heavy metals to water. This interrupted the trend observed since 1995. Households are responsible for this tempered effect as they have a 66 percent share in total emitted heavy metals and increased their emissions of heavy metals by 3.3 percent.

Imports of energy carriers mainly from European countries

The Netherlands have a physical trade deficit for energy carriers and their derived products. At the same time there is a monetary trade surplus indicating that the export value is higher than the import value. The reason for this monetary surplus is that imports consist mainly of crude oil while exports consist of more expensive oil products, like petrol, and domestically extracted natural gas. Energy carriers are mainly imported from European countries like Norway (natural gas) and Russia (crude oil).

Environmental tax revenues back at level of 2008

Revenues from environmental taxes increased by 3.1 percent in 2010, after a decline in the year before. In 2010 government received 19.9 billion euro from environmental taxes was, which was 592 million euro more than in 2009. More revenues came in from the two main environmental taxes: motor vehicle tax and excise duty on petrol and other mineral oils. Motor vehicle tax increased since government raised motor vehicle tax rates for cars depending on the type of combustion engine. As part of the same transition plan for mobility, the Dutch government further lowered the tax rate on the purchase of motor vehicles (BPM). Despite the reduced rate, revenues from the tax on passenger cars and motorcycles fell by only 2.3 percent. This was due to higher sales figures for new motor vehicles. The proportion of environmental tax in total tax revenues remained stable at 14 percent which means that the green tax reform is still stagnating.

Stagnation in Environmental Goods and Services Sector due to the financial and economic crisis

The economy of the Environmental Goods and Services Sector (EGSS) has come to a halt due to the financial crisis and the recession in 2009. Value added in current prices decreased by 1.9 percent in 2009 compared to 2008, as did production in current prices. Looking in more detail at the EGSS it turns out that two activities were hit very hard. Firstly, value added of recycling fell sharply in 2009. The recycling industry received less waste in 2009 than in 2008, so it could not recycle as much waste as in previous years. Secondly, the role of wholesale in waste and scrap as an intermediate between sellers and buyers came under pressure due to the difficult market conditions. In 2009 the Dutch EGSS accounted for 2.3 percent of total GDP (value added was 13.2 billion euro) and employed 137 thousand FTE. The sustainable energy sector is part of the environmental goods and service sector, and consists of all companies and institutions that physically produce renewable energy (exploitation phase) as well as companies active in the value chains that come before it (pre-exploitation phase). The labour volume in the sustainable energy sector is approximately 18 thousand FTE while value added equals 1.7 billion euro.

Nearly quarter of a million employees depend on the North Sea economy

There is increasing recognition of the capacity of the environment to render services. The marine system provides benefits for the Dutch economy. Statistics Netherlands has executed a study commissioned by the Ministry of Infrastructure and Environment in order to analyse the use of the marine environment of the Dutch Continental Shelf (DCS) in terms of value added, employment and other key economic indicators. This study is motivated by the European Union's Marine Strategy Framework Directive. The economic activities taking place on the Dutch Continental Shelf, in seaports and in the coastal zone, which are dependent on the presence of the North Sea, including their spillover effect on rest the Dutch economy, employed 246 thousand employees (FTE) in 2007. Value added reached 35 billion and production 124 billion in 2007. The contribution to value added of the North Sea economy by selected industries and their spillover effect equalled 6.9 percent in 2007. The share of the relevant activities in total employment of the Netherlands in 2007 equalled 4.2 percent. On average the activities selected are characterized by a below average labour intensity.

Decrease in gas reserves not compensated by wind energy

Production of wind power without government intervention results in losses for companies producing wind energy, so the market-based value of wind is equal to zero in the Netherlands. So from a narrow economic point of view, these economic agents produce goods and services that generate losses instead of profits. These agents nevertheless produce wind energy thanks to implicit subsidy schemes for renewable energy production. When we do take subsidies into account, there results a positive value of wind from 2005 onwards. This socially-based value of wind reflects the benefits related to renewable energy production for both the renewable energy producer and society as a whole. In 2010 the socially-based value of wind was estimated at around 5 billion euro. This is still very low in comparison to the Dutch natural gas resources. Figures on fossil and non-fossil reserves in physical terms show that the increase in wind stock cannot compensate for the decrease in oil and gas reserves.

The electricity and gas supply industry receives most environmental transfers

Environmental subsidies are an important economic instrument for achieving national environmental policies. A recent study by Statistics Netherlands presents the experimental results of the size and beneficiaries of environmental subsidies and transfers granted by the Dutch Government. The applied methodology combines an analysis of annual budget data of the relevant ministries and main subsidy agencies, with micro data of actual payments. This allows further disaggregation of the results according to beneficiaries, as a result to industry and to environmental domain. We also compile data on implicit environmental subsidies such as tax exemptions for green investments. It is found that environmental transfers expressed as percentage of total central government expenditure remained more or less constant between 2005 and 2009 at 0.6 percent. They increased from 764 to 1,058 million euro. The electricity and gas supply industry receives most environmental transfers. This is mainly due to the MEP/SDE and other schemes to facilitate a transition towards more sustainable energy production. The second largest beneficiary is agriculture, forestry and fisheries. Total environmental transfers that are environmentally motivated appear to be much smaller than a recent estimate of the range of environmental damaging subsidies by PBL (2011).

Environmental accounts, key figures[1)]

	Unit	1990	1995	2000	2005	2008	2009*	2010*
Economy								
Domestic product (gross, market prices, price level 2005)	*million euro*	352,065	394,332	480,825	513,407	561,597	541,735	550,888
Final consumption expenditure households (price level 2005)[2)]	*million euro*	174,629	190,608	235,168	245,996	252,358	245,782	246,749
Investments in fixed assets (gross, price level 2005)	*million euro*	67,050	73,446	100,979	97,016	114,962	103,231	98,714
Population	*x 1,000*	14,893	15,424	15,864	16,306	16,405	16,486	16,575
Labour input of employed persons	*x 1,000 fte*	5,536	5,774	6,534	6,478	6,832	6,760	6,725
Environmentally adjusted aggregates								
Adjusted national income for depletion of mineral resreves (net)	*%*	1.0	0.8	0.8	1.2	2.2	1.1	1.2
Energy								
Net domestic energy use	*petajoules*	2,935	3,231	3,389	3,630	3,593	3,500	3,723
Energy intensity	*GJ / euro*	8.3	8.2	7.0	7.1	6.4	6.5	6.8
Extraction natural gas	*billion Sm^3*	72	78	68	73	80	74	86
Mineral reserves gas[3)]	*billion Sm^3*	2,113	1,952	1,777	1,510	1,364	1,390	1,304
Valuation mineral reserves gas[3)]	*million euro*	69,236	60,742	64,444	99,846	166,749	161,182	151,953
Water								
Groundwater extraction	*million m^3*	.	.	.	1,021	1,000	1,037	.
Tapwater use	*million m^3*	1,166	1,171	1,127	1,087	1,093	1,093	1,089
Tapwater use intensity	*litre / euro*	3.3	3.0	2.3	2.1	1.9	2.0	2.0
Heavy metals to water[4)]	*1,000 eq.*	149	111	83	53	47	46	.
Nutrients to water[4)]	*1,000 eq.*	26,813	14,803	10,647	7,824	6,877	6,267	.
Materials								
Material consumption biomass	*million kg*	.	.	49,574	47,209	49,697	.	.
Material consumpton metals	*million kg*	.	.	7,766	5,426	9,980	.	.
Solid waste production	*million kg*	52,450	53,983	64,013	61,213	64,474	.	.
Landfilled waste	*million kg*	14,982	9,209	4,907	2,137	2,147	.	.
Greenhouse gas emissions and air pollution								
Greenhouse gas emissions and air pollution	*million CO_2-eq.*	230,376	246,662	242,332	242,340	238,350	233,392	245,836
Greenhousegas emission intensity	*CO_2 eq / 1,000 euro*	654	626	504	472	424	431	446
Acidifying emissions	*million ac-eq.*	45	33	29	26	23	22	22
Fine dust emissions	*million kg*	77	60	51	45	41	39	39
Policy instruments and economic opportunities								
Environmental taxes and fees	*million euro*	5,824	9,249	13,973	17,270	19,757	19,285	19,877
Share Environmental taxes and fees in total taxes	*%*	9.4	13.1	14.1	13.9	13.8	14.0	13.9
Environmental costs	*million euro*	3,864	6,601	9,116	10,105	.	.	.
Labour input environmental goods and services sector	*x 1,000 fte*	.	100	118	127	134	137	.
Value added environmental goods and services sector (basic prices)	*million euro*	.	6,613	9,233	10,772	13,512	13,249	.

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

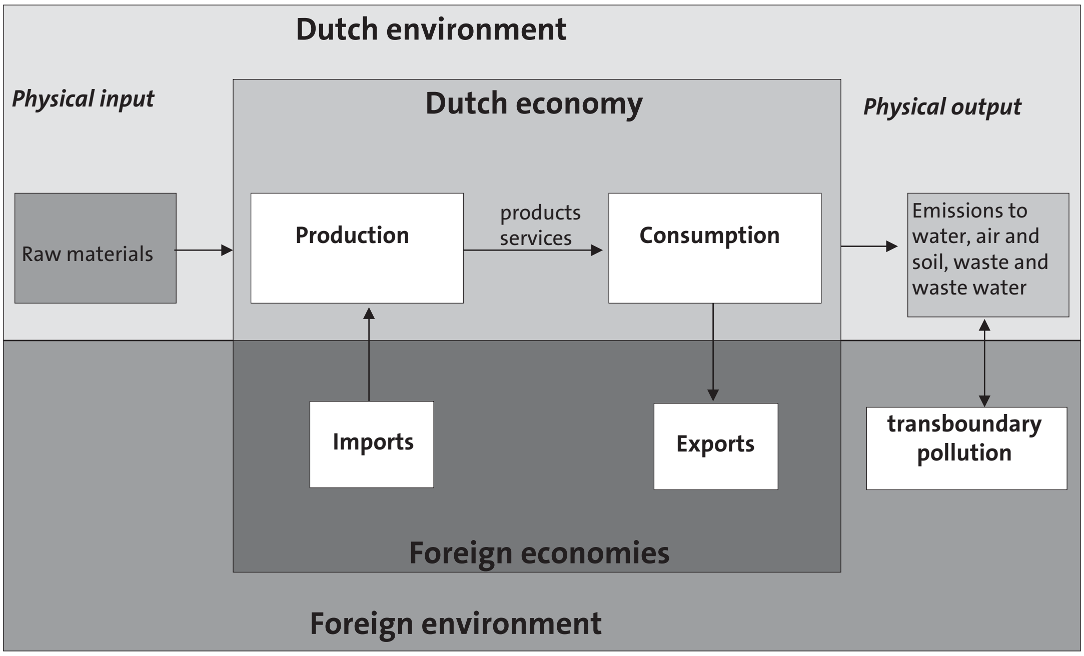
1

Introduction

1.1 Environmental accounting

The economy and the environment are closely interconnected. First, the economy depends on the environment as a source of all kinds of raw materials, such as energy, biological and mineral resources that are essential inputs into economic production processes. Non-renewable resources, such as crude oil and natural gas, are becoming increasingly scarce, which may have significant economic consequences. Renewable resources, such as wood and fish, are often exploited in a non-sustainable way which may have detrimental effects on ecosystems and hamper future production possibilities. Secondly, economic activities also depend on the environment as a sink for their residuals in the form of waste, and emissions to air and water. Pollution contributes to several environmental problems, such as climate change, acidification, local air pollution, and water pollution which may give rise to public health concerns. A consistent statistical description of the interactions between the economy and the environment is therefore important to determine the sustainability of our society. For this purpose the System of Environmental and Economic Accounting (SEEA) has been developed.

1.1.1 Economy and the impact on the environment



The System of integrated Environmental and Economic Accounting (SEEA)

The System of integrated Environmental and 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., 2003; referred to as SEEA 2003). 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).

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 is currently being revised and is scheduled to be released in 2012. The revised SEEA will be the statistical standard for environmental-economic accounting in the same way as the System of National Accounts is the statistical standard for economic accounts. It will provide an internationally agreed set of recommendations expressed in terms of concepts, definitions, classifications, accounting rules and standard tables in order to obtain international comparability of environmental-economic accounts and related statistics.

Environment statistics and environmental accounts

One of the main differences between environmental statistics and environmental accounts 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. Differences therefore primarily arise as a result of international transport and tourism. 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.

SEEA building blocks

The SEEA comprises four 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. Economic accounts for environmental transactions
In these accounts, all sorts of monetary 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 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 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.

4. Accounts for extended SNA aggregates
The fourth category covers the valuation techniques for measuring environmental depletion of natural resources, as well as degradation of natural assets. These accounts further address ways to adjust standard National Accounts aggregates (net income, net savings) for depletion and degradation.

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. Initially, accounts were developed for air emissions, water emissions, waste, energy and water. Recently, new accounts have been added on 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 2003 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). Data by industry are classified according to NACE rev.2, unless indicated otherwise.

This publication

The environmental accounts of the Netherlands 2010 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:

Energy
- Energy consumption
- Oil and natural gas reserves

Water
- Water abstraction and use
- Emissions to water
- Regional water accounts

Materials
- Material flows

Greenhouse gas emissions and air pollution
- Greenhouse gas emissions according to different frameworks
- Greenhouse gas emissions from production
- Quarterly CO_2 emissions
- Local and transboundary air pollution

Policy instruments and economic opportunities

- Environmental taxes and fees
- CO_2 emission permits
- Environmental protection expenditure
- Economic opportunities of the environmental goods and services sector

Part two presents three studies that provide more in-depth analyses for specific subjects. In the first study the direct and indirect economic activities that are related to the North Sea are quantified in terms of employment, production and value added. The information from this study is used in the evaluation of the European Union's Marine Strategy Framework Directive. The second article examines the methodology to valuate renewable energy resources and provides a comprehensive overview into the economy behind wind energy production. It shows that wind energy production is not yet profitable without government support schemes. The third article presents experimental results on the size and beneficiaries of environmental subsidies and transfers granted by the Dutch Government. It is found that environmental transfers expressed as percentage of total central government expenditure remain more or less constant between 2005 and 2009.

Future work

The Dutch environmental accounts are still being developed. New projects will be initiated in the coming years to expand and improve the system. Among other things, projects are under way to further improve and extend existing parts of the accounts, for instance by compiling a longer time series for greenhouse gases as well as asset accounts for renewable resources such as water. Other envisaged additions are adaptation expenditure and resource use and management. Lastly, the data from the environmental accounts will be used to conduct detailed environmental-economic analyses. Future publications will report on the results of these projects.

Energy

2

Energy

2.1

Energy consumption

- Record high energy use in 2010
- Significant increase in net energy use since 1990
- Energy intensity increases in 2010
- Energy dependency decreasing
- Energy use per capita stable

2.2

Oil and natural gas reserves

- Production of natural gas highest since 1996
- Exploration potential fairly constant
- Depletion of oil and gas reserves reduces net national income by 1.2 percent

2.1 Energy consumption

Energy is essential to all economies, both as input for production processes and as a consumer commodity. There are two main channels through which energy enters the economy. The first is by extraction of fossil and nuclear energy resources from the stocks deposited in the environment or through the capture of energy from renewable resources. The second is by imports of energy products. Use of fossil fuels is directly related to the depletion of non-renewable energy resources like crude oil and natural gas. Consumption of fossil fuel energy for economic activities also has negative impacts on the environment. Combustion of oil products, natural gas and coal causes emissions of the greenhouse gas CO_2 and many other pollutants. Improvement of energy efficiency and decoupling energy consumption from economic growth are important 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.

Record high energy use in 2010

Energy use by Dutch economic activities has never been as high as in 2010. Overall, net energy use increased by 6.4 percent on 2009. This means that economic growth increased far less (1.7 percent) than energy consumption. Particularly the use of natural gas increased, while the use of other energy products increased only slightly (oil products, coal and coal products). There are two main reasons for the increase in energy consumption: the economic recovery and the low average temperatures during the winter months.

After the economic downturn in 2009, value added in manufacturing increased by 7.3 percent in 2010. Due to the economic recovery more energy was used for production processes in almost all industries. The chemical industry, the largest energy user in manufacturing, used 11 percent more energy as a result of the increase in demand for Dutch chemical products. The basic metal industry recovered from the low production levels of the recession, but energy use levels are still below the pre recession level. The oil industry used more energy, as the level of production also increased.

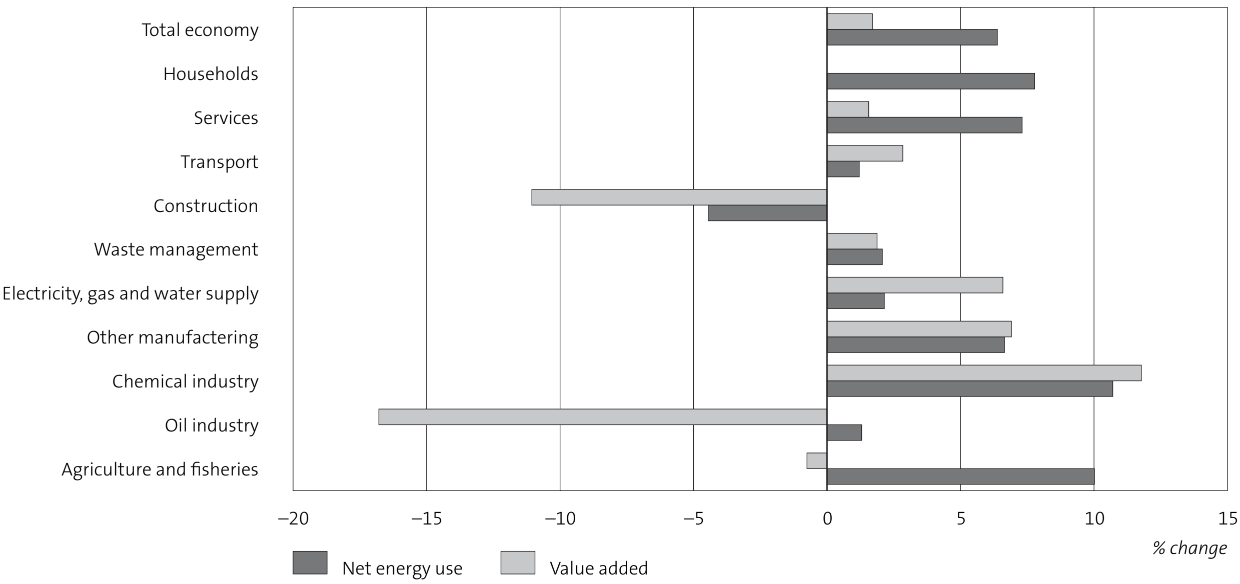
Domestic electricity use did not increase in 2010. However, energy companies still increased their production of electricity as exports increased by 21 percent. They used more natural gas

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.

and biomass, but less coal. Construction did not show a recovery yet in 2010. The volume of construction output fell by more than 10 percent, as the construction of both buildings and civil engineering decreased. This resulted in a lower use of energy products for construction activities, such as bitumen, and fuel for mobile equipment. The transport sector shows a mixed picture. More goods were transported by road, increasing fuel consumption by 0.4 percent. Inland water transport also transported more goods, resulting in a higher use of gasoline. Dutch sea transport, by contrast, showed a production decrease. This is mainly explained by foreign takeovers, which decreased the consumption of diesel and fuel oil by Dutch residents. In aviation, finally, fuel use increased. Despite financial setbacks such as the closure of airspace over Europe during five days, there was more air traffic in 2010 than in 2009.

The months January, February, November and December of 2010 were much colder than in 2009. The wintry cold was comparable with the slightly colder year 1996. As a result more natural gas was consumed to heat homes and offices. In agriculture energy use increased with 10 percent while production levels remained more or less the same as in the previous year. In horticulture, more natural gas was needed to heat the greenhouses due to the cold weather. Also, the energy use increased sharply in the service sector with limited increase in value added. Without the cold weather conditions, total energy use would not have increased by 6 percent, but by 4 percent.

2.1.1 Change in value added and net energy use, 2009–2010



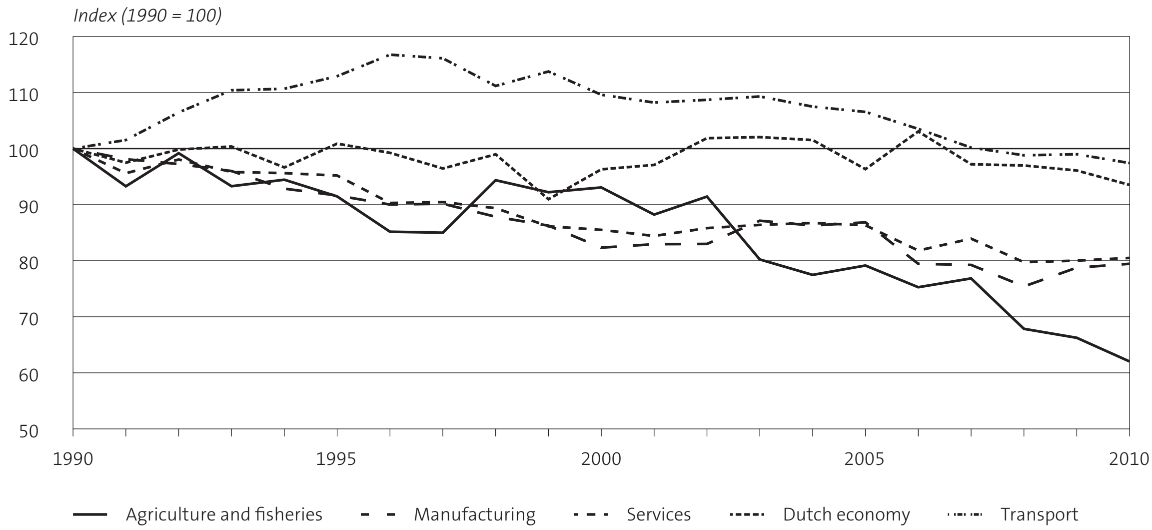
Significant increase in net energy use since 1990

The net energy use of the Dutch economy has increased by 27 percent since 1990. Energy use increased in particular by the aviation sector, chemical sector, refineries and electricity producers. The largest increase was in air transport, where the use of jet fuel doubled. In fishery and textile manufacturing energy use has decreased as the economic significance of these sectors has declined.

Energy intensity increases in 2010

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 2.1.2 shows the figures corrected for this effect. Since 1990 the energy intensity of the Dutch economy has decreased by 20 percent. Agriculture and manufacturing particularly contributed to this improvement. The energy intensity in the transport and services sectors did not decrease significantly in this period. In 2010, the energy intensity of the economy as a whole increased by 0.5 percent on the previous year. This increase was mainly caused by the manufacturing industry.

2.1.2 Energy intensity of industries and the economy



Energy dependency decreasing

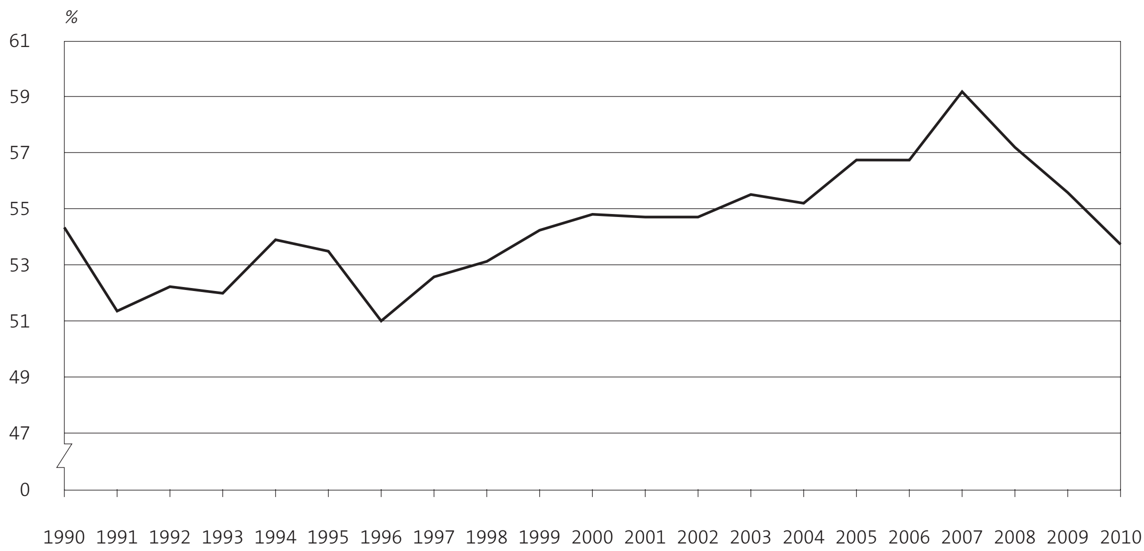
Energy sources such as oil, coal or natural gas can be either extracted from a country's own territory or imported from other countries. If a large amount of these resources has to be imported, a national economy will become dependent on other countries. Energy dependency can be calculated as the share of net domestic energy consumption originating from imported energy products. In 2010 the energy dependency of the total Dutch economy was 54 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

[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.

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 the opposite. The few oilfields on 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.

More than half of the energy we consume comes from abroad

2.1.3 Energy dependency of the Dutch economy



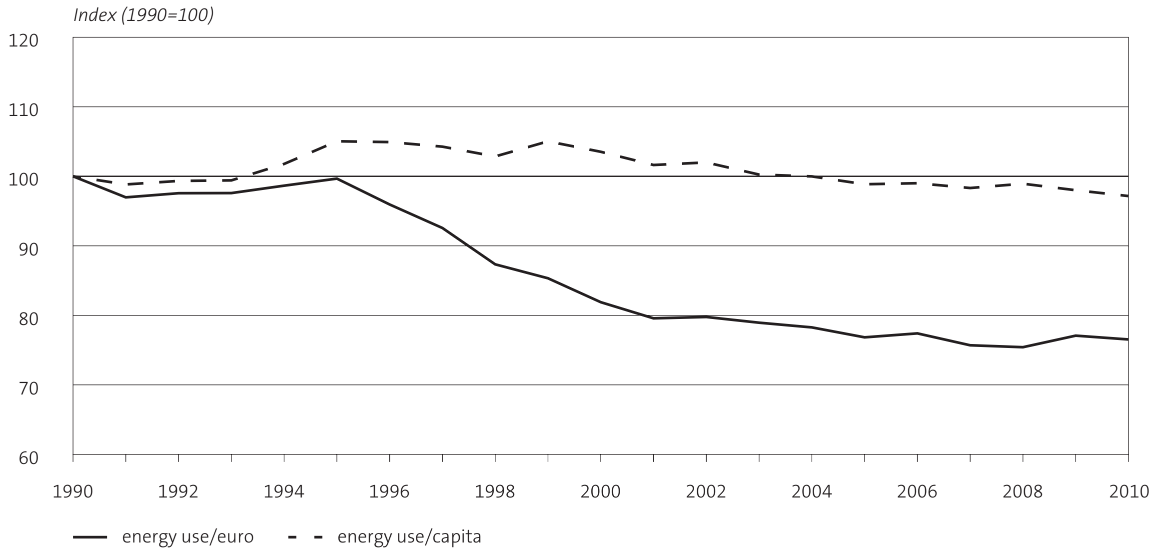
Between 1996 and 2007 the Dutch economy became increasingly dependent on imported sources of energy. The share of imported energy rose from 51 percent in 1996 to 59 percent in 2007. The increase in dependency was mainly caused by the growing demand for oil products. In the 1990s the growing demand for crude oil products was compensated by the increasing use of natural gas supplied by domestic sources, for the production of electricity. The domestic demand for natural gas has remained 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. 2010 saw a further decrease of the energy dependence. This is mainly due to the increased use of natural gas for heating as a result of the lower temperatures during the winter months.

Energy use per capita stable

In 2010 households used 751 PJ of energy, which is 20 percent of the total energy use by economic activities. This energy use mainly consists of the use of natural gas (48 percent) for heating, cooking and hot water production, electricity (12 percent) for all kind of electric equipment, and motor fuels (36 percent) for driving cars and other motor vehicles. Energy use of households increased by 8 percent on 2009. This is mainly the result of the increased use of natural gas for heating purposes. Fuel consumption for driving cars remained stable.

Since 1990 the energy use of households has increased by 8 percent[3]. On a per capita basis energy use remained more or less the same, indicating that the overall energy use per person has not increased. The use of natural gas per capita decreased by 20 percent. All kinds of energy saving measures, such as isolation of houses and the application of high efficiency boilers, have significantly reduced the relative energy use for heating houses. The use of electricity per capita increased by 35 percent, which is related to the more intensive use of all kind of electric equipment. Also, the use of motor fuels per capita has gone up by 17 percent due to the increased mobility in this period. Energy use can also be compared with household consumption expenditure (in constant prices). Here we see a gradual decrease since 1995.

2.1.4 Changes in the energy use by households



[3] Corrected for average annual temperature variations.

2.2 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 nineteen 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. The revenues from oil and gas extraction in recent years contributed on average about 3 percent to the total government revenue. These resources are not inexhaustible however. Although new reserves are discovered occasionally, more than two thirds of the initial gas reserves has been extracted already, as far as current knowledge goes. 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).

Production of natural gas highest since 1996

In 2010, the production of natural gas[4] from the Dutch gas fields amounted to 86 billion Sm^3 compared to 74 billion Sm^3 in 2009. The last time the annual production of natural gas was this high was in 1996. The increase is due to the cold winter and the large supply in spring. For instance, in January 2010 the production from the Groningen field reached its highest value since 1987. At the same time, the export of gas increased by about 7 percent compared to 2009, while imports remained more or less constant.

2.2.1 Physical balance sheet of natural gas

	1990	1995	2000	2005	2006	2007	2008	2009	2010
	billion Sm^3								
Opening stock	1,865	1,997	1,836	1,572	1,510	1,439	1,390	1,364	1,390
Reappraisal	248	–45	–59	–62	–71	–49	–26	26	–86
New discoveries	33	15	25	15	9	5	3	3	5
Re-evaluation of discovered resources	287	18	–17	–46	–9	14	52	95	–5
Gross Extraction	–72	–78	–68	–73	–71	–68	–80	–74	–86
Underground storage			1	0	0	–1	1	–0	2
Other adjustments	0	0	0	42	–0	2	–2	1	–2
Closing stock	2,113	1,952	1,777	1,510	1,439	1,390	1,364	1,390	1,304

Source: TNO / Ministry of Economic Affairs (1988-2010); TNO/EL&I (2011)

[1] In 1997 natural has been injected in one of the underground storage facilities for the first time.

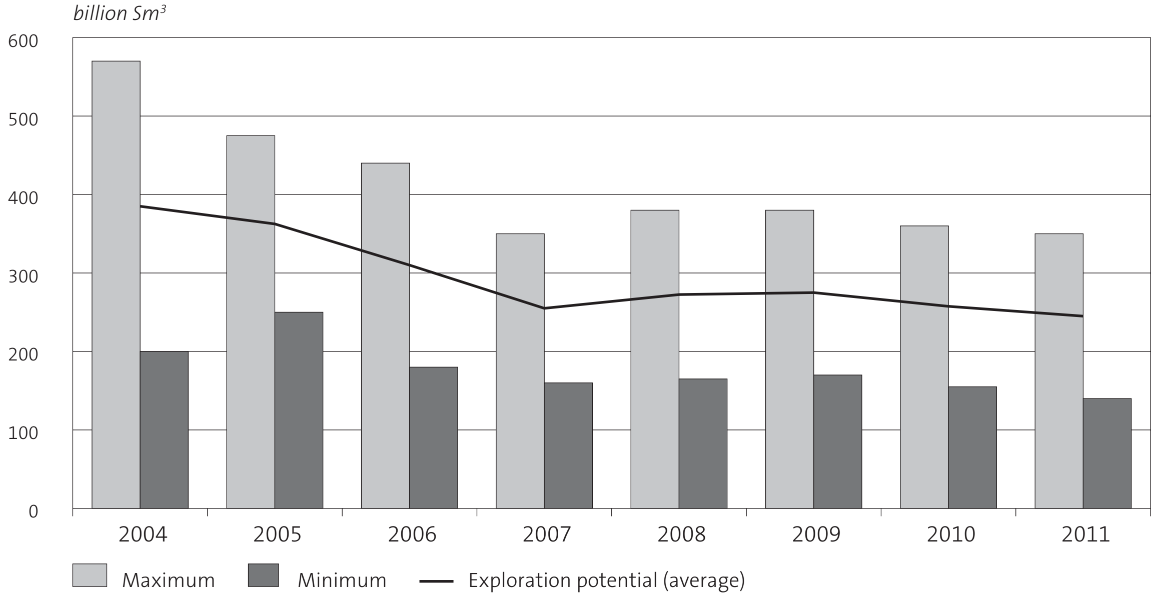
[4] The production equals the gross extraction at the expense of the reserve, which excludes the use of natural gas from underground storage facilities, as these are considered inventories that have been produced already.

At the end of 2010, the remaining expected reserves of natural gas in the Netherlands were estimated at 1304 billion standard cubic metres (Sm^3).[5)] This corresponds to 44,420 PJ. The Dutch economy used 3,723 PJ of net energy in 2010, part of which was imported. Assuming that the net annual production remains constant at its 2010 level, Dutch natural gas will last about another 15 years.

Exploration potential fairly constant

The expected reserves consist of the remaining amount of gas or oil based on geological surveys which is supposed to be extractable with existing technology. The expected reserve corresponds to a so-called best estimate, which includes the proven plus probable reserves, as well as inventories.[6)] The expected reserves, however, exclude so-called future reserves. These consist of fields that have not been confirmed by actual drilling, but may potentially yield reserves based on geological considerations. As Figure 2.2.2 shows, the exploration potential[7)] has remained fairly constant in recent years with an average (of the minimum and maximum range) of 245 billion standard cubic metres (Sm^3) as of 1 January 2011. This amounts to an additional 19 percent compared to the expected reserves.

2.2.2 Exploration potential of natural gas



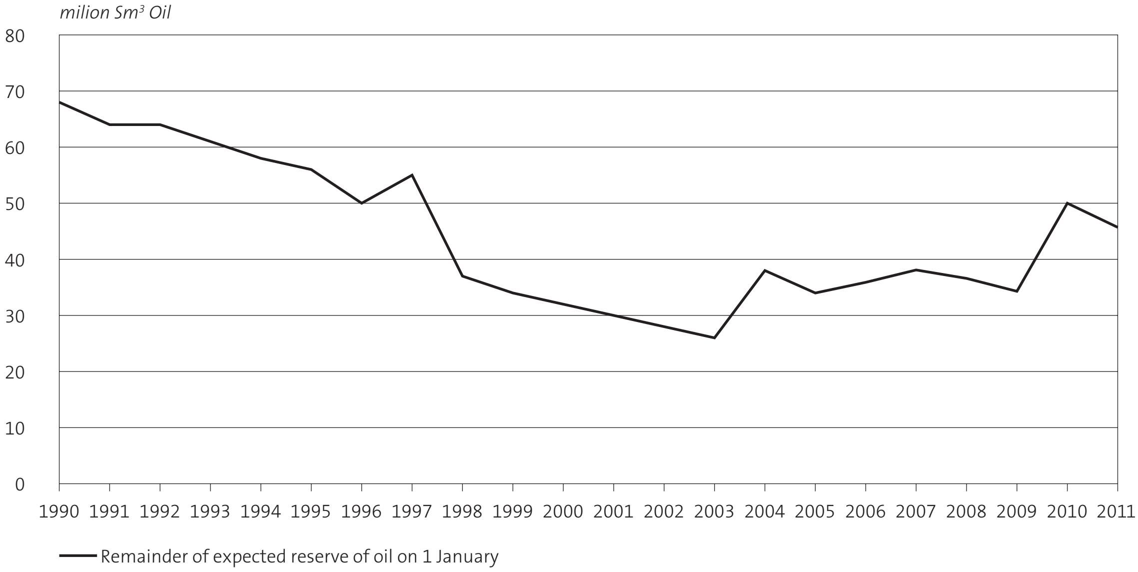
Source: TNO / Ministry of Economic Affairs (1988-2010); TNO/EL&I (2011).

5) 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.
6) The best estimate is obtained from the probability distributions from individual fields which are probabilistically summed.
7) The exploration potential is defined as a subset of the prospect portfolio that satisfies certain minimum conditions.

Production of oil declining

The expected oil reserves were estimated at 45.7 million Sm^3 at the end of 2010, which is a reduction of 8.6 percent compared to 2009. This is caused by the production of 1.26 million Sm^3 of oil, but more importantly due to a revaluation of 3.1 million Sm^3. The production of oil declined by 19 percent on 2009, although the production from land showed an increase of 6.3 percent. The latter is due to the first production from the Beijerland-Noord field.

2.2.3 Dutch Reserves of oil



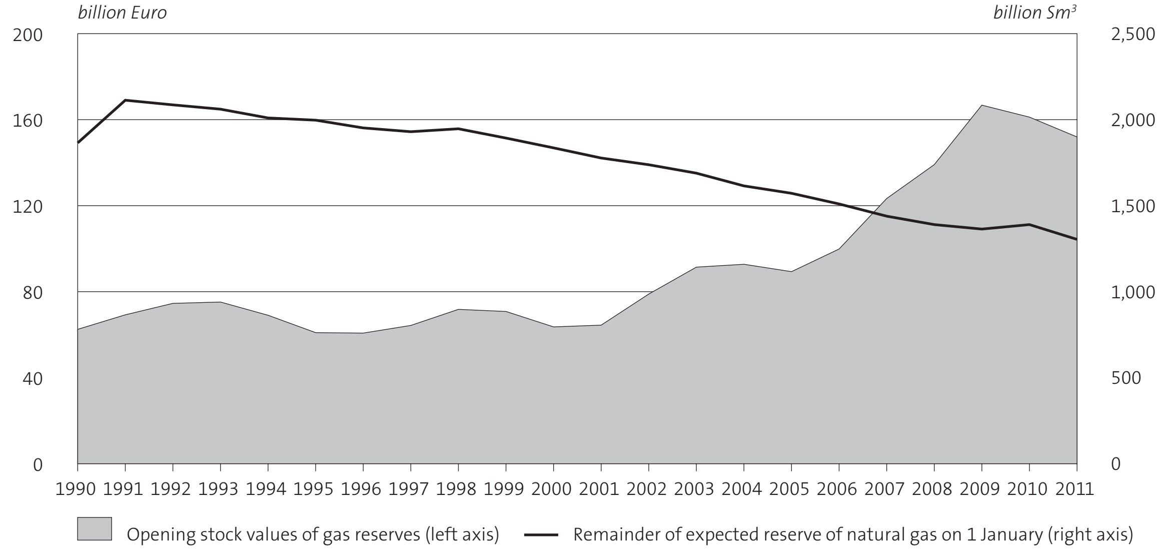
Value of gas reserves decreased by 6 percent

On 1 January 2011, the value of the reserves of natural gas[8)] amounted to 152 billion euro. This is a decrease of 6 percent compared to 2010 when the reserves were estimated at 161 billion euro. The decrease in value is caused by the decrease in the expected reserves due to extraction and revaluation due to lower prices for natural gas and oil.

8) In the absence of market prices, the value of oil and gas reserves has been derived with the net present value methodology (Veldhuizen et al., 2009; CBS, 2007 & 2009) in which assets are valued as discounted streams of expected resource rent which is calculated using the operating surplus of the oil and gas industry. Main assumptions used in the calculation are that the unit resource rent is calculated as the average of the past three years, and for the future is supposed to increase according to the existing inflation rate. Furthermore, a constant decline in the extraction rate has been applied until the point of exhaustion.

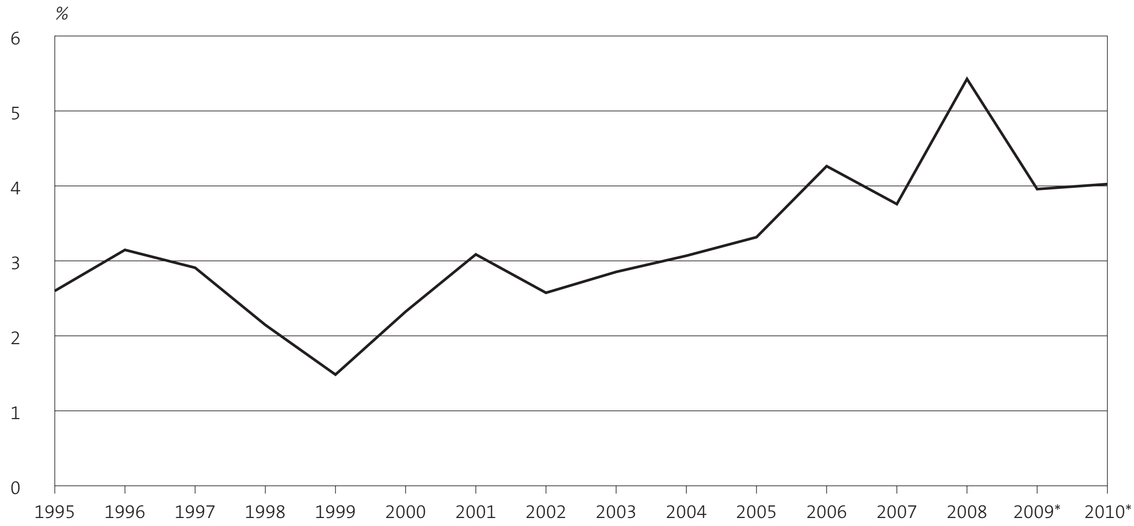
Value remaining gas reserves 152 billion euro

2.2.4 Natural gas reserves in physical and monetary units



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 2010 government revenues from oil and gas amounted 11 billion euro. This implies a 4 percent contribution to general government revenues. Over the last twenty years, the benefits arising from oil and gas extraction, contributed on average 3 percent to total revenue of the Dutch Government. The share in revenues increased from 1.5 percent in 1999 to 4.0 percent in 2010 with a peak of 5.4 percent in 2008.

2.2.5 Share of oil and gas revenues in governments revenues



Depletion of oil and gas reserves reduces net national income by 1.2 percent

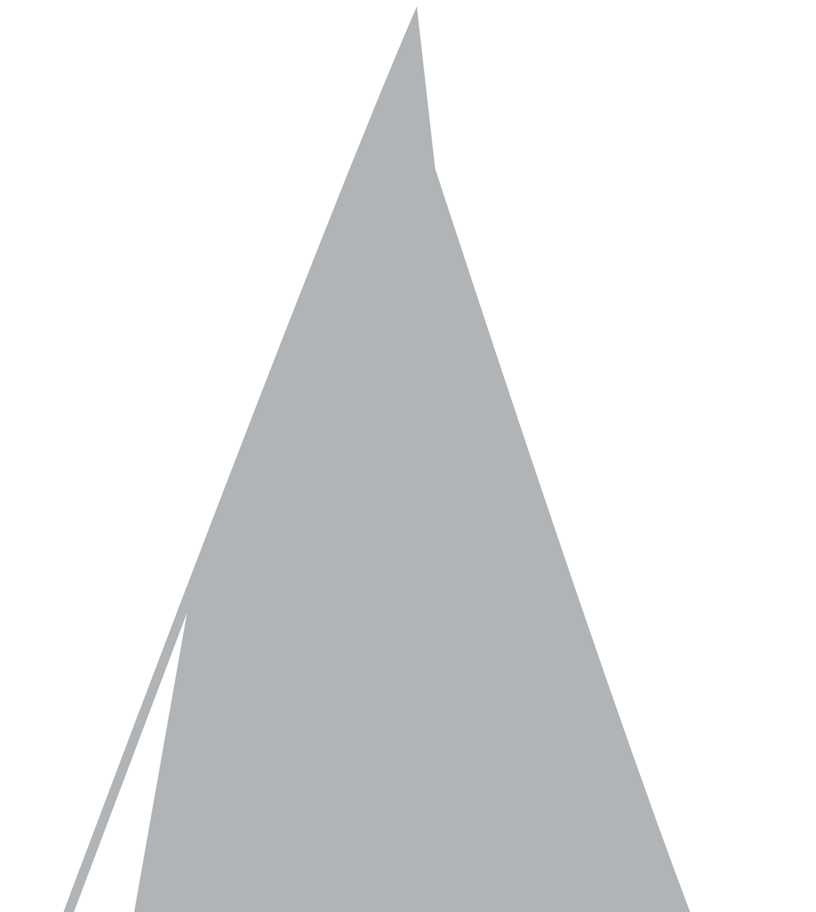
The total value generated by the exploitation of the oil and natural gas reserves is regarded as income in the national accounts. The System of National Accounts (SNA) does in fact record the depletion of natural resources in the balance sheets but not in the production or income generation accounts. 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'[9]. 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 2010 of 1.2 percent. This is a slight increase compared to 2009 when the correction was close to 1.1 percent. The combination of a lower return to capital in 2010 due to the decrease in value of the mineral reserves, and a higher value of extraction, caused the absolute value of depletion to increase by almost 17 percent compared to 2009.

9) The depletion is calculated as the value of the extraction less the return to natural capital.

Water

3



Water

3.1

Water use
- Abstraction of ground and surface water by the Dutch economy increased in 2009
- Household use of tap water per capita continues to decline
- Tap water use by industries stable
- Water in livestock production predominantly used for drinking purposes
- Tap water use intensity slightly increased
- Regional water use
- Fresh water abstraction concentrated in Rhine West and Meuse

3.2

Emissions to water
- Reduced water emissions in 2009 due to economic downturn, but interruption of environmental performance by Dutch economy for heavy metals
- Reduction of phosphorus and nitrogen emissions by sewage and refuse disposal services and the food industry
- Households and manufacture of chemicals and chemical products increased copper emissions
- Manufacturing succeeded in improving emission intensity

3.3

Regional water accounts
- A lot of emissions to water in the Rhine West river basin
- Low emission intensity in Rhine West and Meuse

3.1 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 water to produce tap water of drinking water quality that is subsequently used by industries and households. Depending on its source, water can be distinguished into surface water, groundwater, supplied tap water and 'supplied other kinds of water'[1)]. Given the importance of water for society, policies are 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 for compiling the water accounts is described in the report *Dutch water flow accounts* (Graveland, 2006). The data of the water accounts can be found on StatLine, the electronic database of Statistics Netherlands.

Abstraction of ground and surface water by the Dutch economy increased in 2009

The total abstraction of groundwater by the Dutch economy in 2009 amounted to 1037 million m^3, which is an increase of 4 percent compared to 2008. This is primarily caused by the increased demand from agriculture due to dry conditions in spring and summer and the need for extra irrigation as a result. Abstraction from surface water amounted to 14.2 billion m^3 in 2009, an increase of 7 percent compared to 2008. This is to a large extent caused by an increase in demand by the electricity supply companies. Also the chemical industry showed an increase of 18 percent in surface water use, returning to a level of abstraction similar to the period 2005–2007.

Household use of tap water per capita continues to decline

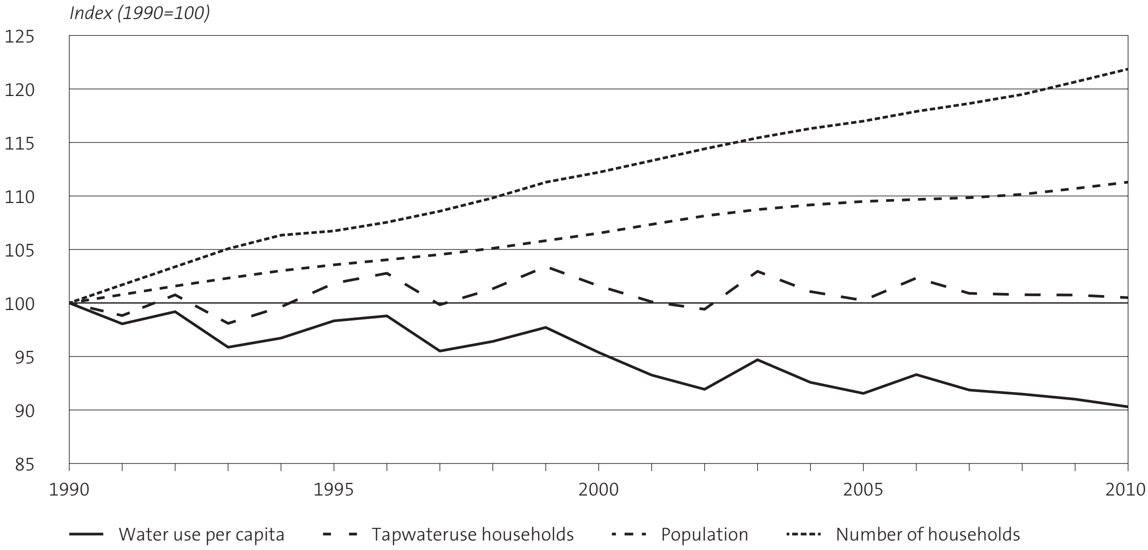
In 2009 around 7.2 percent of the water abstracted from ground and surface water was turned into tap water as supplied by the water supply industry. Total tap water use in 2010 amounted to 1.1 billion m^3. Households account for nearly two thirds (66 percent) of overall tap water use in the Netherlands[2)]. Since 1990, the total annual amount of water used by households increased by only a half percent, despite population growth. Through efficiency measures such as water saving toilets and shower heads as well as new and improved household appliances such as dishwashers and washing machines, household water use per capita has been reduced from 47.9 m^3 in 1990 to 43.2 m^3 in 2010. This is a decrease of 10 percent in twenty years.

1) 'Other water' is water of different, superior or inferior quality compared to tap water. One can think of unfiltered and filtered water, or distilled and demineralised water. This water is produced by water companies and delivered to other companies particularly in the chemical industry. This category of 'other water' on average compares to 6–7 percent of the total use of tap water (VEWIN, 2011B). 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 differ slightly from the VEWIN figures. (See VEWIN water statistics 2007, 2008, 2010, and 2011A).

Daily tap water use per household has dropped by 16 percent from 322 litres in 1990 to 266 litres in 2010, which equals 97 m^3 per year. This drop can be explained by the strong increase in the number of households. This is due to the smaller size of the average household, partly due to the increased number of one-person households. In years with hot and dry summers, as was the case in 2003 and 2006, water use is usually a few percent above average as more water is used for showering and watering the gardens.

3.1.1 Development of tap water use by households, size of population and number of households

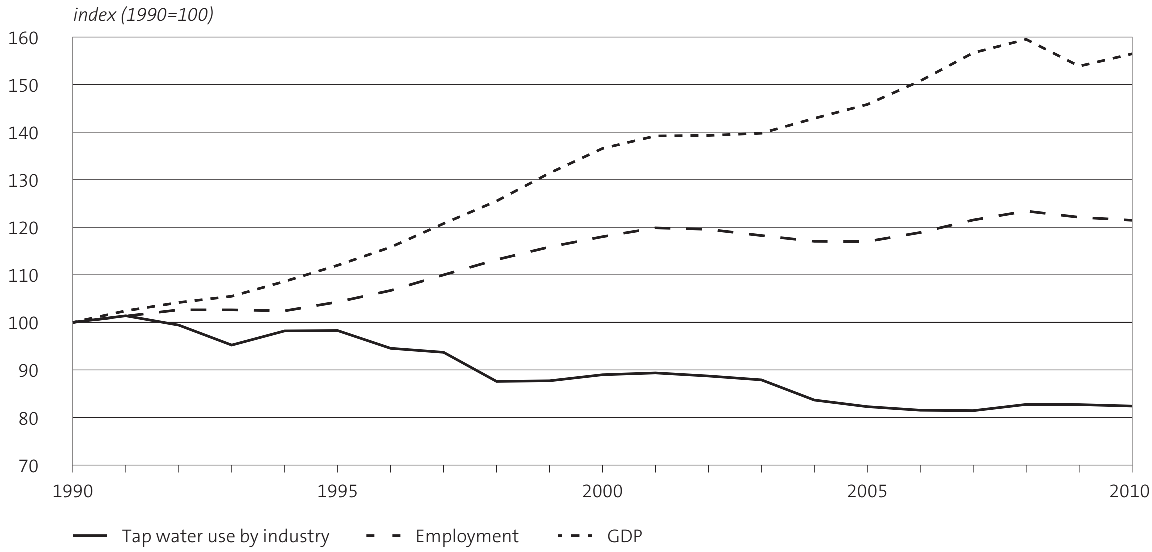


Source: VEWIN, 2010; 2011A, 2011B; Statistics Netherlands 2011.

Tap water use by industries stable

Industries have progressively used less tap water since 1990, but from 2005 onwards the water use is more or less stable. In 2010 tap water use by businesses decreased by 0.4 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 as well.

3.1.2 Volume change GDP, employment and tap water used for production

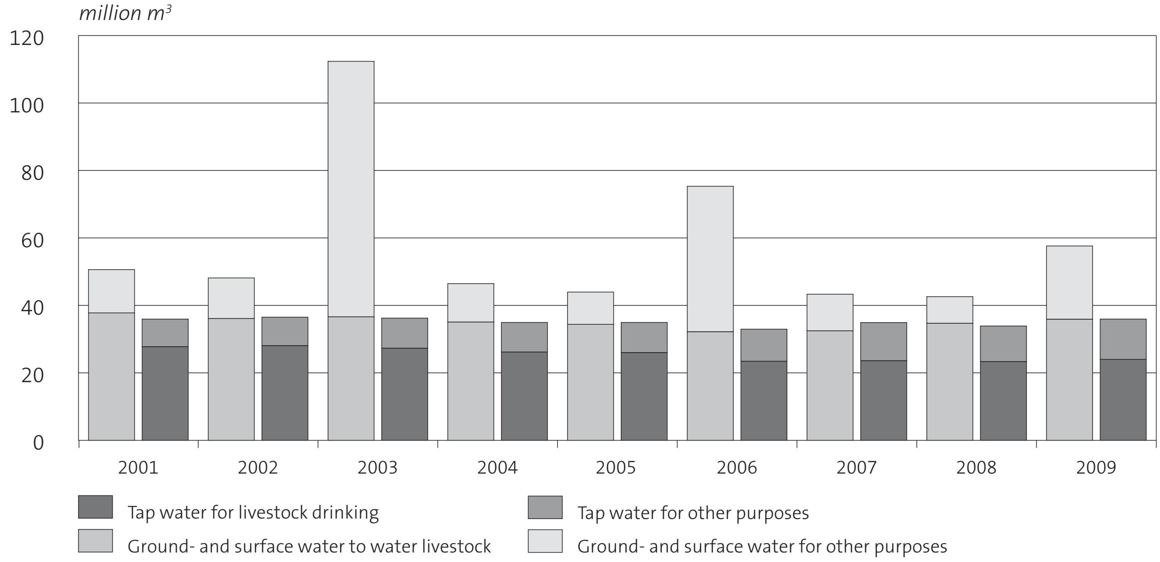


Source: VEWIN, 2010; 2011A; 2011B; Statistics Netherlands 2011.

Water in livestock production predominantly used for drinking purposes

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. However, there is an evidential influence of the weather in warm and dry years, when use is generally higher. A major category of tap water use in agriculture is drinking by cattle and other livestock. As figure 3.1.3 shows, this covers on average over 70 percent of the tap water used in livestock production. One of the main causes of the reduction in tap water use is therefore the smaller herd. In 2009, 14 percent less tap water was required for drinking by cattle compared with 2001. Switching from tap water to ground water and/or surface water for drinking by livestock offers an opportunity to further reduce tap water use in livestock production. On the other hand, the constant quality of tap water is valuable for livestock.

3.1.3 Water used in livestock production



Besides tap water, livestock also drink ground and surface water. In the livestock sector close to two-thirds of ground- and surface water abstracted was used for drinking in the period 2001 to 2009 (Meer, van der R, and H. van der Veen (2011); LEI, 2011; Veen, van der, et al. 2010). The remaining use of ground and surface water is mainly for irrigation of crops such as (green) maize and pastures. In agriculture in general, groundwater is mainly used for irrigation and for watering livestock. In 2009 agriculture had an 8 percent share in total groundwater abstraction. Crops in the Netherlands are predominantly grown under rain-fed conditions.

Tap water use intensity slightly increased

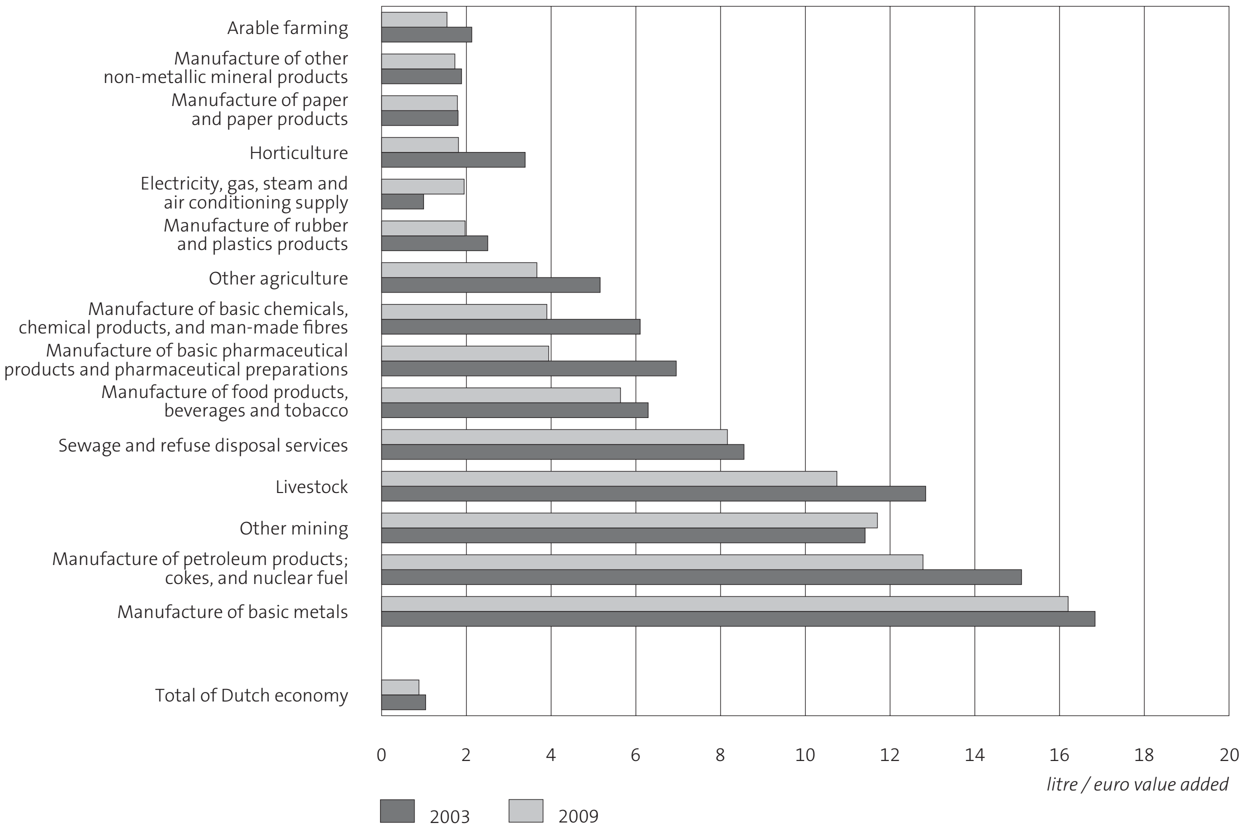
Water use intensity for an industry can be defined as the use of water in litres divided by its value added.[3)] Figure 3.1.4 shows the water use intensities of tap water for selected industries for the years 2003 and 2009. On average, nearly one litre of tap water is used for every euro of value added generated by the Dutch economy. This water use intensity decreased from 1.04 litres in 2003 to 0.88 litres in 2009. Compared to 2008, however, the intensity slightly increased. The contraction of the economy was not accompanied by a corresponding reduction of water use.

The manufacturing of basic metals has the highest water use intensity rate for tap water, followed by the manufacturing of petroleum products, cokes, and nuclear fuel, other mining, and livestock. The industries with the highest use intensity rates use 13 to 19 times more water to earn a euro than the average level for the Dutch economy. As depicted in Figure 3.1.4 the water use intensity for tap water in 2009 was less than in 2003 for most sectors, with the exception of the electricity sector and other mining industry. The electricity sector more than tripled its use of tap water. This can be explained by the establishment of a new plant for steam

3) Value added is expressed in constant year 2000 prices.

production in a combined heat and power (CHP) plant. This plant generates both electricity and steam, and for the latter it makes use of tap water. The steam is produced for external parties.

3.1.4 Industries with the highest use intensities for tap water



The largest reductions were achieved by horticulture (–46 percent), and the pharmaceutical industry (–43 percent). Tap water-intensive industries, like the manufacture of basic metals (–4 percent), manufacture of petroleum products (–15 percent), and livestock (–16 percent) also showed significant reductions in tap water use intensity rates.

Regional water use

There is increasing interest in obtaining regional data on water use and abstraction, in particular according to river basins[4]. Such data is relevant for analysis for and reporting to the Water Framework Directive. 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). It should be noted that the data presented in this section refer to 2008 and have not been disaggregated to NACE rev2.

[4] 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.

Fresh water abstraction concentrated in Rhine West and Meuse

Table 3.1.5 demonstrates that abstraction of surface water is largest in the Rhine-West (sub-) river basin, which is responsible for 46 percent of total abstraction. The second largest user is the Meuse area with 40 percent. Most power plants are located in these (sub-) river basins, as well as major industries. In the Rhine-West, electricity supply is responsible for 50 percent, while the second largest user, chemical industry together with refineries, uses 30 percent. Besides the amounts presented in table 3.1.5, it must be mentioned that in regions like Rhine-West, Scheldt and Ems also significant amounts of (salt) marine water are used by power plants and by major industrial sites.

Rhine-West river basin responsible for almost half of total water abstraction

3.1.5 Abstraction of fresh surface water per (sub-)River Basin, 2008

		Total NL	Ems	Rhine-North	Rhine-East	Rhine-Central	Rhine West	Meuse	Scheldt
	NACE rev.1	*million m³*							
Fresh surface water									
Total		9,639.8	43.6	430.6	276.3	64.5	4,437.5	3,888.1	499.1
of which:									
agriculture, forestry, fishing	01–05	24.4	1.6	5.4	3.2	5.2	6.4	2.3	0.3
of which									
arable farming (irrigation)	0111	3.5	0.8	0.4	0.0	1.2	0.5	0.6	0.0
horticulture	0112	1.2	0.0	0.1	0.0	0.1	0.2	0.8	0.0
livestock drinking	012	16.0	0.7	4.7	2.8	2.8	4.8	0.0	0.2
other or combined		3.6	0.0	0.2	0.3	1.0	0.9	1.0	0.1
mining and quarrying	10–14	1.1	0.1	0.1	0.1	0.1	0.3	0.3	0.0
manufacturing industry, total	15–37	2,998.6	34.5	28.8	80.2	57.3	1,506.6	793.4	497.8
of which used by									
food processing	15	153.3	17.1	20.0	7.3	3.1	69.6	32.6	3.8
textiles, clothing and leather	17–19	4.5	0.0	0.0	0.9	0.2	0.6	2.6	0.1
paper and paper products	21	106.5	4.1	2.4	5.2	4.5	67.4	20.7	2.2
chemicals, refined petroleum	23–24	2,683.0	12.9	5.3	55.9	46.6	1,345.7	725.2	491.4
basic metals	27	29.7	0.2	0.3	2.0	1.7	18.9	6.5	0.1
other manufacturing industry		21.7	0.3	0.8	8.9	1.2	4.3	5.9	0.3
production of electricity	40	5,695.1	0.0	395.2	189.6	0.6	2,231.8	2,877.9	0.0
public Water supply	41	489.8	6.9	0.0	0.0	0.0	278.1	204.8	0.0
waste processing	9002	430.8	0.5	1.2	3.2	1.4	414.3	9.3	0.9
other activities (excl. 9002)	45–93								
private Households		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Baas and Graveland (2011).

As shown in Table 3.1.6, the abstraction of groundwater is distributed more evenly than the distribution of surface water across river basins. This is because groundwater is used predominantly by the water supply industry, which is present in each river basin. The Meuse region is the largest abstractor of ground water, which is responsible for 31 percent of total groundwater abstraction. In the Meuse region, 81 percent is abstracted by the water supply industry.

3.1.6 Abstraction of ground water per (sub-)River Basin, 2008

		Total NL	Ems	Rhine-North	Rhine-East	Rhine-Central	Rhine West	Meuse	Scheldt
	NACE rev.1	*million m³*							
Fresh ground water									
Total		966.5	42.9	70.4	181.0	115.8	230.2	303.4	22.8
of which:									
agriculture, forestry, fishing	01–05	46.7	0.8	3.0	16.4	5.6	1.1	19.3	0.5
of which									
arable farming (irrigation)	011	7.7	0.0	1.1	1.1	3.2	0.0	2.3	0.0
horticulture	013	9.2	0.0	0.0	0.9	1.3	0.5	6.5	0.1
livestock drinking	012	26.6	0.7	1.8	13.4	1.0	0.7	8.6	0.3
other or combined	01	3.2	0.0	0.0	1.0	0.0	0.0	2.0	0.1
mining and quarrying	10–14	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
manufacturing industry, total	15–37	154.5	4.3	6.8	28.8	15.1	57.5	39.1	2.9
of which:									
food processing industry	15	50.9	2.5	4.1	11.7	6.3	10.1	14.3	1.9
textile, clothing and leather	17–19	2.7	0.0	0.0	1.1	0.2	0.4	0.9	0.0
paper and paper products	21	18.6	0.5	0.4	2.0	5.7	8.3	1.5	0.2
chemicals, refined petroleum	23–24	25.5	0.3	0.1	2.5	0.6	15.4	6.6	0.1
basic metals	27	17.4	0.0	0.0	0.8	0.4	14.4	1.6	0.0
other manufacturing industry		39.4	0.9	2.2	10.7	1.9	8.9	14.2	0.6
production of electricity	40	1.7	0.0	0.0	0.1	0.0	1.4	0.2	0.0
public Water supply	41	762.4	37.8	60.6	135.2	94.9	169.9	244.7	19.4
waste processing	9002	1.2	0.0	0.1	0.5	0.1	0.4	0.1	0.0
other activities	45–93								
private Households		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Baas and Graveland (2011).

It is useful to make a comparison between the initial abstracted amounts of fresh water (both ground and surface water) by water supply industries and their final supply of drinking water per river basin. Such data illustrate the existing practices of transport of water between river basins[5].

Table 3.1.7 shows that the total abstraction by water supply companies is usually higher than total supply. The difference stems from production losses, changes in stocks, artificial infiltration, quantities of water supplied but not accounted for, and supply of 'other water' to end users. Analyzing the individual basins as presented in table 3.1.7 shows that abstraction in the Meuse region is much higher than use in this region. This is because large quantities of Meuse water are transported by pipe-line to the dunes in the Rhine-West region where it is artificially infiltrated for purification purposes. Subsequently, the water supply companies in the Rhine-West region abstract the water from the dunes for the production of drinking

[5] Data on total abstraction have been disaggregated to (sub-)river basin based on data on individual abstraction locations of the water supply industry (VEWIN 2011). The distribution of the final supply across (sub-)river basins is based on an analysis of customer files obtained from the individual water supply companies (Baas and Graveland (2011).

water.[6)] Moreover, water supply companies responsible for the supply in the Scheldt region use large quantities of water abstracted in the Meuse region. For other river basins similar relations exist but on a smaller scale. Part of the water abstracted in the Ems river basin is destined for the water supply company in the Rhine-North region. The same holds for abstraction in the Rhine-Center region in conjunction with the water supply company in the Rhine-East region.

3.1.7 Abstraction by water supply companies versus final supply of tap water, 2008

	Total NL	Ems	Rhine-North	Rhine-East	Rhine-Central	Rhine West	Meuse	Scheldt
	million m^3							
Activities								
Abstraction by water supply companies	1,252.1	44.7	60.6	135.2	94.9	447.9	449.5	19.4
Total drinking water supplied	1,093.1	35.9	66.3	143.0	68.2	486.8	245.1	47.8

Source: national totals: VEWIN (2010). Regional aggregates: Baas and Graveland (2011).

The seven (sub-)river basin aggregates on ground- and surface abstractions presented here, next to the (sub-)river basin figures on tap water allows for the compilation of intensities for the seven (sub-)river basins separately. Disaggregated intensities can be calculated for tap water use and for ground- and surface water extractions.

3.2 Emissions to water

The availability of clean water is essential for both humans and nature. However, everyday surface waters are exposed to discharges of harmful substances by industries and households that could cause severe damage to ecosystems in ditches, rivers and lakes. The European Water Framework Directive (WFD) was introduced to meet European environmental quality standards in the future. The Water Framework Directive states that all domestic surface waters should meet certain specific targets by 2015, in qualitative and quantitative terms. Two important groups of substances causing water pollution 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 disproportionally, which can cause certain species of fish, aquatic plants and other organisms to disappear. Economic activities are often directly linked to the emission of pollutants into the environment. Improvements in the emission intensity of production processes and decoupling between water emissions and economic growth are essential to guarantee a good water quality for the future.

6) In the data on total abstraction by water supply companies, only initial abstractions are included. Likewise, abstractions of surface water destined for artificial infiltration is included in the data, while abstractions of artificially infiltrated water from dunes are not included.

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. Indicators for the pollution of surface water by heavy metals and the eutrophication of the surface water are derived from the water accounts. Because it is consistent with the national accounting framework, this physical information on the emissions to water could be directly compared with economic information like value added. This consistency also suits environmental-economic modelling. For a description of the methodology used to compile the water accounts see Statistics Netherlands (2010). The data of the water accounts can be found on StatLine, the electronic database of Statistics Netherlands.

Reduced water emissions in 2009 due to economic downturn, but interruption of environmental performance by Dutch economy for heavy metals

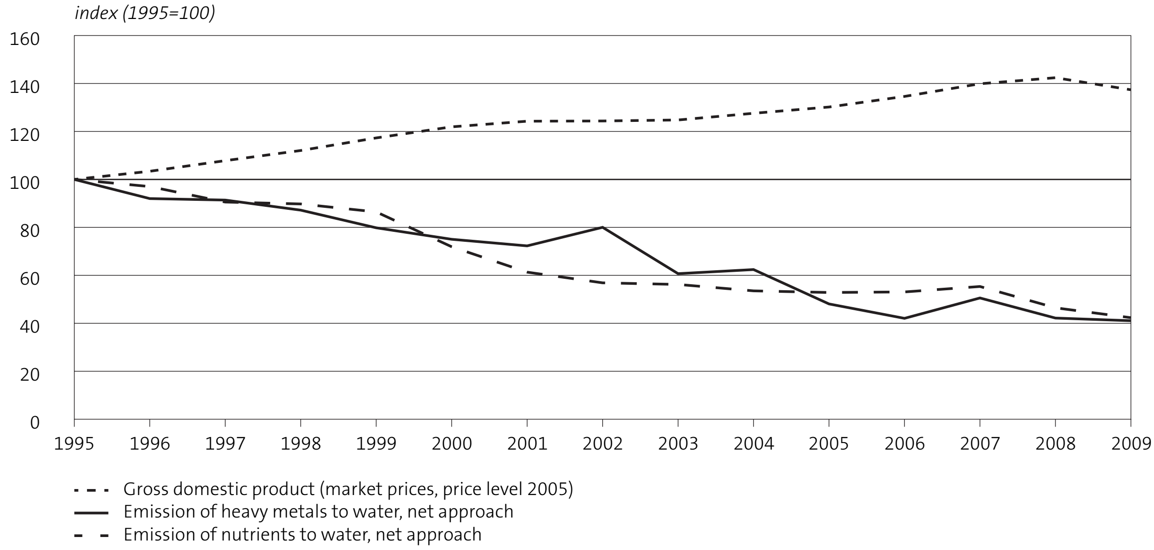
The net discharge of heavy metals and nutrients to water by the Dutch economy decreased in 2009 compared to 2008[7)8)]. Expressed in heavy metal equivalents, emission of heavy metals to water decreased by 2.6 percent[8)]. Emission of nutrients to water, expressed in nutrient equivalents, declined by 8.9 percent. At the same time the economic growth of the Netherlands declined by 3.5 percent in 2009. As a result of production cuts due to the economic downturn, emissions to surface water and sewer systems decreased.

Regarding the emission of nutrients to water, the environmental performance of the Dutch economy improved in 2009. Emission of nutrients to water by producers (–13 percent) and other domestic sources (–7 percent) fell much more than economic growth (–3.5 percent) while the discharge by households remained more or less constant. Accordingly, the nutrient emissions to water decreased more than the economy shrank.

Regarding the emission of heavy metals in 2009 the environmental performance of the Dutch economy got worse. Although emission of heavy metals by producers and other domestic sources decreased, economic decline was larger than the reduction in emission of heavy metals to water. This is an interruption of the trend that has been observed since 1995. Households are responsible for this tempered effect. Their share in total emitted heavy metals is 66 percent and they increased their emissions of heavy metals by 3.3 percent. The population grew by 0.5 percent in 2009 which means that population growth is just one reason for this increase for households. The major reason is the increase in the consumer fireworks displayed at New Year's Eve. These fireworks contain significant amounts of copper. Via deposition on streets and other paved areas, the copper flushes into the sewer system due to run-off of precipitation.

7) Run-off and seepage by agriculture are excluded in this analysis.
8) The damaging nature of different heavy metals varies, which is expressed in different weights for each heavy metal in the equivalent. For example, mercury and cadmium have a more damaging effect on water bodies than chromium and lead. The same applies for the nutrients phosphorus and nitrogen. The weight of phosphorus in the equivalent is ten times that of nitrogen (see Adriaanse, 1993).

3.2.1 Economic growth and contribution of the Dutch economy to water emissions

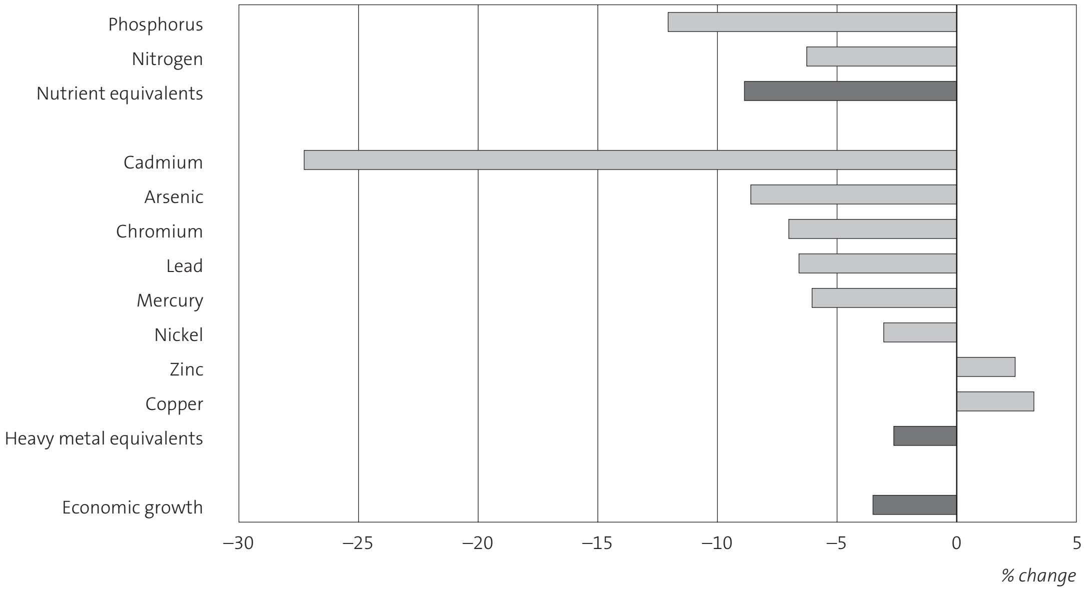


In the period 1995–2009 emissions were substantially reduced: heavy metals by 59 percent and nutrients by 58 percent. This reduction is mainly caused by a reduction in the emission intensity by producers and reduced emissions by other domestic sources like atmospheric deposition. Economic growth equalled 37 percent in this period (figure 3.2.1). The environmental performance of companies and institutions has improved substantially in the period 1995–2009. In contrast, the discharge of nutrients to water by households has increased, partly due to the population increase. Another explanation is the increased use of dishwasher tablets containing relatively much phosphate. In 1995 the emission of heavy metals and nutrients (measured in heavy metal equivalents and nutrient equivalents) was almost equal for producers and households. However, in 2009 households emitted almost three times more nutrients to water than producers did. Households emitted almost two and a half times more heavy metals than producers.

Reduction of phosphorus and nitrogen emissions by sewage and refuse disposal services and the food industry

Although emissions of nutrients and heavy metals to surface water and sewer systems decreased in 2009, the individual nutrients and heavy metals show different emission levels and trends. Emission of nutrients to water decreased for both phosphorus and nitrogen by 12.1 and 6.3 percent respectively between 2008 and 2009. Phosphorus had the highest share in the total decrease in emitted nutrient equivalents by the Dutch economy. Besides the higher weight for phosphorus in the equivalents, this is the result of reduced phosphorus emissions by the manufacture of food products, beverages and tobacco, by sewage and refuse disposal services, and by electricity and gas supply. In the latter case, the trend in the emission of phosphorus is influenced by an incidental peak discharge in 2008. Nitrogen emission decreased especially in manufacturing chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations, textiles, wearing apparel and leather products and by sewage and refuse disposal services. The treatment efficiency of sewage treatment plants improved for both nutrients.

3.2.2 Emissions to water 2008-2009, net approach



Households and manufacture of chemicals and chemical products increased copper emissions

Regarding heavy metals percentage changes vary from minus 27.3 percent for cadmium to plus 2.4 percent for zinc and plus 3.2 percent for copper. Cadmium and mercury had the highest share in the total decrease in emitted heavy metal equivalents by the Dutch economy. Both of these heavy metals have a relatively big damaging effect on water bodies. This was partly the result of reduced cadmium emissions in manufacturing basic metals and chemicals and chemical products, and sewage treatment plants that reduced mercury emissions. The treatment efficiency of sewage treatment plants improved for both cadmium and mercury.

Consumer fireworks result in high copper emissions

Although percentage change is not that big for copper, the impact of this increase for copper on total change of emitted heavy metal equivalents is quite high. First of all the absolute emission of copper by the Dutch economy is considerable. Second reason is the relatively big damaging nature of copper on water bodies. Therefore the weight for copper in the equivalents is relatively high. Copper emissions increased especially by increased emissions by households and by manufacturing chemicals and chemical products. In the first case, increased copper emissions are caused by the increase in the consumer fireworks displayed at New Year's Eve. In the latter case, increased copper loads are caused by a higher additional estimate of emissions within

NACE 20.16 Manufacture of plastics in primary form. Possibly, this additional estimate is too high due to the extrapolation of incidental peak discharges by some companies in this NACE category. However, this conclusion can only be drawn after assessing the emission reports of the coming reporting years.

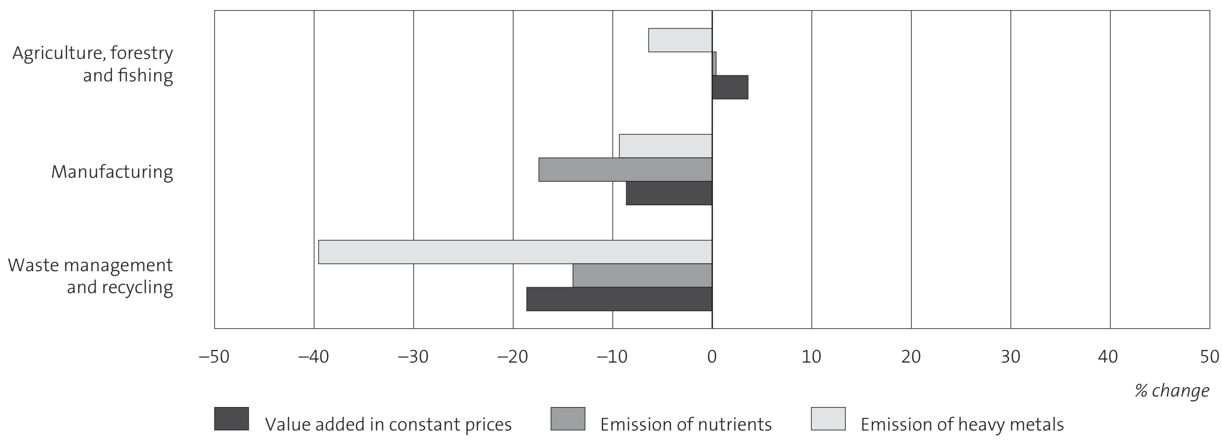
Manufacturing succeeded in improving emission intensity

The way the economic crisis has influenced water emissions differs a great deal between industries[9]. In spite of lower production, some producers succeeded in lowering their emission intensity (water emissions per euro value added). Others were not able to improve their environmental performance because part of their water pollution is fixed and depends much less on output levels and value added generated.

Manufacturing was especially hit hard by the economic crisis. However it succeeded in decreasing emissions to surface water and sewer systems by more than the decline of value added. In manufacturing the environmental performance between industries differed. For example, in manufacturing of food products, beverages and tobacco products emissions to water decreased quite a lot (–2.9 percent for heavy metals and –7.5 percent for nutrients), while value added almost did not change (–0.3 percent). Value added for manufacturing of chemicals and chemical products, on the other hand, decreased by 3.5 percent while at the same time change in emissions to water was + 8.5 percent for heavy metals. This means that regarding heavy metals the environmental performance of the chemical industry got worse.

A difference in development between value added and emissions to water was extremely striking for waste management and recycling. This subsector managed to reduce emission of heavy metals by 39.5 percent. Value added decreased for this subsector by 18.6 percent caused by a reduction in the supply of waste. This subsector reduced emission of nutrients by 14.0 percent.

3.2.3 Change in water pollution and value added, 2008–2009



9) Run-off and seepage by agriculture are excluded in this analysis and for sewage and refuse disposal services effluents are not included.

3.3 Regional water accounts

Water pollution is primarily a local environmental problem. For this reason the water quality targets that have been defined within the European Water Framework Directive were determined at river basin level (PBL, 2008). There are large differences between river basins in emissions to water and economic activity. Usually, a river basin with many economic activities will have more emissions to water than a river basin with less economic activities. In addition, a river basin that is characterised by many manufacturing activities will generally cause more emissions than a river basin that only houses service industries. These relationships can be determined by making use of the regional water accounts.

The water accounts, also known as NAMWA (National Accounting Matrix including Water Accounts), describe the relationship between the physical water system and the economy at national and river basin scale (see also chapter 3.2). NAMWARIB is developed in order to provide information at river basin level and provides economic and environment related information at the level of the four main river basin districts in the Netherlands: Rhine, Meuse, Scheldt and Ems. As the Rhine basin covers approximately 70 percent of the entire Dutch territory, this basin is split into four sub regions: North, East, West, and Central (see figure 3.3.1).

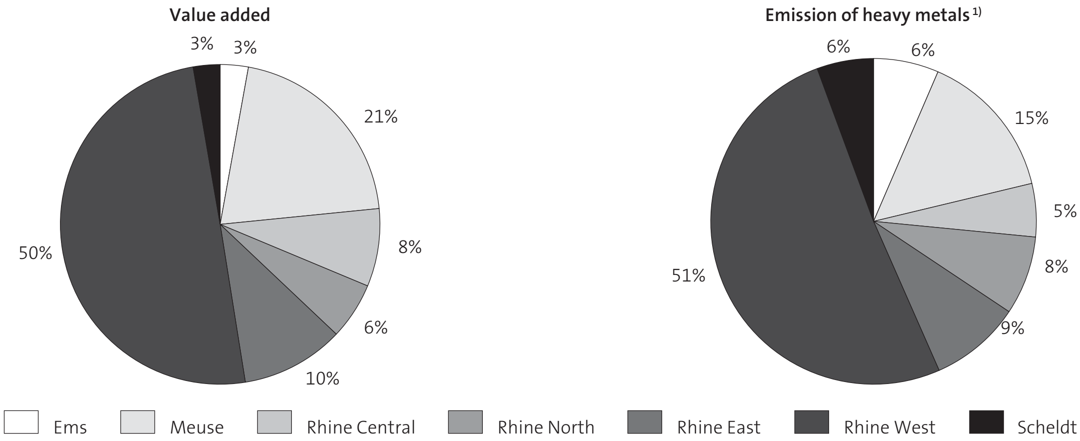
3.3.1 The Dutch main river basins

The regional water accounts are, like the national water accounts, fully consistent with the concepts of the national accounts. In NAMWARIB (National Accounting Matrix including Water Accounts for River Basins), the emission of nutrients and heavy metals to the water are allocated to the economic activities causing these emissions. Key economic indicators (value added, production, employment, and others) for the different economic activities (58 industries) are compiled for the seven different river basins. The methodology of the regional water accounts is described in the report *"Integrated river basin accounting in the Netherlands and the Water Framework Directive"* (Brouwer *et al* 2005). In the Netherlands, data on water emissions are compiled by a number of government institutions working together in the framework of the Pollutant Release and Transfer Register (PRTR). Statistics Netherlands is one of the partners in this project. Regional data on water emissions are also accessible via the website of the PRTR (http://www.emissieregistratie.nl).

A lot of emissions to water in the Rhine West river basin

The river basin Rhine West is the largest river basin and encompasses the urban agglomeration of Western Holland, which is the economic centre of the Netherlands. Accordingly, the Rhine West river basin contributed 50 percent to the Dutch gross domestic product in 2007. Rhine West is also the river basin where producers emit the largest amount of emissions for heavy metal equivalents (51 percent) as well as for nutrient equivalents (28 percent). The river basins Ems and Scheldt have a relatively low share in total value added of 3 percent each. The shares in total heavy metal emissions and total nutrient emissions are 2 to 3 percent points higher than the shares in total value added. This is because of the concentration of some above average emission-intensive activities in this area, such as manufacturing chemicals. The Meuse river basin, which is characterised by a lot of manufacturing activities, has a relatively high share in total value added (21 percent). Its share in total emission of nutrients is equally high, namely 22 percent. Its share in total emission of heavy metals is lower, namely 15 percent. These differences between value added and emission in these different river basins for heavy metals and nutrients can partly be explained by the nature of the different economic activities located in the different areas. Each industry emits its own industry-specific pollutants. In addition, the environmental efficiency for the different economic activities varies.

3.3.2 Value added and emission of heavy metals to water by river basin, 2007, producers



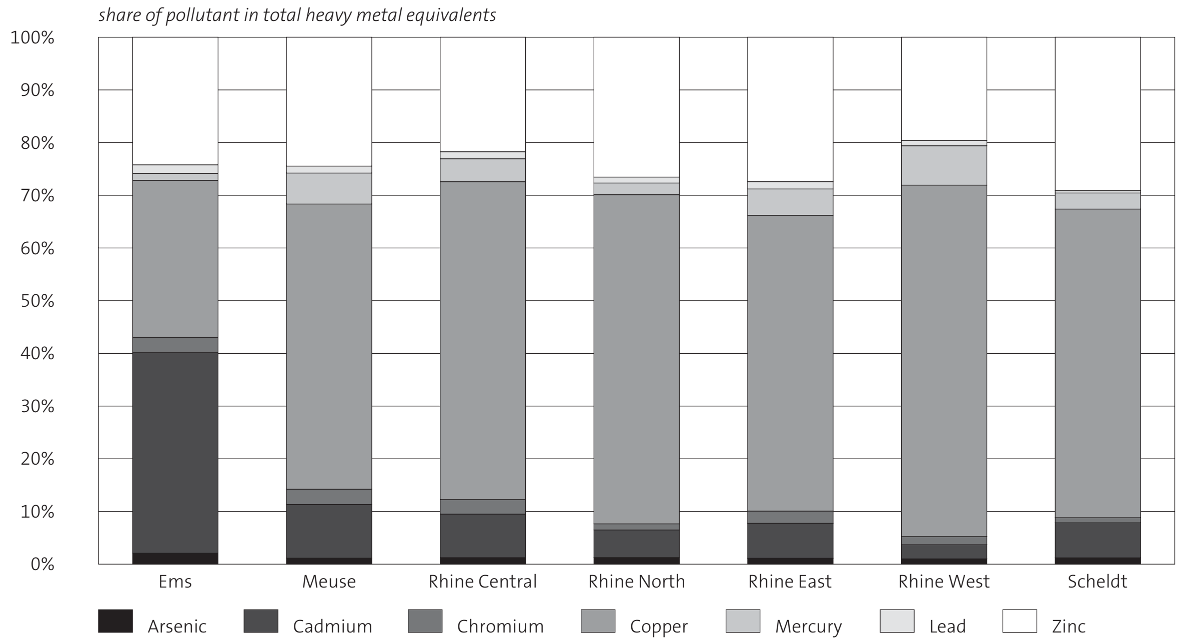
1) Run-off and seepage are included in this analysis. Effluents by sewage and refuse disposal services are excluded.

Looking at the different river basins, we find a great deal of variation for the share of different pollutants (figure 3.3.3). For instance, copper has the highest share in almost all river basins except for the river basin Ems. Pollutants with a relatively less damaging nature like lead, chromium and arsenic have a less prominent share, unless their emission in kilograms is really high. Mercury is a heavy metal that is not emitted in large amounts or by many industries. However, only a small amount of this harmful heavy metal can already cause a considerable share[10]. For example, the activities manufacturing chemicals and chemical products and human health care in the river basin Meuse are responsible for a relatively high share of mercury in total emissions. Human health activities, in particular dentists, are responsible for a relatively high share of mercury emissions in Rhine East and Rhine Central too. In Rhine West in addition to human health care, the relatively high share for mercury is caused by the activities manufacturing of basic metals and manufacturing of chemicals and chemical products. In the less densely populated river basins Ems, Rhine North and Scheldt the population is small and therefore the health services in these river basins are small too. As a result the emissions of mercury are not so high in these areas.

Cadmium, another heavy metal with quite a damaging nature, is predominantly emitted in the river basins Ems and Rhine West. This explains why the share of heavy metal emissions in the Ems area is 3 percent higher than its share in value added. In the Ems area, the manufacture of basic chemicals is largely responsible for the cadmium emissions. The chemical sector is relatively large in this river basin and also relatively emission intensive. The presence of this industry is partly explained by the favourable locations of industrial zones near important shipping routes in this river basin. In the Rhine West area emissions of cadmium are also quite substantial. These emissions are caused by several economic activities such as the industries live stock, manufacture of basic metals, water transport, and arable farming. Due to the presence of lots of other activities in Rhine West, the share of cadmium in total heavy metal emissions is relatively smaller than it is for the Ems area.

10) The damaging nature of different heavy metals varies, which is expressed in different weights for each heavy metal in the equivalent. For example, mercury and cadmium have a more damaging effect on water bodies than chromium and lead. The same applies for the nutrients phosphorus and nitrogen. The weight of phosphorus in the equivalent is ten times that of nitrogen (see Adriaanse, 1993).

3.3.3 Heavy metal emissions to water by producers for the various river basins, 2007[2)]



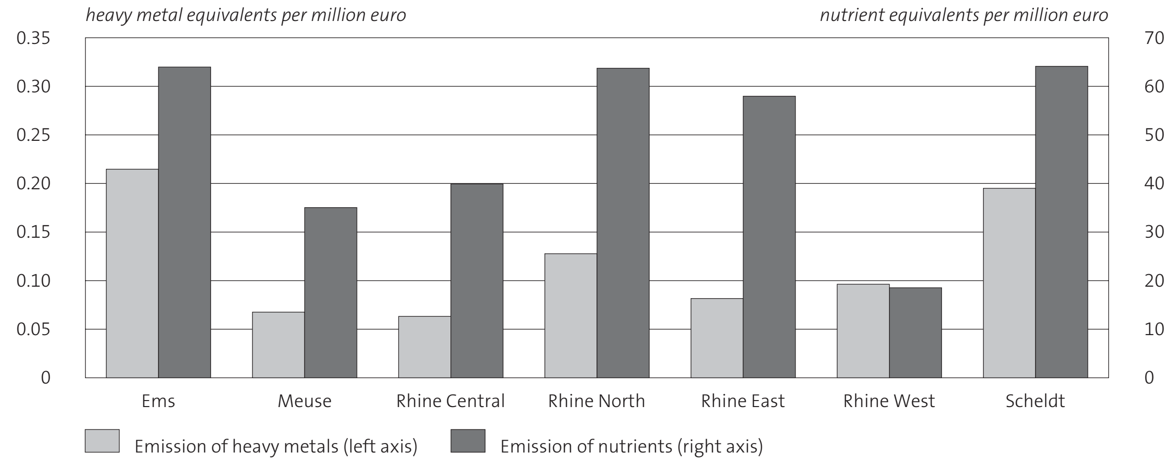
2) Run-off and seepage are included in this analysis. Effluents by sewage and refuse disposal services are excluded.

Low emission intensity in Rhine West and Meuse

Despite the relatively high shares in value added and emissions to water of Rhine West and of the Meuse river basin, their economic activities are relatively emission extensive. Emission intensity is defined here as water pollution (measured in equivalents) per euro value added. In Rhine West river basin this feature especially holds for nutrient equivalents. This difference can partly be explained by the type of economic activities carried out in Rhine West. Rhine West accommodates a relatively great part of the services industries, which are on average less emission intensive. In the Meuse area the emissions intensity is relatively low for both heavy metal equivalents and nutrient equivalents. Livestock is an important activity generating value added in this region. As manure contains a lot of cadmium, zinc and copper, the Meuse region is responsible for the emission of relatively many heavy metal equivalents. One might therefore expect that the emission intensity for agriculture in Meuse river basin is pretty high. However, the realized emission intensity of agriculture in Meuse river basin is relatively low. Much of the manure produced in this river basin is transported to areas other than Meuse. This is triggered by the relatively strict environmental regulation related to manure treatment in the Meuse area (LEI, 2006). It means that the manure intensive livestock industry transports its environmental problems related to manure production to other regions.

In contrast, emission intensity is relatively high in the river basins Ems and Scheldt. This high amount of water pollution per euro value added can partly be explained by the presence of some particular industries in these river basins performing below average with respect to environmental efficiency. The low environmental efficiency in Ems and Scheldt is explained by the more flexible environmental regulations of the local authorities. The discharge permits issued by the Directorate-General for Public Works and Water Management are more flexible in the Ems and Scheldt regions. The water authority fine tunes the permits in accordance with the impact on the aquatic system. For instance, the aquatic system in marine waterways is less vulnerable than small river aquatic systems. This means that although environmental efficiency may have been low in these regions, the actual impact on water quality could be moderate (van Rossum and van de Grift, 2009). However, those flexible regulations for Ems area possibly are about to change as Ems area is one of the European Natura 2000 sites. Natura 2000 is an integrated network of protected nature reserves in the European Union (http://europa.eu). Under pressure of society, organisations for nature conservation and politics, the water authority might set more strict regulations for this area.

3.3.4 Emission intensity per river basin, 2007



Materials

4

Materials

4.1 Material flows

- Extraction mainly consists of sand and gravel
- Physical trade deficit, monetary trade surplus
- Dependency on European countries largest for energy carriers
- Change in domestic material consumption determined by sand and gravel

4.1 Material flows

The consumption of goods affects the environment in many ways. First of all natural resources, needed as input for the production process, are being extracted which may cause their depletion. Secondly, environmentally harmful substances may be released into the environment during the production process. Finally, at some point in time goods are discarded and become waste that needs further treatment. Waste will for the largest part be recycled but some part will end up in the environment, either after incineration or landfilling. Besides these environmental issues, materials, and especially natural resources, play an important role in the industrial production processes. In recent years, the high demand of some resources has led to scarcity and high prices. This development put pressure on the security of supply.

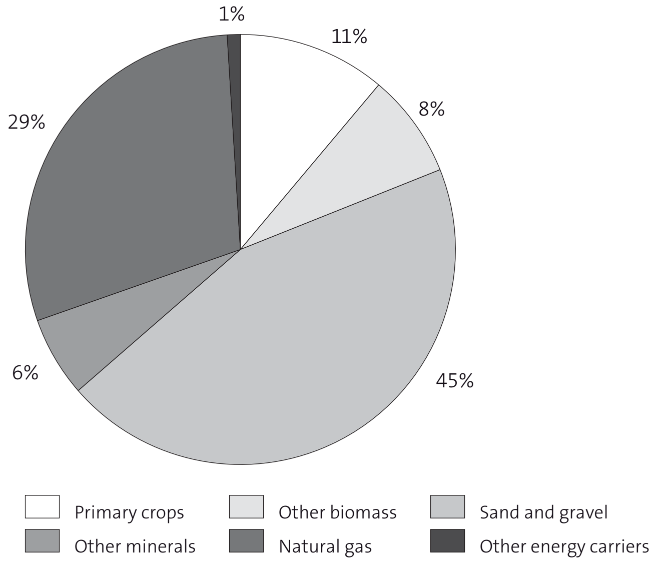
Material flow accounts describe the inputs, throughputs and outputs of goods in the economy in material terms. They include all goods that enter or leave the economy[1)] ranging from raw materials, semi-finished products and final products. All goods are assigned to one of five basic categories – biomass, metals, non-metal minerals, fossil fuels and other products – based on their predominant make-up. Cars for instance are assigned to metals. Material flow accounts support policies that deal with material use, dematerialization and material substitution. For a description of the methodology and definitions used see Delahaye and Nootenboom (2008). The data on materials flows can be found on StatLine, the electronic database of Statistics Netherlands.

Extraction mainly consists of sand and gravel

Domestic extraction of natural resources in the Netherlands (221 billion kilo in 2008) largely consists of gravel and sand. Around 84 percent of the sand and gravel is used for infrastructural projects to raise roads and land for the construction of buildings or to strengthen dikes and coastal defences. The remainder is used in the production of concrete and cement. The extraction of natural gas accounts for 29 percent of total extraction due to the exploitation of the substantial natural gas reserves of the Netherlands.

1) excluding bulk water

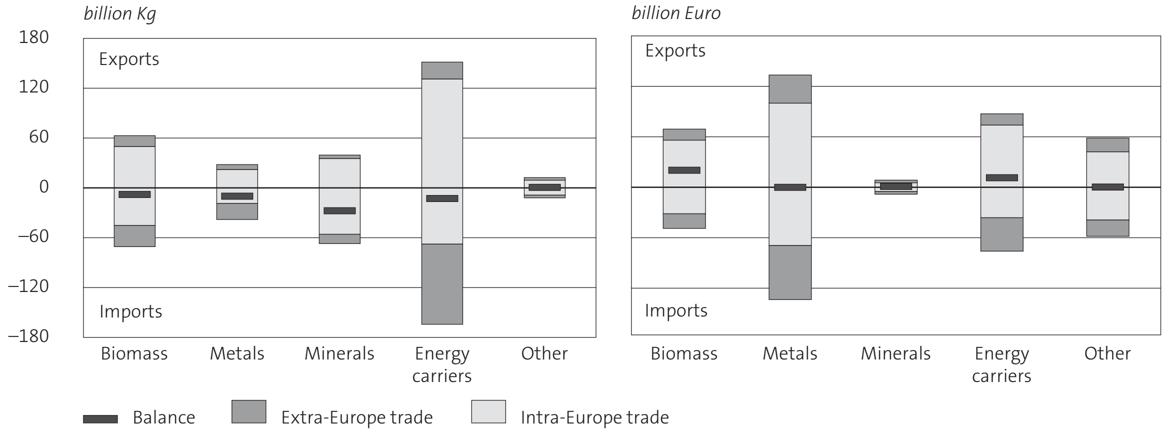
4.1.1 Domestic extraction (total of 221 billion Kg) for the Netherlands, 2008



Physical trade deficit, monetary trade surplus

The extraction of natural resources is not sufficient to meet Dutch domestic demand. Therefore, the Netherlands depend on imports of resources and goods from other countries. At the same time other countries depend on us for their material needs. The Dutch exports of goods amounted to around 300 billion kilos in 2008. Figure 4.1.2 shows the monetary (left hand side) and physical (right hand side) imports (–) and exports (+) for five groups of materials. A distinction is made between flows from and to European countries (intra European) and between flows from and to non-European countries (extra European).

4.1.2 Physical (left-hand side) and monetary (right-hand side) imports (–) and exports (+) for groups of materials by the Netherlands, 2008



The Netherlands have a physical trade deficit which implies that in terms of weight imports of materials exceed exports. At the same time there is a monetary trade surplus indicating that the export value is higher than the import value. The Dutch economy can therefore be characterized as one that turns cheap bulky materials into more expensive high-quality products. The monetary trade surplus is particularly high for biomass due to large exports of, for example, vegetables, flowers and cigarettes. A monetary trade surplus exists also for energy carriers. Imports consist mainly of crude oil while exports consist of more expensive oil products, like petrol, and domestically extracted natural gas. In monetary terms the volume of imports and exports is relatively large for metals and metal products. The metals category includes metal products such as cars and electronics, so due to the high prices per kilo the physical imports and exports of these materials are relatively low.

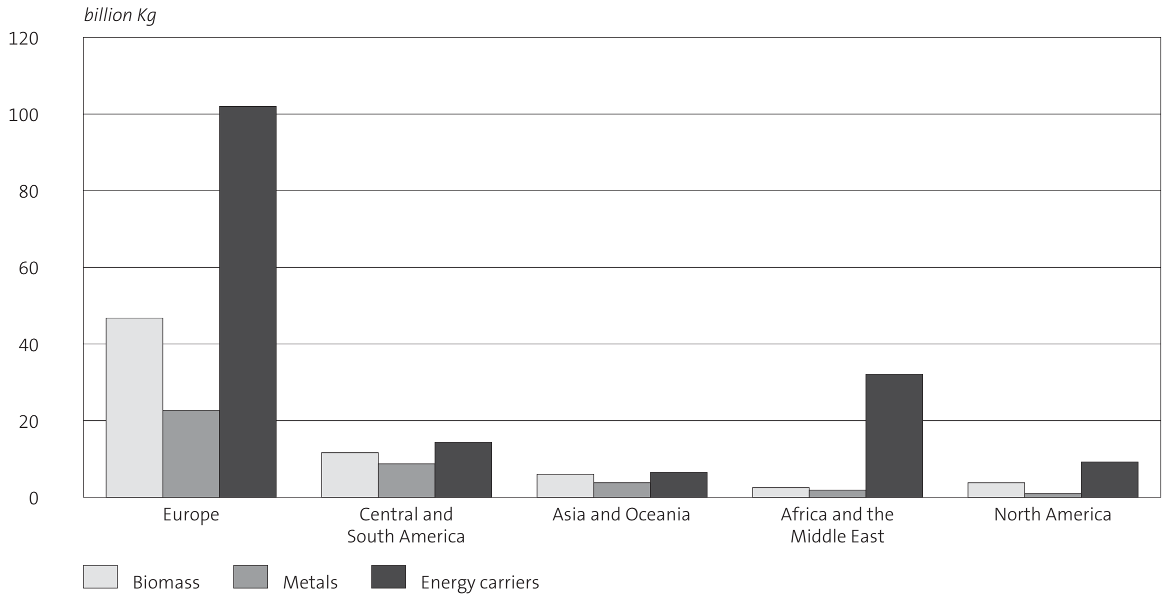
Large physical trade deficit for minerals

The largest physical trade deficit can be observed for minerals. This deficit can be attributed to the large import of sand and gravel. Imports are required because the extraction of sand and gravel in Netherlands is somewhat limited by spatial and socioeconomic constraints. Besides re-exports, imported sand and gravel are mainly used in the construction industry and for the production of concrete and cement. Sand used for infrastructural work, for example as foundation for roads and houses, is not imported.

Dependency on European countries largest for energy carriers

The physical amounts of imports and exports are dominated by energy carriers. Energy carriers and their derived products are for a large part imported from European countries like Norway (natural gas) and Russia (crude oil). Almost all coal comes from non-European regions like South America and Africa. Exports of energy carriers are destined for the European market and consist mainly of petroleum products and natural gas. Biomass flows are also relatively large in physical terms. 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). Imported primary crops consist for 40 percent of cereals. Most of the cereals are imported from France. The import of oil bearing crops, especially soybeans (19 percent), is also relatively large. Soybeans come for the largest part from Brazil and are mainly processed into animal feed. The physical export of primary biomass consists mainly of vegetables and products made from potatoes.

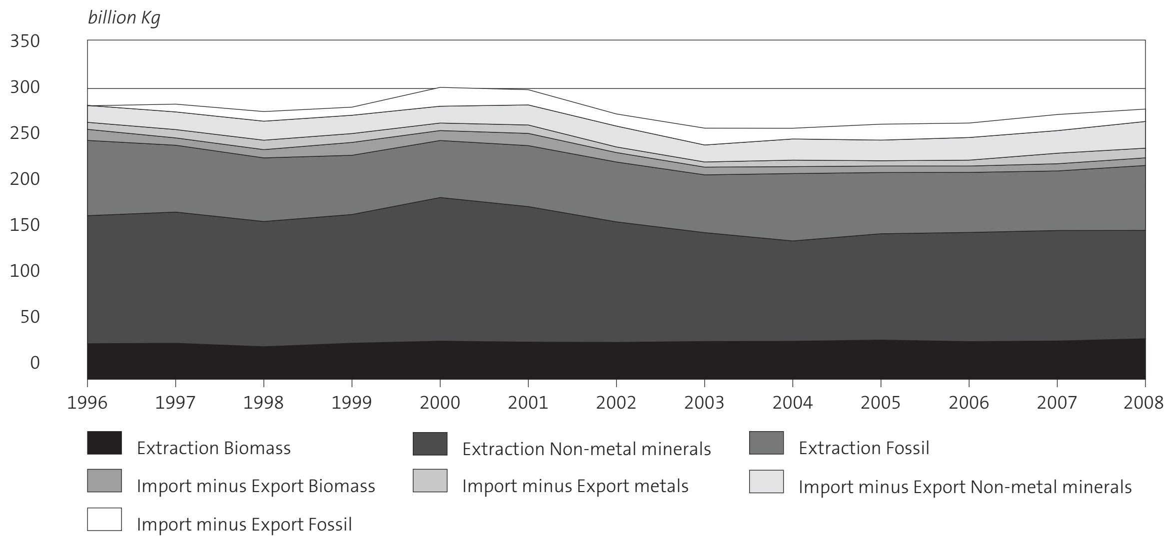
4.1.3 Physical imports for three material categories (primary and processed) for different regions of the world, 2008



Change in domestic material consumption determined by sand and gravel

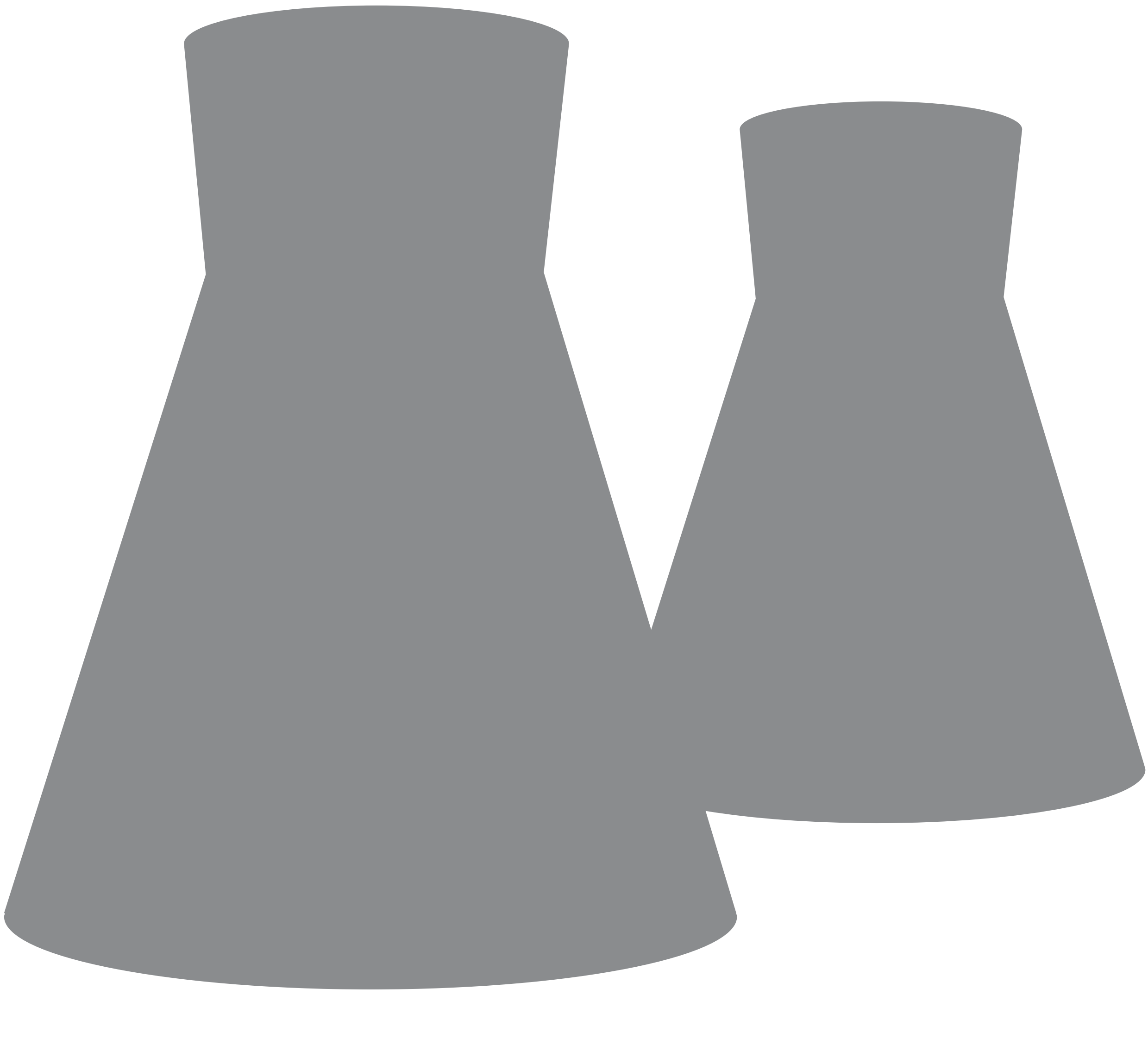
Domestic material consumption (DMC) is an indicator which expresses the total consumption of materials by the economy. It is estimated by adding the amount of extraction to the imports and subtracting the exports. In 2008 the DMC was only slightly lower than in 1996. In the same period the economy grew 36 percent. These findings point to a dematerialization of the Dutch economy. The difference between exports and imports is a relative small part of the total DMC. Therefore, changes in DMC over time are mainly determined by the extraction of materials. In turn, extraction is dominated by minerals and especially sand and gravel. There is a peak around the year 2000, when there was a great demand for sand used for the construction of two high-speed railway links. The expansion of the Rotterdam harbour will raise the demand for extracted sand from 2008 onwards.

4.1.4 Domestic material consumption broken down for extraction and import-export balance for different material categories



Green house gas emissions and air pollution

5



Greenhouse gas emissions and air pollution

5.1

Greenhouse gas emissions according to different frameworks
- IPCC emissions decrease, emissions by economie activities increase
- Emission data and the Dutch climate policy

5.2

Greenhouse gas emissions from production
- Strong increase in greenhouse gas emissions by industries
- Emission intensity deteriorated in 2010
- CO_2 emissions from biomass doubled since 2000

5.3

CO_2 emissions on quarterly basis
- CO_2 emissions in the first quarter of 2011 decreased sharply.
- Strong increase CO_2 emissions by transport in the second quarter 2011

5.4

Air pollution
- Emissions of acidifying pollutants increased again in 2010
- PM10 and emissions of ozone precursors increased in 2010
- Non-greenhouse gas emissions to air not decoupled from economic growth in 2010
- Acidification intensity decreased in all sectors
- Reduced particulate matter emissions driven primarily by improved efficiency

5.1 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 0.74°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 gasses. Enhanced concentrations of greenhouse gasses 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 paragraph we explain the above mentioned frameworks and their resulting estimates. A bridge table (see table 5.1.1) provides insight in the relations between these different conceptions.

5.1. 1 Bridge table for greenhouse gases

	1990	1995	2000	2005	2008	2009*	2010*
	Mton CO_2-eq.						
1. Stationary sources [1)]	187	195	183	182	176	173	185
2. Mobile sources on Dutch territory	34	36	40	42	43	42	43
3. Mobile sources according to IPCC	31	34	38	39	40	38	39
4. Short cyclic CO_2	6	6	8	10	11	12	13
5. Total, IPCC (excl. LULUCF) = 1 + 3 - 4	**213**	**223**	**213**	**211**	**205**	**199**	**211**
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**	**208**	**202**	**214**
8. Actual emissions in the Netherlands = 1 + 2	**220**	**231**	**223**	**224**	**219**	**215**	**227**
9. Residents abroad	15	20	25	25	26	25	25
10. Non-residents in the Netherlands	5	5	6	7	7	6	7
11. Total emissions by residents = 8 + 9 - 10	**230**	**247**	**242**	**242**	**238**	**233**	**246**

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

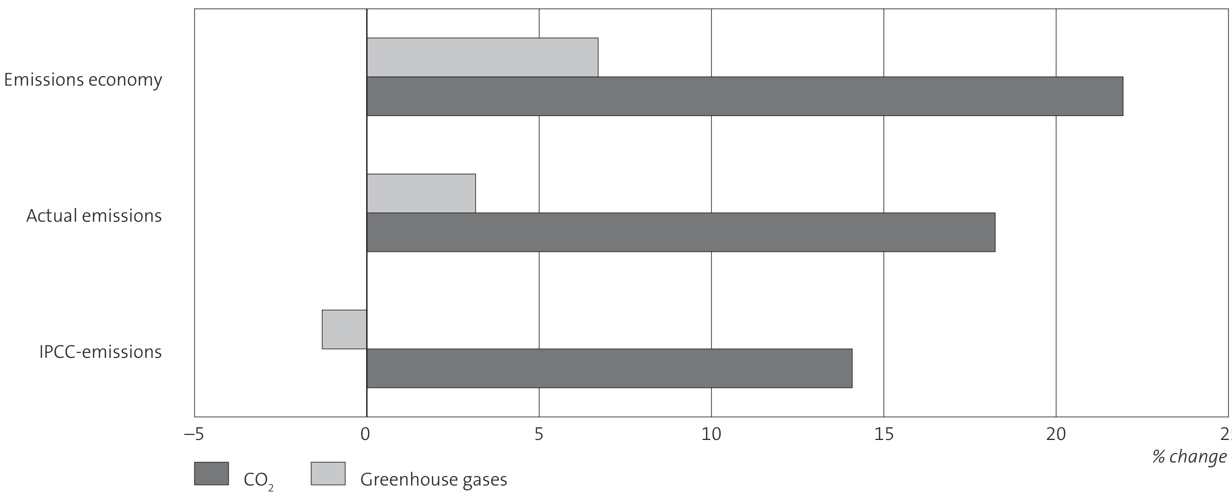
Statistics Netherlands annually publishes the actual greenhouse gas emission for the Netherlands. These are greenhouse gas emissions that actually take place within the Dutch territory. In contrast to the IPCC guidelines, all emissions by mobile sources that occur within the Dutch territory are accounted 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.

5.1.2 Change in CO_2 and greenhouse gas emissions between 1990 and 2010 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 211 Mton CO_2 equivalents in 2010[2)]. This is 1.3 percent below the emission level in 1990, the base year for the Kyoto Protocol. The CO_2 emissions, however, increased by 14 percent during this period, which was less than the reductions in emissions of all other greenhouse gases (CH_4, N_2O, F-gases). This puts the Netherlands on course to realise its Kyoto targets (see below). The emissions of greenhouse gases generated by the Dutch economy were equal to 246 Mton in 2010 and increased by 6.7 percent between 1990 and 2010. 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 increased since 1990 (3 percent). Accordingly, the IPCC emission data presents the most optimistic viewpoint.

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 for the period 2008–2012. To meet its Kyoto target, the Netherlands will make use of the three flexible Kyoto mechanisms, namely emission trading, Joint Implementation (JI) and Clean Development Mechanism (CDM). As the Dutch government aims to acquire 13 Mton CO_2 eq. from emission permits abroad (JI and CDM projects) the domestic emission target is 213 Mton CO_2 eq. each year.

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 in 2020 an emission reduction of at least 20 percent compared to 1990. For the Netherlands this amounts to an emission reduction of 16 percent in 2020 with respect to emission levels in 2005. 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 compared with the estimated use in 2020), renewable energy (20 percent of the final use of the EU in 2020) and bio fuels (minimum 10 percent of the total fuel consumption in 2020).

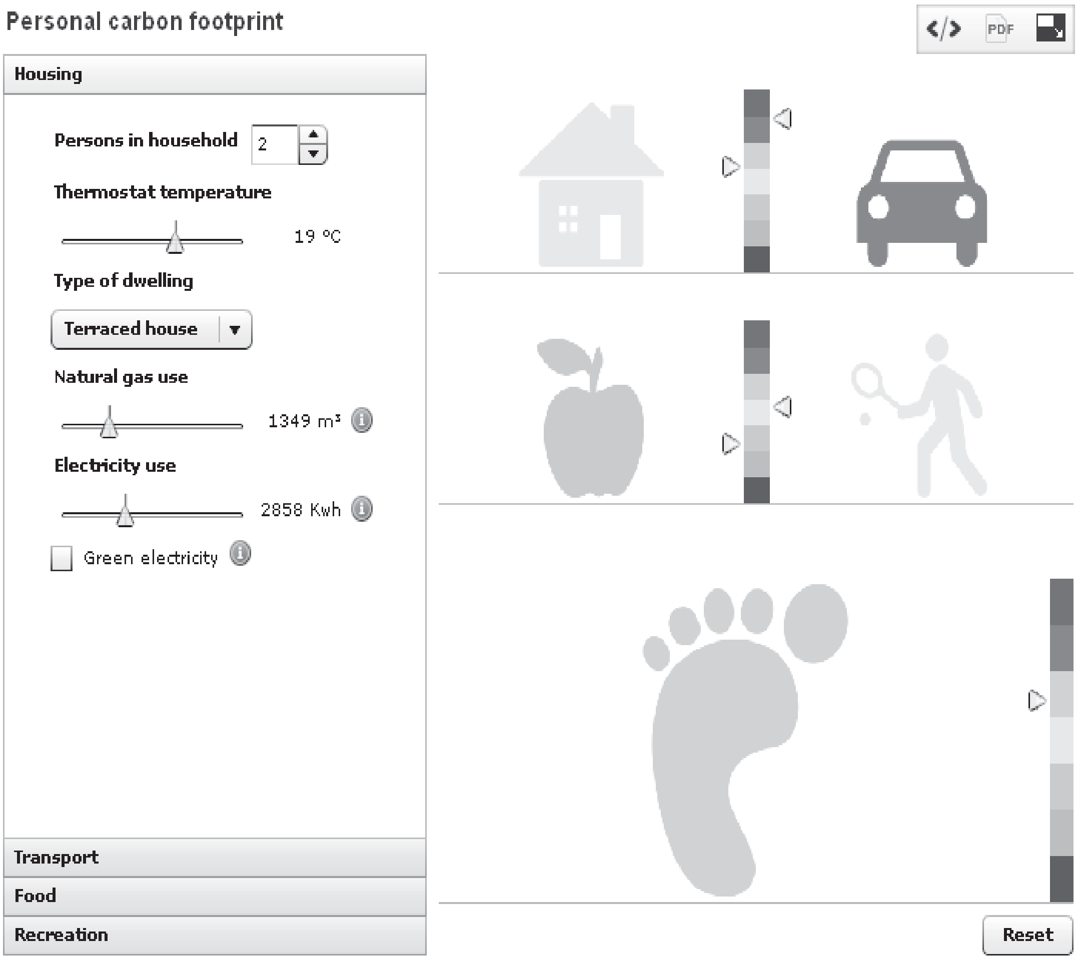
The Dutch climate policy and emission targets are primarily based on the emissions as calculated by the IPCC guidelines. These emissions, however, do not provide a complete picture of all emissions related to Dutch (economic) activities. Particularly, emissions caused

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.

Emissions from consumption

The *'personal carbon footprint'* is an interactive internet application that estimates greenhouse gas emissions related to consumption habits. Your personal footprint is compared with the Dutch average in the areas of living, transport, food and recreation. The impact of changing your diet or the size of your car can be derived. Not only direct emissions (e.g. from driving a car or heating) but also indirect emissions (e.g. from production of food or public transport) are taken into account. Indirect emissions are estimated using input-output analysis (a.o. Edens et al., 2011).



Source: Statistics Netherlands

Edens, B., Delahaye, R., Rossum, M. and Schenau, S. (2011) Analysis of changes in Dutch emission trade balance(s) between 1996 and 2007, Ecological economics, 10.1016/j.ecolecon.2011.07.006

5.2 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).

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

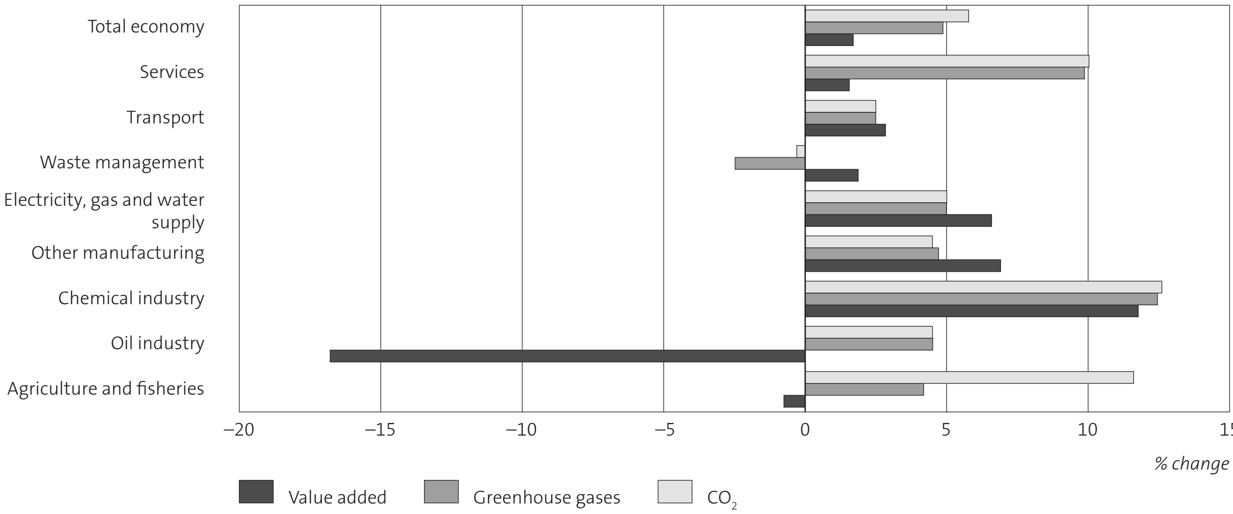
Strong increase in greenhouse gas emissions by industries

The total greenhouse gas emissions by industries equalled 203.1 Mton CO_2 eq. in 2010, which was 4.9 percent higher than the previous year[3]. CO_2 emission even increased by 5.8 percent. The main reason for this strong increase is the higher energy consumption due to the economic recovery and the low temperatures in the winter months (see also paragraph 2.1). Emissions of nitrous oxide and methane decreased by 1 and 2 percent respectively.

In agriculture, greenhouse gas emissions rose by 4 percent, primarily due to higher combustion of natural gas in horticulture. Methane emissions from cattle remained stable. In manufacturing, emissions increased in most industries. Particularly in the chemical industry, basic metal and the refineries, where the production processes are very emission intensive, emissions rose fast. The increased demand for products from these industries for exports is the main driver for the higher emissions. Waste management produced less greenhouse gas emissions. Although CO_2 emissions from waste incineration increased, the methane emissions from land fill sites decreased by 7 percent. These emissions have been decreasing steadily over the years as waste deposited in landfill sites has been reduced and historic emissions from existing sites are becoming less every year. The increased emissions in the transport sector closely follow the greater transport activities. Finally, in the service sectors, emissions increased as more natural gas was combusted for heating offices.

[3] The total emissions by the economy, which includes emissions by households, equalled 245.8 Mton CO_2 eq. (see also paragraph 5.1), which is 5.3 percent higher than in 2009.

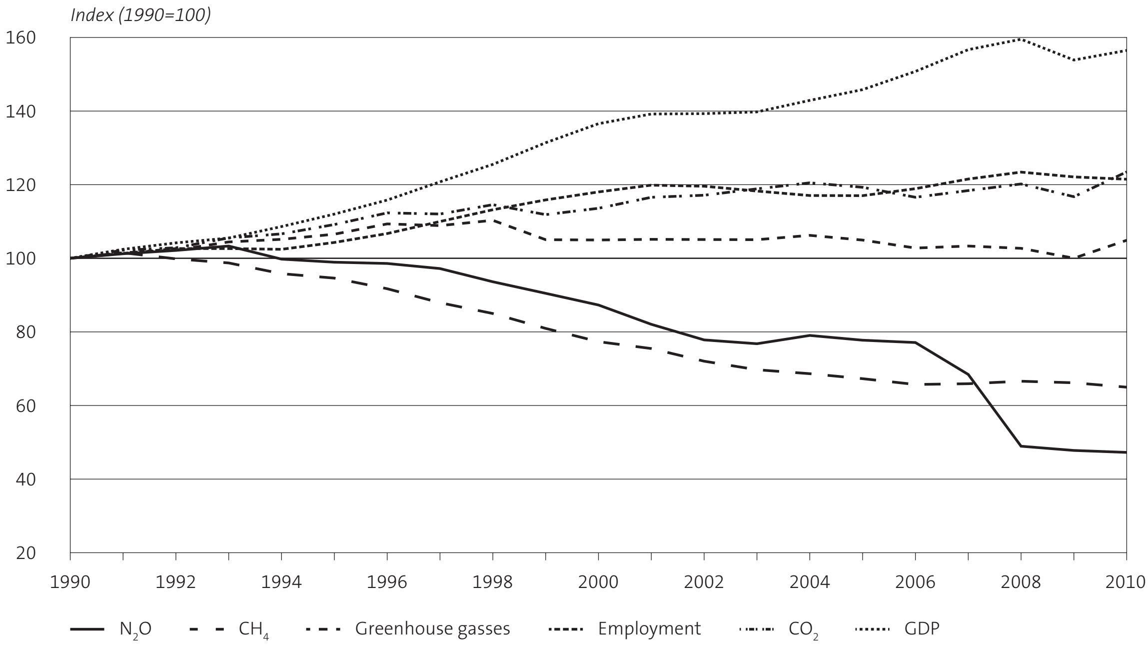
5.2.1 Change in value added, greenhouse gas and CO_2 emissions, 2009–2010



Emission intensity deteriorated in 2010

In 2010 the economy grew by 1.7 percent, whereas the increase in greenhouse gas emissions was 5 percent. The emission intensity for greenhouse gases, which is an important measure of the environmental pressure caused by economic activities, deteriorated for the second year in a row. The main reason is the cold winter months of 2010. As a result more energy was used for heating offices and greenhouses in horticulture, causing more CO_2 emissions per unit output. In manufacturing, with the exception of the manufacture of chemicals, and energy supply the emission intensity improved.

5.2.2 Volume change GDP, employment and greenhouse gas emissions by industries

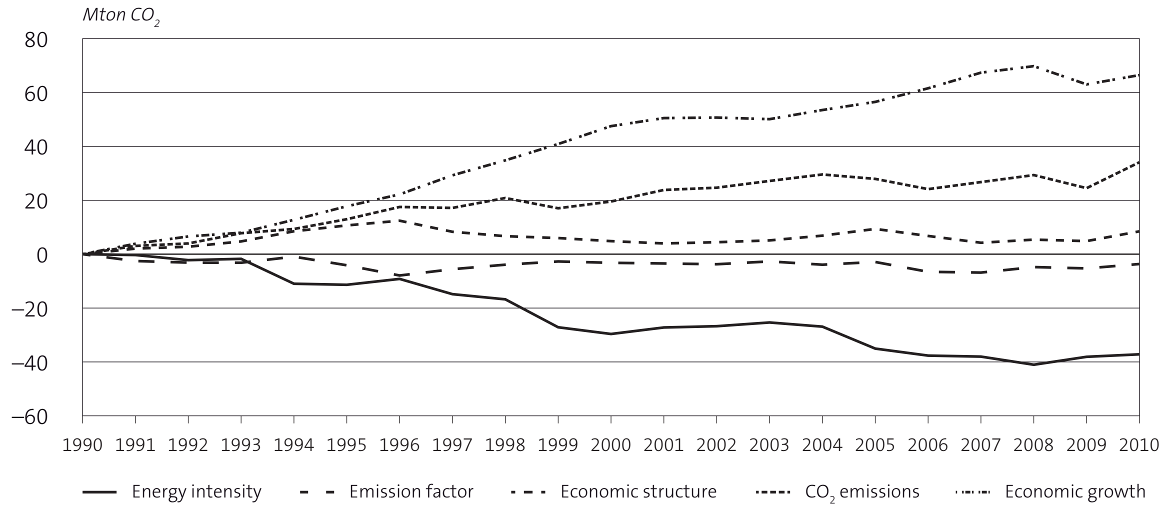


Considering the rather long time period 1990–2010, we see that economic growth was considerably higher than the increase in greenhouse gas emissions. While the economy grew at a rate of 56 percent and employment by 21 percent, the emissions of greenhouse gases by industries increased only by 5 percent. Accordingly, relative decoupling took place in the Netherlands: i.e., the growth rate of greenhouse gases from production processes was lower than the GDP growth rate. Absolute decoupling only took place for methane and N_2O emissions.

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 1990–2010 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.

5.2.3 Structural decomposition analysis of CO_2 emissions



During the last twenty years 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 (emission factor and energy intensity effect). Emissions would have been about 66 Mton 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 in particular. Structural changes in the economy or a change in the mix of energy products clearly had less effect on the total change in emissions. The increase in emissions between 2009 and 2010 is the result of both economic growth and a worsening of the energy intensity.

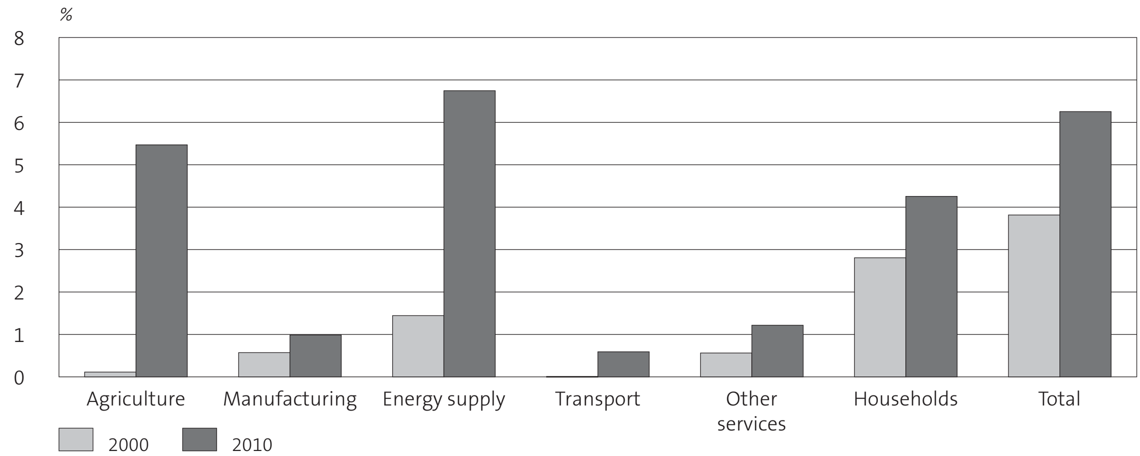
Increase of CO_2 emissions from biomass

CO_2 emissions from biomass doubled since 2000

CO_2 is captured from the atmosphere during the growths of plants. When this plant material is used, for example as food, fuel or during waste processing, the sequestered carbon is returned again as CO_2 to the atmosphere within a rather short time period. CO_2 that originates from biomass is therefore called short cyclic CO_2, as opposed to CO_2 originating from fossil fuels. The emission of short cyclic CO_2 is generally not taken into account in many emission reports (such as the IPCC) as there is no net contribution to the CO_2 concentration in the atmosphere (see also paragraph 5.1). The share of short cyclic CO_2 is an important indicator to monitor the transition to a bio based economy.

Short cyclic CO_2 emissions in 2010 amounted to 13.5 Mton, which is 6.3 percent of the total CO_2 emissions from economic activities. In the last decade this share has almost doubled. In energy supply, combustion of biomass for the production of electricity has increased, primarily to achieve targets set for renewable energy production. Subsidies for renewable energy production made this increase possible (see also chapter 9). Most of this biomass is imported. In agriculture the application of biomass combustion in livestock farming has increased rapidly in recent years, particularly because biogas produced from manure is used. In transport the percentage of short cyclic CO_2 has increased in a few years time from zero to 0.6 percent after the introduction of compulsory adding of bio fuels to diesel and petrol. This is also the reason why the share of households in total biomass related emissions has increased during the last few years. In manufacturing the share of short cyclic CO_2 is still relatively low. This reflects that manufacturing is still primarily dependent on the input of fossil fuels. Environmental services have the highest share of all industries (70 percent). This share, however, has been steadily declining as relatively more non-biomass waste is incinerated.

5.2.4 Share of short cyclic CO_2 emissions in total CO_2 emissions



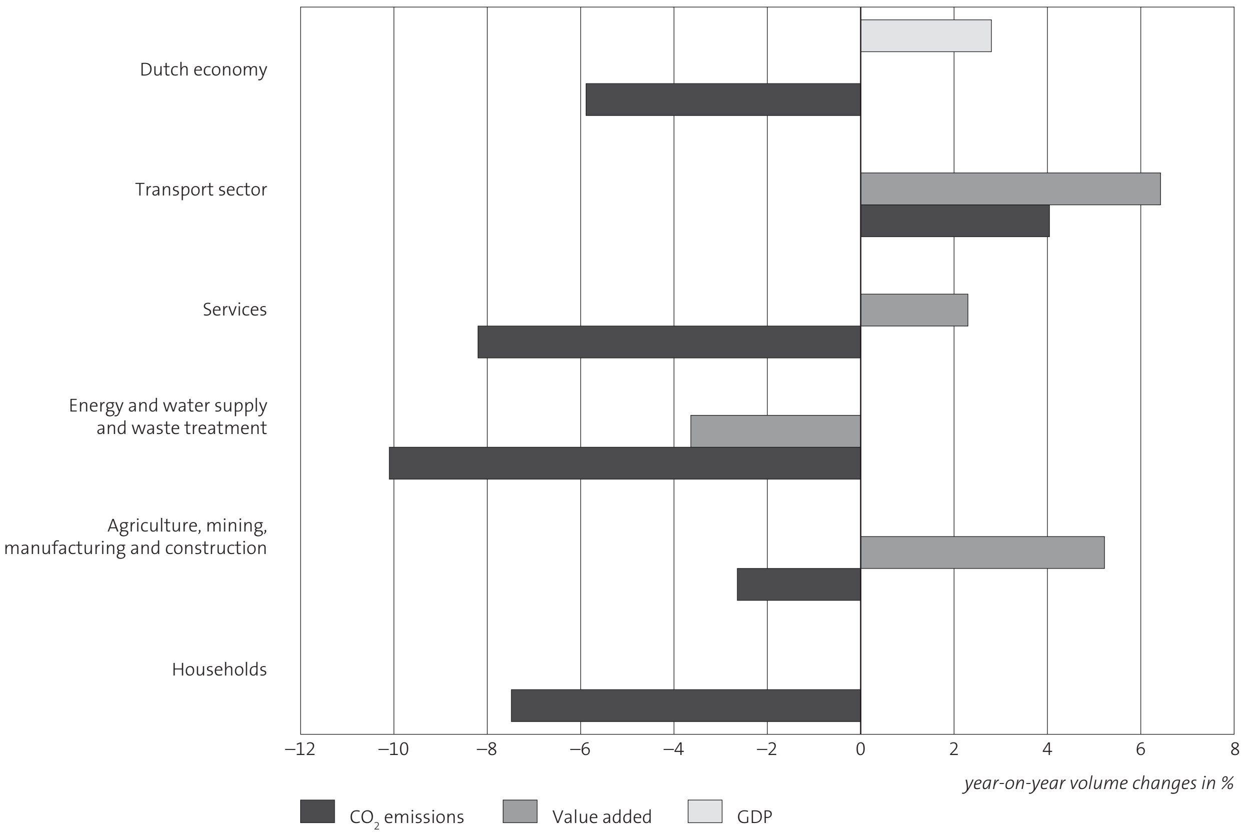
5.3 CO_2 emissions on quarterly basis

Accurate and timely measurements of the amount and origin of the emitted greenhouse gasses 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 the first estimation for quarterly GDP is published. The quarterly CO_2 emissions are compatible with national accounts, and thus can be linked directly to economic output allowing the comparison of the environmental performance of different industries.

CO_2 emissions in the first quarter of 2011 decreased sharply.

In the first quarter of 2011, 5.9 percent less CO_2 emissions were emitted by Dutch economic activities than in the same quarter in 2010. The economy grew by just 2.8 percent, according to Statistics Netherlands' provisional estimates.[4)] The CO_2 emissions of Dutch economic activities are calculated according to the definitions of the Environmental accounts.

5.3.1 Change in CO_2 emissions and economic development, first quarter of 2011



The decrease in CO_2 emissions by 5.9 percent was mainly the result of a relatively warm first quarter in 2011 compared to 2010. Especially horticulture, households and services had lower CO_2 emissions as a result of less space heating.

The energy sector emitted less in the first quarter of 2011 than the year before. This is because the energy companies in the Netherlands generated less electricity in the first quarter of 2011 than in 2010. Electricity generation by means of coal and natural gas combustion goes along with a lot of CO_2 emissions. The lower production of electricity in the Netherlands was offset by additional imports of electricity. The development in value added of the energy sector was negative in the first quarter of 2011.

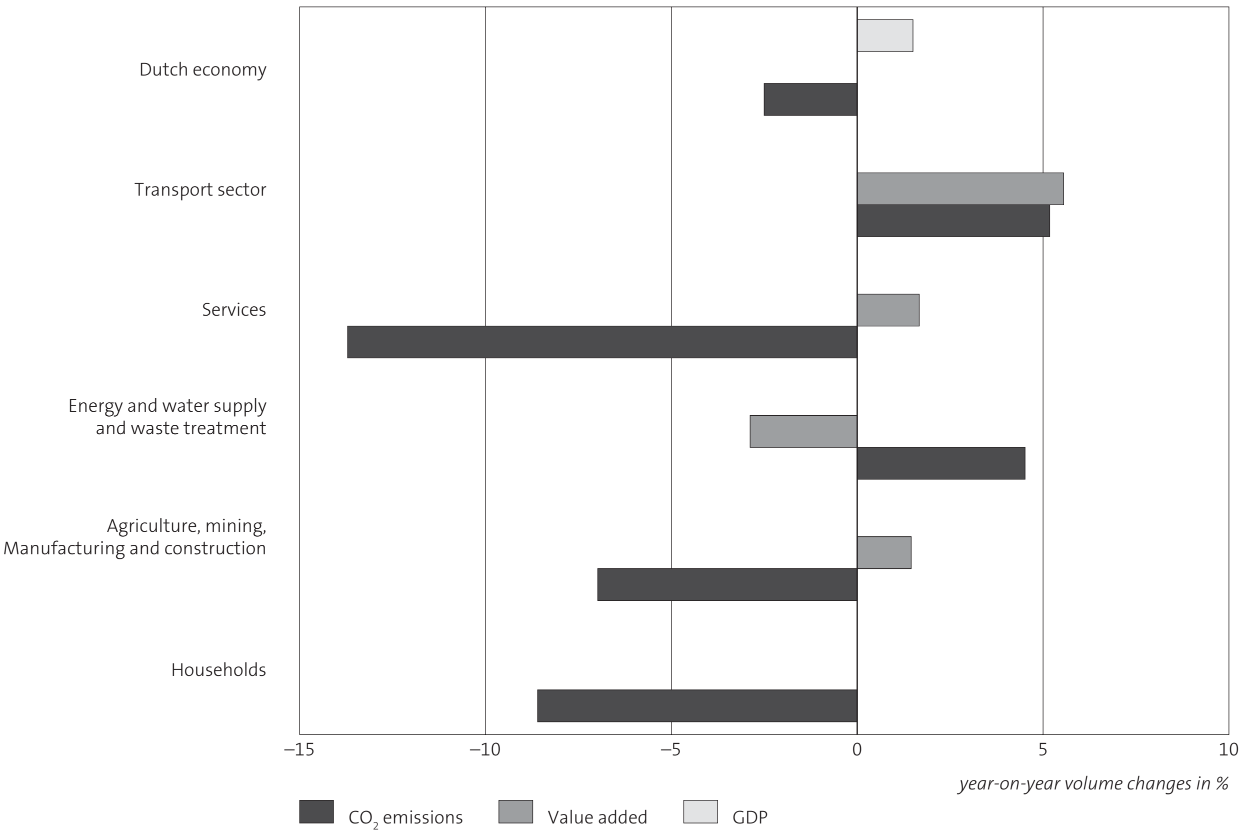
4) Source: Statline; 3 October 2011.

The transport sector rebounded in the first quarter of 2011. The increase in value added in the transport sector was slightly over 6 percent. The CO_2 emissions also increased by 4 percent, due to the additional transport movements. Especially inland water transport and road transport emitted substantially more CO_2. The airliners have emitted more because they flew more. Within manufacturing, CO_2 emissions have remained fairly stable. The chemical industry emitted a bit less CO_2 emissions by reducing the residual gases used.

Strong increase CO_2 emissions by transport in the second quarter 2011

In the second quarter of 2011, 2.5 percent less CO_2 emissions were emitted by Dutch economic activities than in the same quarter in 2010. The economy grew just 1.5 percent, according to Statistics Netherlands' first provisional estimates.[5)] The CO_2 emissions of Dutch economic activities are calculated according to the definitions of the Environmental accounts.

5.3.2 Change in CO_2 emissions and economic development, 2nd quarter of 2011



The spring of 2011 was sunny and very warm compared to 2010. Especially horticulture, households and services lowered their CO_2 emissions due to less space heating than in the

5) According to the second estimate of Statistics Netherlands, the Dutch economy grew 1.6 percent in the second quarter of 2011. This second estimate of economic growth is 0.1 percentage point higher than the first estimate of August 16.

second quarter of 2010. This is the main reason for the decoupling between economic growth and CO_2 emissions in the second quarter.

Less CO_2 emissions emitted in the second quarter of 2011

Production shrunk especially in the emission-intensive manufacturing in the second quarter. In the refinery and the basic chemicals industry production levels decreased. The decline in production was associated with less energy use and therefore less CO_2 emissions. The electricity companies emitted more in the second quarter of 2011 than in the previous year. In particular, the consumption of coal for electricity generation increased. Combustion of coal goes along with more emissions than the combustion of natural gas for the same purpose. Production of electricity went up due to stronger domestic demand and lower imports of electricity from abroad. The transport sector performed well in the second quarter, growing by 5.6 percent. The emission of CO_2 increased by 5.2 percent. Especially inland and air traffic emitted substantially more CO_2 due to more transport movements. Also transport by road grew considerably in the second quarter.

5.4 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 (see paragraph 5.1 and 5.2). The air emissions discussed in this chapter, such as particulate matter or nitrogen oxides, have a local impact on human health or an impact on quality of the local 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.[6)]

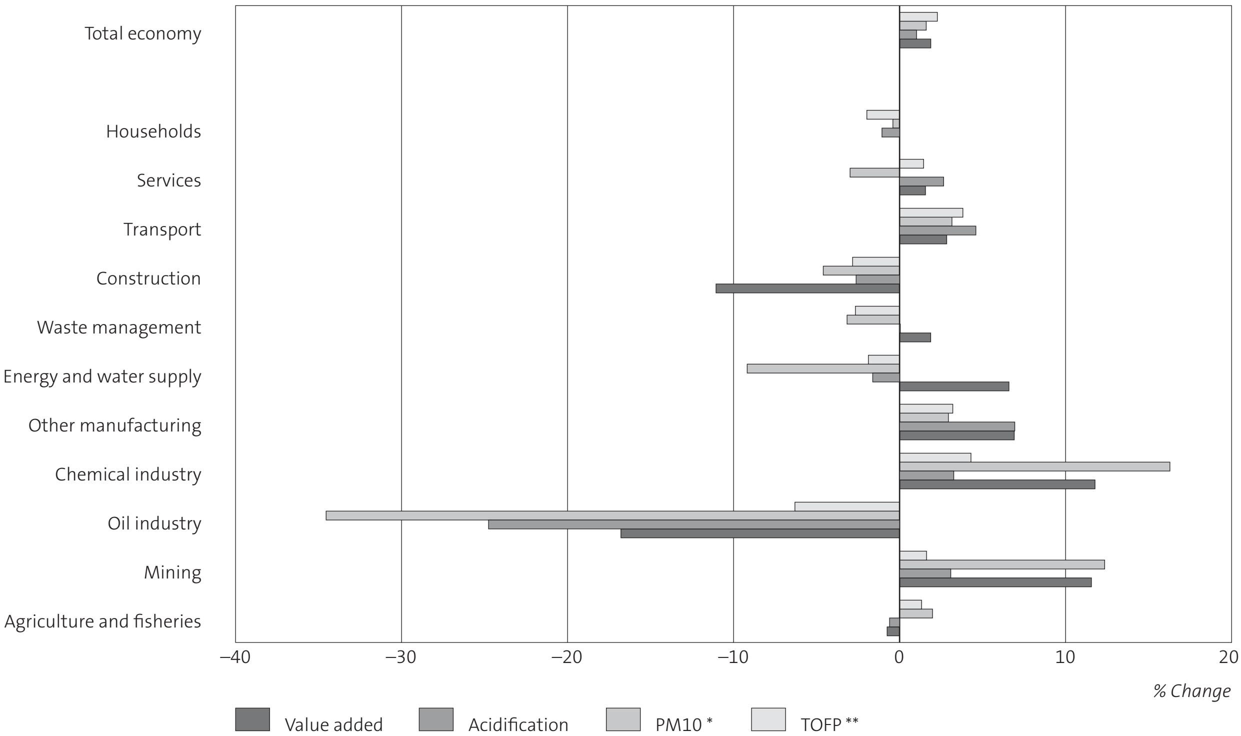
For a description of the methodology used see CBS (2010). The data of the air emission accounts can be found on StatLine, the electronic database of Statistics Netherlands.

[6)] 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 increased again in 2010

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 strong 5 percent decrease in 2009, increased again in 2010 by just 1 percent. Since 1990 acidifying emissions have been halved (minus 51 percent). As a result of the economic recovery in 2010, emissions increased slightly due to the increased output of several economic activities, predominantly in manufacturing. However, strong differences exist in timing and magnitude of the economic recovery between industries and the related acidifying substances and environmental themes. [7)]

5.4.1 Change in value added, emissions of acidifying substances, particulate matter (PM10) and smog, 2009-2010



* 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 2010 rose by 2 percent. Transport, in particular transport over water and to lesser extent air transport were the main contributors to this increase. In road transport the growing fleet of vehicles with cleaner engines together with less fuel consumption helped to cut emissions. Electricity companies reduced NO_x emissions again in spite of burning more (fossil) hydrocarbons and rising electricity production. Strict environmental measures taken at power plants have resulted in emissions being less than a third of 1990 emission despite the soaring electricity production. Households too have steadily decreased their NO_x emissions to one third of the 1990 emission level. This is predominantly due

7) Figures for 2010 are provisional, as some sources are not complete and/or definitive.

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 increased by 1 percent in 2010. Sulphur dioxide emissions are mainly caused by water transport (58 percent), followed by the oil industry (12 percent), air transport (7 percent) and electricity production (6 percent), and basic metal industry (5 percent). Several industries with large emissions that were hit by the 2009 recession and decline of international trade, began to recover in 2010 affecting emission levels. Moreover, advancing technology and implementation of policies cause an impact on 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 significant reduction again of 29 percent after having achieved a 30 percent reduction already in 2009. 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 concentration.

Ammonia emissions, primarily stemming from livestock and from the application of manure on arable land, stayed practically at the same level in 2010 as in 2009. 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 2010. The shares of SO_2 and NH_3 has decreased since 1990.

PM10 and emissions of ozone precursors increased in 2010

The total emissions of particulate matter in 2010 increased by 1 percent compared to 2009. Especially the chemical industry, transport sector (except for road transport), and the manufacturers of basic metals showed significant increase in emissions in 2010 as a first sign of economic recovery after the 2009 crisis. 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 growth of 1 percent across all activities.

5.4.2 Contributions to value added and environmental themes in 2010

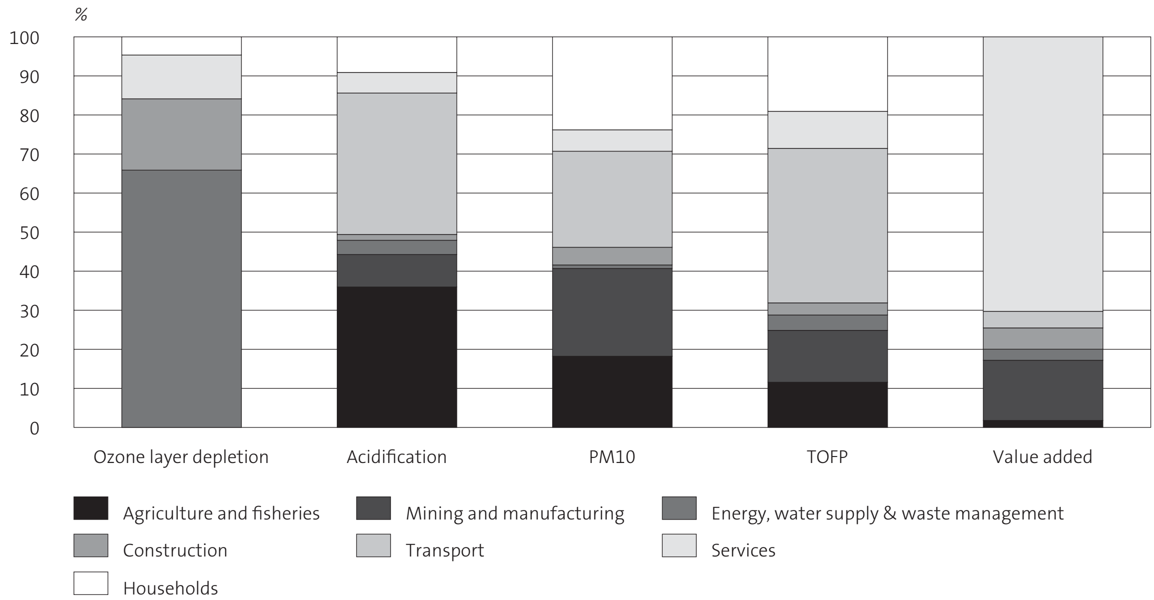


Figure 5.4.2 provides a breakdown of the environmental themes and value added in 2010 by economic sectors and households. It demonstrates that whereas services (excluding transport) are responsible for 70 percent of value added, their contribution to environmental themes is small with 11 at most. Acidification 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.

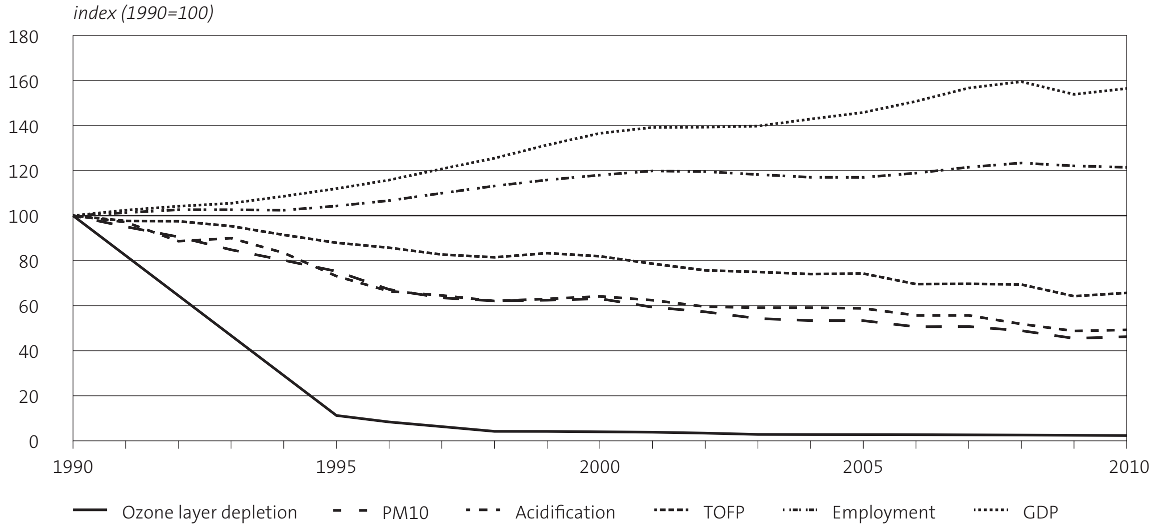
Non-greenhouse gas emissions to air not decoupled from economic growth in 2010

Between 1990 and 2010 the Dutch economy grew at a rate varying between 0 to 5 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 half or more, with the exception of CO_2 emissions (for details see paragraph 5.2) and emissions that contribute to tropospheric ozone formation (minus 34 percent). The drop in all local air pollutants described in this paragraph implies that both absolute and relative decoupling have taken place in the Netherlands since 1990[8)]. Gasses contributing to ozone layer depletion were no exception, showing relative and absolute decoupling. However, 2010 showed a different trend for local air pollutants that contribute to acidification, tropospheric ozone, and particulate matter. For those three environmental themes principally no absolute decoupling was observed, as previous levels of emission were restored. More surprisingly also no relative decoupling was found for tropospheric Ozone and particulate matter. Next to ozone

8) 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 occurs when the emission of a pollutant is stable or decreases while the economic driving force shows growth. Decoupling is supposed to be relative when the growth rate of a pollutant or environmental theme is positive, but less than the growth rate of the economic variable.

layer depletion, only acidifying substances showed relative decoupling. This observation may not be surprising because of the strong decline in the emissions of local air pollutants in 2009 due to the strong economic downturn. Looking back over a longer period and comparing the size of the Dutch economy and employment in 2010, these appear to be back at exactly the 2007 levels, while emissions of local non-greenhouse gasses have been cut by 6 to 12 percent in the same three year period.

5.4.3 Volume changes in GDP, employent and several environmental themes



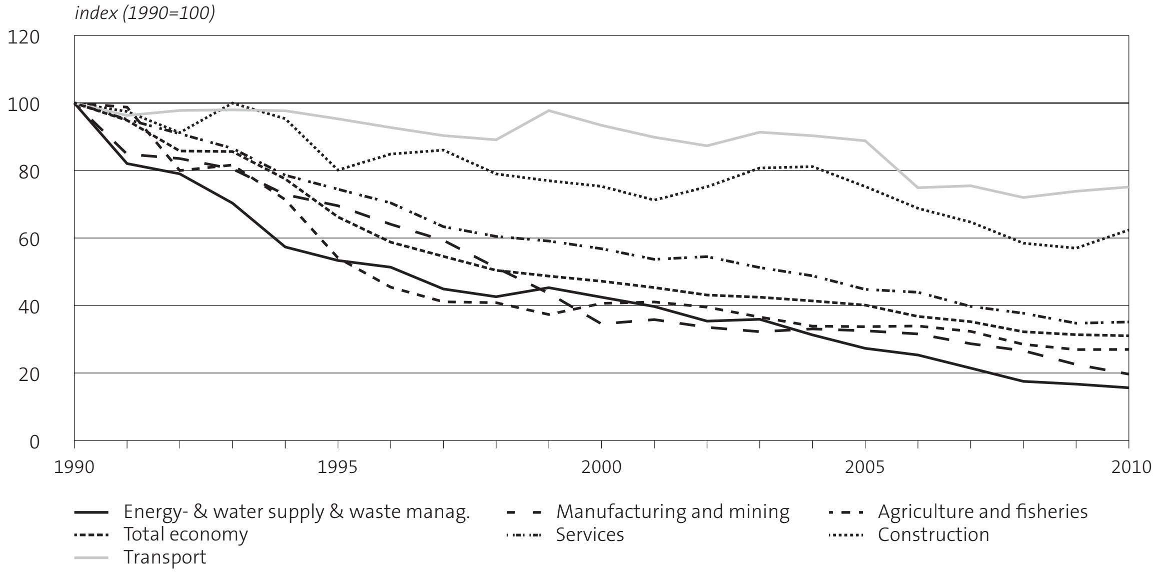
Emissions of particulate matter by industry in the last twenty years never have increased by more than 1 percent per year, except for 2010 (2 percent). At the start of the century yearly reductions averaged around 3 percent after a series of steep reductions in the nineties. The easiest reduction measures thus seem to have been implemented already. Finding new possibilities for reductions appears to be harder.

Acidification intensity decreased in all sectors

The emission intensity is equal to the amount of emissions per unit of value added. In the last twenty years the emission intensity for acidifying substances was gradually reduced by 69 percent for the economy as a whole. This sharp decrease was achieved in all business sectors. For each single year in the same period the intensity for the economy as a whole has gone down. Only transport and construction are lagging behind with reductions of only 25 and 38 percent respectively. For transport this is related to a combination of nitrogen oxides from combustion and sulphur dioxide related to the sulphur content of fuels that proved hard to be reduced.

Manufacturing and mining and energy supply and waste management companies yielded the best environmental performance over the last twenty years. Their emission intensity in 2010 was less than 20 percent of the 1990 emission intensity level.

5.4.4 Development emission intensity for acidification



Reduced particulate matter emissions driven primarily by improved efficiency

In order to better understand the pattern of PM10 emissions over time, a structural decomposition analysis (SDA) was done for the period 1990–2010. SDA is an instrument that provides information about the driving forces behind emissions.[9] Figure 5.4.5 demonstrates that growth of economic activities in the last twenty years would have caused emissions of acidifying substances to be 29 percent higher. Fortunately, the impact of economic growth was offset by several other driving forces.

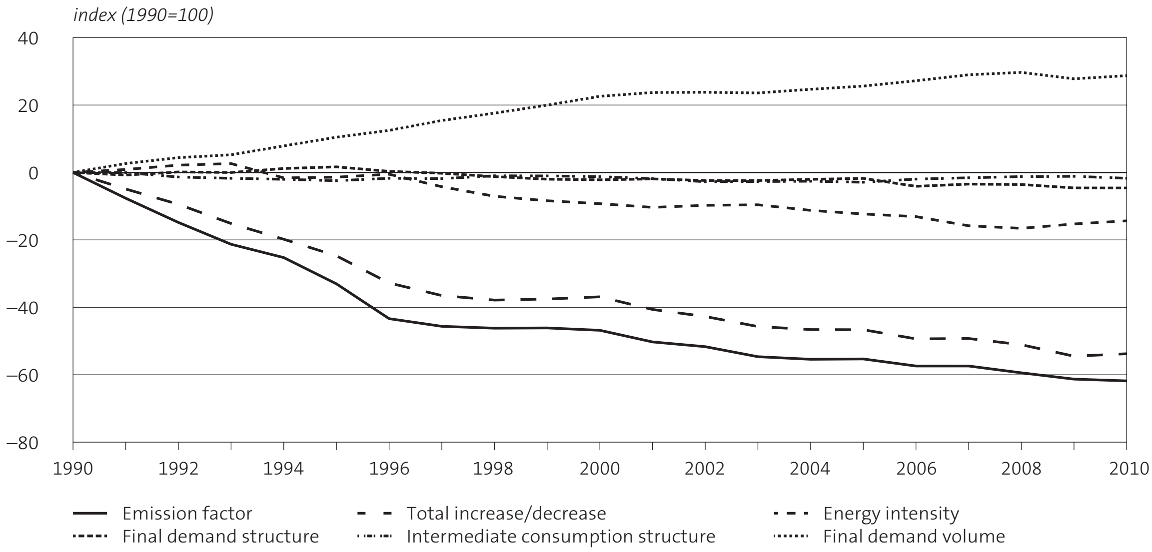
The main driver is emission intensity improvement, which we broke down into two aspects: the effect of improved emission factors (i.e. less emissions per unit of energy use) and lower energy intensities (i.e. less use of energy per unit value of output) that contributed 62 and 14 percent respectively to the reduction of the original 1990 emissions of 64 mln. kg. Changes in the composition of final demand and the structure of the economy contributed another 5 and 2 percent respectively towards emissions reduction. The result of these driving forces is an overall emission reduction of 54 percent.

The decomposition analysis underpins that in the early nineties reductions were primarily achieved by technological measures that improved combustion processes as well as end-of-pipe technologies such as filters and air scrubbers, which resulted in lowered emission factors. Strong improvements were achieved with emissions from stationary sources. After these low hanging fruits were picked, further reductions are driven by innovation and application of more integrated technologies, those partly stimulated by stricter regulations. Examples are the reduction of the sulphur content of marine fuel oil and reductions in road transport via adjusted fuels and engines as a direct result from tightening emission rules. Reduction in the

[9] The methodology of the SDA can be found on the website of Statistics Netherlands (www.cbs.nl), the section being dedicated to the Environmental Accounts and background documents.

energy intensity particularly provided a contribution to reduced particulate matter emissions from the mid 1990-ies till 2008. Reductions therefore continue, but at a slower pace. Finally, the increase in emissions between 2009 and 2010 is largely explained by the economic growth again after the shrink in 2009, as is shown by the growing final demand factor.

5.4.5 Structural decomposition of particulate matter, change in percent compared tot 1990



Manufacturing, particularly some of the heavy energy intensive industries, waste management, energy companies and road transport showed strong improvement in terms of reducing particulate emission intensities. Livestock production showed no reduction and even increase. Emissions of particulates are inherent in keeping livestock, as they originate from feed, manure, skin flakes and litter. These emissions are primarily a function of the number of livestock and therefore hard to reduce.

Policy instruments and economic opportunities

6

Policy instruments and economic opportunities

6.1

Environmental taxes and fees

- Environmental tax revenues back at level of 2008
- Strong increase of excise duties for manufacturing and construction
- Revenues from environmental fees increased

6.2

CO_2 emission permits

- ETS companies contribute less than 10 percent to GDP
- Excess of CO_2 emission permits again in 2010
- Credits account for 20 percent of the trade since the start of Kyoto
- Volume of emission permits traded since 2005: down in 2010 after a peak in 2009
- Emission trading in the Netherlands still largely by non-residents
- Large price fluctuations in CO_2 permits
- Value of the permits initially grandfathered over a billion euro a year
- The energy sector had to secure permits for over 150 million euro for their emission in 2010

6.3

Environmental protection expenditure

- Environmental investments decreased in 2010
- Net environmental burden for companies lower due to higher subsidies

6.4

Economic opportunities for the Environmental Goods and Services Sector

- Stagnation in EGSS due to financial and economic crisis
- Many activities contribute to value added EGSS
- Relative contribution of EGSS to GDP is quite stable over time

6.1 Environmental taxes and fees

Everybody in society contributes to environmental pressures by producing waste and by buying and using products and undertaking activities that harm the environment. One of the duties of the government is to take care of public goods like the environment. To fulfil this task, central government can use various policy instruments, among which environmental taxes and fees. Tax revenues are a government's main source of income. An environment-related tax is a tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment (European commission – Eurostat, 2001). Environmental taxes are levied to discourage people from undertaking activities that pollute the environment. These taxes include excise duties on petrol and other motor fuels, import or sales tax on motor vehicles, motor vehicle tax and tax on the abstraction of water.

The government can use revenues from environmental taxes for all kind of purposes and does not have to use them exclusively to finance environmental protection measures. Besides levying taxes, central and local government, for instance water boards, have the possibility to charge fees. Companies and households are charged directly for some polluting activities, such as the discharge of waste water to the sewers and the production of waste. Revenues from these environmental fees are used directly to finance environmental measures, like the sanitation of waste water or the collection and processing of waste. This means environmental fees are seen as payments for services, while no service is supplied in return for environmental taxes.

Statistics Netherlands compiles annual data on environment-related taxes and fees by economic activity. The data can be found on StatLine, Statistics Netherlands' online database. For a description of the methodology see Statistics Netherlands (2010).

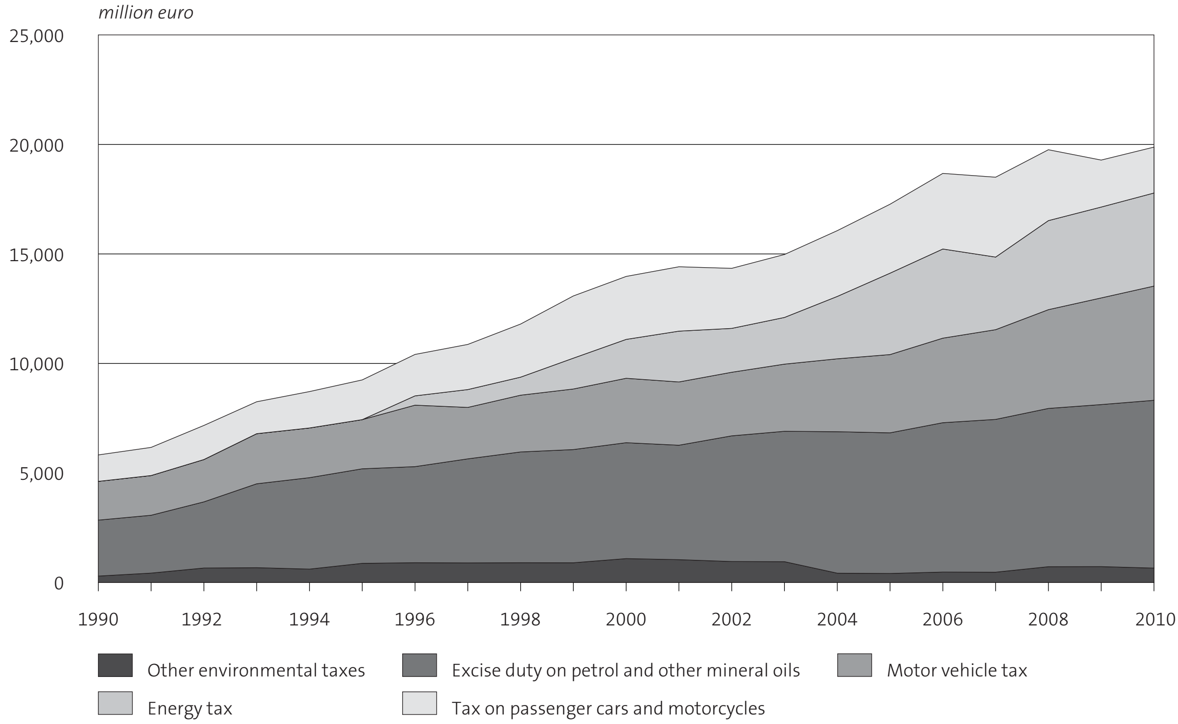
Environmental tax revenues back at level of 2008

Revenues from environmental taxes in 2010 increased by 3.1 percent, after a decline in 2009. In 2010 government income from environmental taxes was 19.9 billion euro, which was 592 million euro more than in 2009. This was mainly because of higher revenues from the two main environmental taxes: motor vehicle tax and excise duty on petrol and other mineral oils. Motor vehicle tax is a recurrent tax paid by people in whose name a car, van, motorcycle or lorry is registered. In line with the raised rates of the motor vehicle tax for 2010, revenues from this tax increased by 7.1 percent in 2010 to 5,215 million euro. The government raised the rate of the motor vehicle tax for passenger cars depending on the type of combustion engine. The rate for petrol engines increased by 7.3 percent and rates for diesel and gas engines increased by 7.1 percent. Rates for hybrid passenger cars were set to zero euro per quarter, which is a decline of 30 euro per quarter on the previous year. As part of the same transition plan for mobility, the Dutch government further lowered the tax rate on the purchase of motor vehicles (BPM; general percentage 27.4 percent in 2010 to 40.0 percent in 2009). Despite the reduced rate, revenues from the tax on passenger cars and motorcycles fell by only 2.3 percent due to higher sales figures for new motor vehicles. Total revenues from energy tax and other environmental taxes such as waste tax, tax on groundwater, and flight tax remained more or less stable in 2010. Mid-2009 flight tax was repealed what led to lower revenues from the group of other environmental taxes in 2010. On the other hand, increased revenues from energy tax compensate the loss of revenues from flight tax.

Share environmental taxes in total taxes does not increase

In 2010, green taxes accounted for 13.9 percent of total tax revenues. Environmental tax reform aims to shift the tax burden away from taxes on income and capital and towards taxes on consumption, pollution, and inefficient use of energy and resources. This shift can be monitored by looking at environmental taxes as a percentage of total taxes and social contributions. Between, 1990 and 1996, the share of environmental taxes increased from 9.4 to 13.5 percent. Since then it has stabilised.

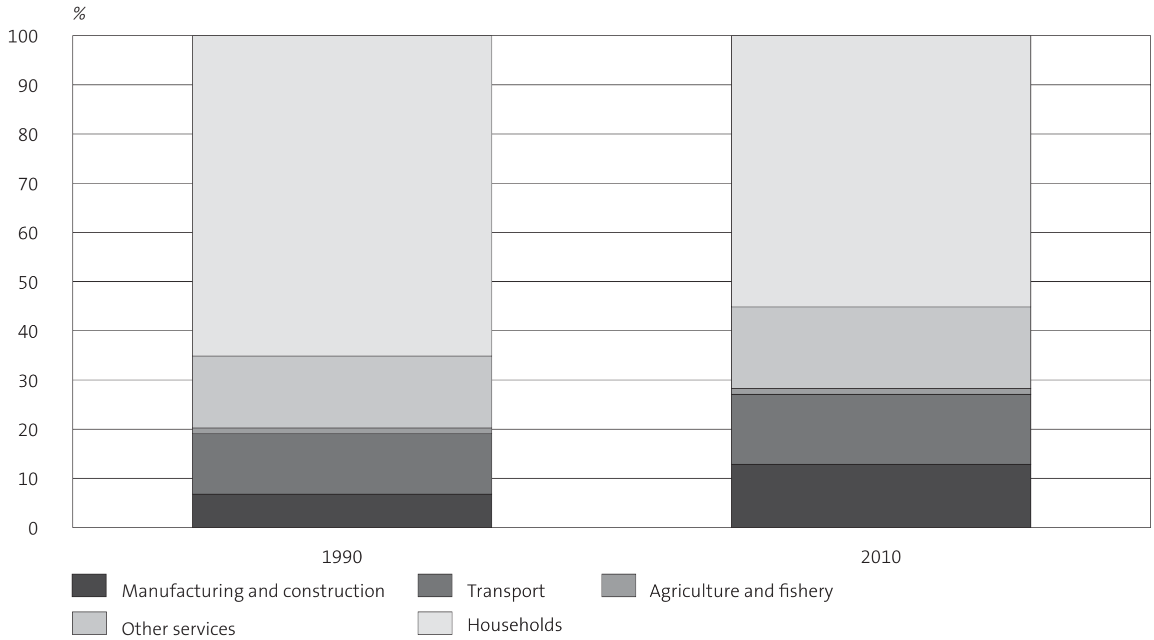
6.1.1 Environmental tax revenues



Strong increase of excise duties for manufacturing and construction

Excise duties constitute the government's main taxation instrument. Roughly 70 percent of excise duties are levied on petrol and other mineral oils. Yearly excise rates for motor fuels are adapted to inflation. The period 1990–2010 saw a change in the contribution of producers in total excise duties paid on petrol and other mineral oils. The share of producers increased from 35 percent in 1990 to 45 percent in 2010. This means that households still paid more than half of total excise duties levied on mineral oils. Compared to 1990 producers paid almost four times more excise duties in 2010. Households paid two and a half times more excise duty than they did in 1990. The increase in excise duty on petrol and other mineral oils for producers differs between industries. The manufacturing and construction industries were responsible for relatively the biggest increase as they paid almost six times more in 2010 than they did in 1990.

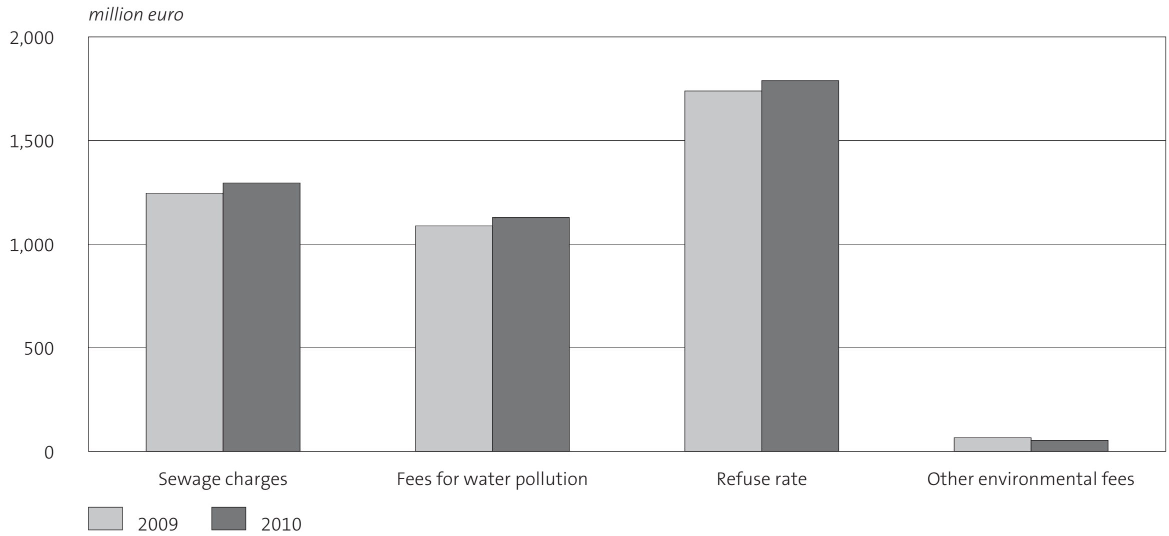
6.1.2 Share of industries and households in tax revenues on excise duty on petrol and other mineral oils



Revenues from environmental fees increased

Revenues from environmental fees increased slightly in 2010 to 4.3 billion euro. Compared to 1990, revenues from environmental fees went up 2.6 times. Local government is responsible for the majority of environmental fees levied. Water boards collected in 2010 1.1 billion euro levies on water pollution, which is a 3.3 percent increase on the previous year. Revenues from the municipal refuse rate increased by 2.9 percent in 2010, to 1.8 billion euro. Sewage charges, another important municipal fee, increased by 3.9 percent in 2010, compared to 7.1 percent in 2009. Nowadays, most municipalities are able to completely finance sewage maintenance costs from revenues from sewerage charges. This is the reason why revenues from this environmental fee do not have to increase as much as they did before.

6.1.3 Environmental fee revenues in 2009 and 2010



6.2 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 a sufficient amount of permits in order to cover the actual emissions that occurred during the period mentioned.

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 tonne of CO_2 equivalents. JI and CDM are mechanisms that allow parties to obtain emission reduction credits (CER and ERU) through investments in e.g. energy conservation projects in developing countries that reduce greenhouse gas emissions. These credits can also be traded on the (secondary) market.[1)] The objectives of these mechanisms are to enhance cost-effectiveness and, as a result, the effectiveness of and commitment to emission reductions, as well as stimulate green investments. The national target or emission

1) CERs: Certified Emission Reductions obtained from CDM projects in developing countries. ERUs: Emission Reduction Units obtained from emission reduction JI projects in developed countries.

cap is distributed over the ETS sector and non-ETS sector with roughly a 40 and 60 percent share respectively.
In 2005, the European Union Emissions Trading System (EU ETS) was launched. Although the EU ETS also covers limited amounts of other greenhouse gases like N_2O in the Netherlands, in this chapter we will focus on CO_2. Currently, the EU ETS is the world's largest emissions trading system. The ETS sector consists of large energy- and emission-intensive enterprises, denominated as operators which are obliged to participate in the EU ETS[2)]. These companies will be referred to here as ETS companies. Based on a national allocation plan the Dutch government has reserved, from its total of 1001.3 million AAU, around 437 million allowances to the ETS sector (these are called AAU-EUA), 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[3)]. So the ETS companies themselves bear the risk for their emissions.

The non-ETS sector consists of small and medium sized enterprises (SMEs), households and the majority of the transport sector. For meeting the emission target of the non-ETS sector, the government takes responsibility in terms of ensuring sufficient amounts of allowances or credits to hand over to the United Nations each year. As part of this responsibility, the government itself is allowed to purchase permits on the market, or either obtain credits via investments in CDM and JI projects abroad.

If a company emits less CO_2 in a particular year than their allocated allowances allow for, it can sell the surplus on the market or save it for use (surrender) or sale in another year. Companies that emit more than their allowances will have to secure additional permits or do risk a fine. In the Netherlands, like in other 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 such companies of their obligation to hand over sufficient number of permits. So the ETS companies themselves bear the risk for their emissions. 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[4)]. Each country that participates in the EU ETS must have a national emissions authority which is the entity responsible for registration and facilitation of the emission trading in the country.

A distinction can be made between the first trading period, 2005–2007, and the second, 2008–2012. Whereas the first period aimed to test the registration system and trading operations, the current second trading period 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

2) It covers around 10,500 installations across the 27 Member States of the European Union 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 themselves have requested to participate as operator under the EU ETS.
3) 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, they have different prices due to different risks and conditionalities.
4) In the Dutch CO_2 Emissions Trading Registry these parties have a 'person holding account' and are referred to as 'persons'.

of the previous year (T-1) to the NEa, the Dutch Emissions Authority[5)] at the end of March. Then they have to surrender permits connected to emission of the previous year (T-1) no later than 30 April. This implies, however, that the trade in permits continues for several months after the end of the emission year.

In this chapter we present the second detailed (physical) balances for CO_2 emission permits in the Netherlands, as well as results of a first attempt to compile a monetary balance sheet. 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 emission in the Dutch economy and in the context of the Kyoto protocol, we refer to chapter 5.

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 2010 amounted to 84.4 Mton[6)]. This is 4.2 percent more than the 81.0 Mton CO_2 emitted in 2009. In 2010, ETS companies accounted for about 48 percent of total CO_2 emissions by industries (i.e. excluding direct emissions by households) in the Dutch economy. This share is slightly lower than in 2009 and 2008 but 2 percent more than in 2005–2007. The slight decrease is related to the relatively high emissions by the service sectors due to the relative cold winter weather conditions.

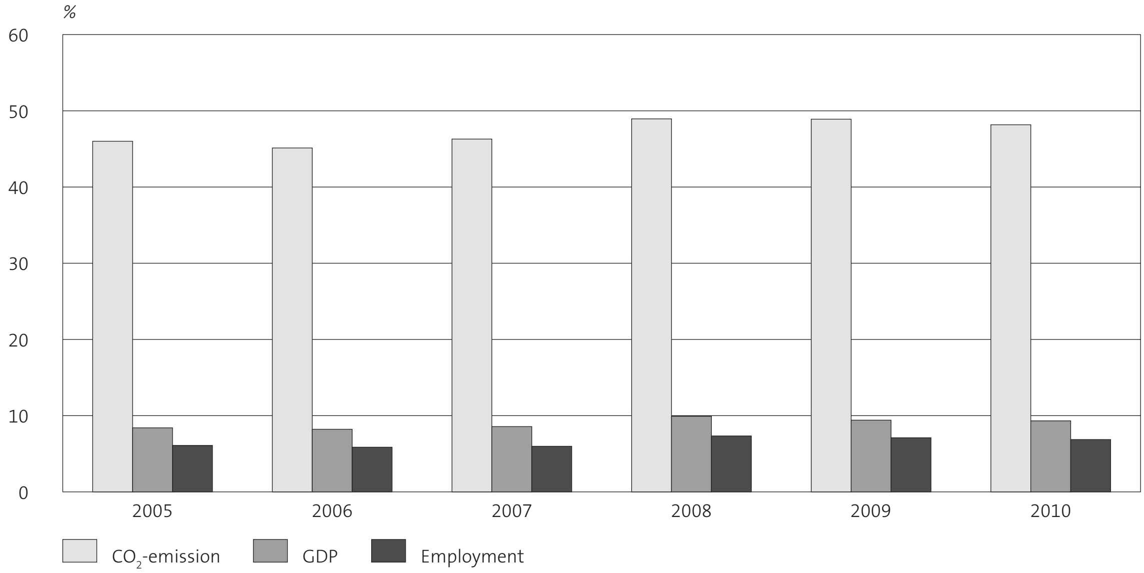
The Dutch Registry includes close to 800 parties of just under 600 were active in 2010. Operators form the majority with approximately 380 active accounts users. Around 330 traders have set-up an account in the Registry of the Dutch Emissions Authority since its inception in 2005. In 2010 194 had remained active, while over 40 percent of the traders had closed their accounts, some of them had not been active for over a year.

As figure 6.2.1 shows, the joint contribution to GDP of the companies participating in the EU ETS amounted to 9.3 percent in 2010. The share in total employment of the ETS companies is 6.9 percent. 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, from 2008 onwards, this has only led to a slight increase in the share of GDP.

5) The Dutch Emissions Authority (NEa) is a government organization 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.

6) The Netherlands has opted to include also N_2O emissions from nitric acid production in the emission trading system. Therefore this figure as well as other figures in this chapter include the N_2O emissions. These N_2O emissions are however small compared to the total CO_2 emissions under the Dutch ETS system (about 0.6–0.7 percent in CO_2 – equivalent terms).

6.2.1 Share of ETS companies in CO_2 emissions of industry, GDP and employment

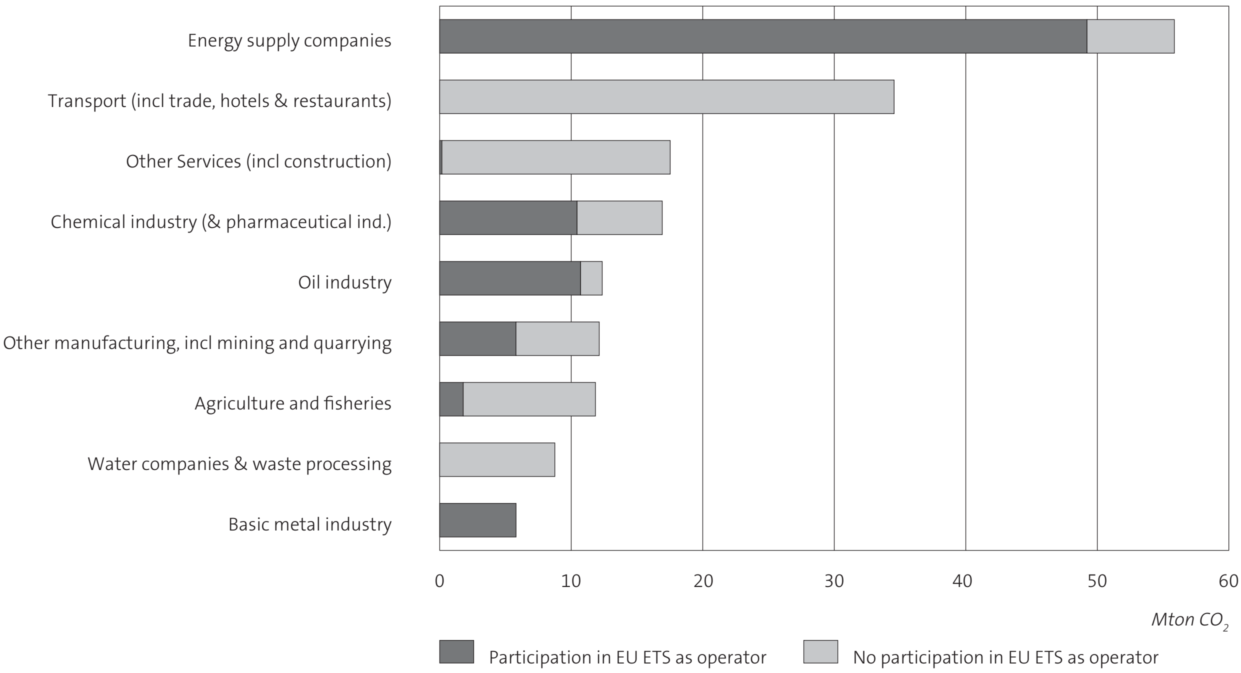


Among the industries, the share of companies that participate in the EU ETS as measured by their share in the CO_2 emissions can be very different, as only companies with production plants with large thermal power installations are obliged to participate[7]. As figure 6.2.2 shows, almost all companies in energy supply (88 percent), the oil industry (87 percent), and the manufacturers of basic metals (100 percent), and a large part (62 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 do not participate in ETS at all. In agriculture and fisheries only 15 percent is represented, as only some major horticultural holdings are obliged to participate in the trading system. Notably the transport sector, including trade, hotels and restaurants, that account for 20 percent of the Dutch CO_2 emissions, is not represented in the trading system. This may change in the (near)future when airlines will be required to participate in the EU ETS as well. Only 1 percent of the CO_2 emissions of the remaining 'other services inclusive construction' sector are accountable under the trading system. This comes mainly from a few large university hospitals that participate right now.

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

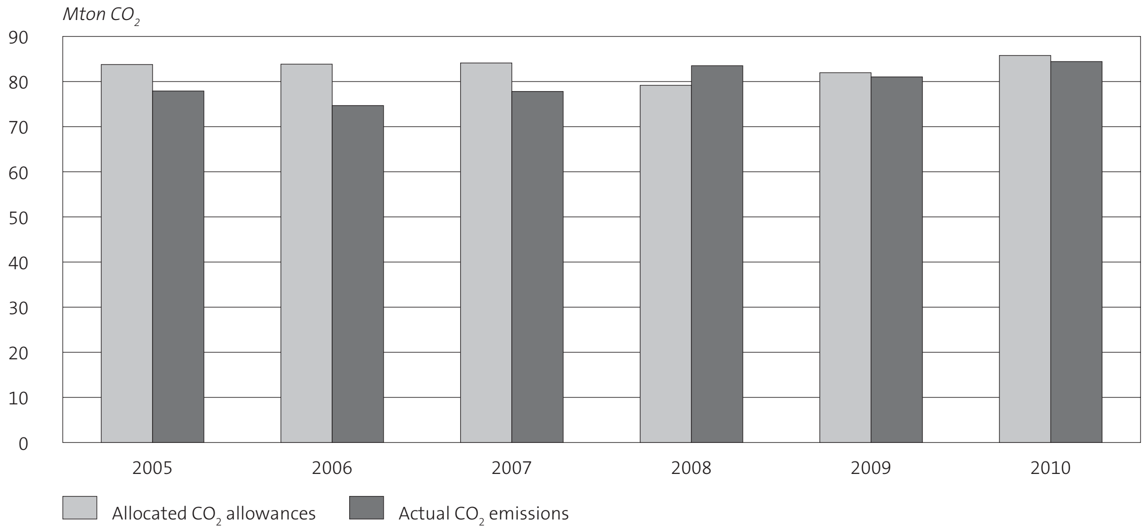
6.2.2 CO_2-emissions of industries and the share of participation in the ETS as operators, 2010



Excess of CO_2 emission permits again in 2010

Although fewer allowances were allocated for the second trading period, in an attempt to downsize the market and as a result of the national emissions, so far there has only been an overall shortage in allowances for 2008 (figure 6.2.3). This shortage amounted to 4.3 million CO_2 permits. In 2010, the ETS companies together emitted 84.4 Mton of CO_2, an increase of over 4 percent. That is however 1.6 percent under the amount of emission allowances received at the beginning of the year. The small surplus is partly explained by the continuing economic low tide with limited growth as a result of the economic recession in 2008 and 2009 which caused the economy to structurally act at a slower pace, although CO_2 emissions nation wide have partly recovered (see chapter 5). As a result in 2010 no shortage for the country as a whole existed, with incentives for emission reductions remaining below expectations. Although significant part of the industry sites operated by the ETS companies faced shortfall of allowances since 2008. For 2010 over 40 percent of these sites faced shortfall of allowances (Dutch Emissions Authority, 2011A).

6.2.3 Emission allowances allocated and actual CO_2-emissions ETS sector

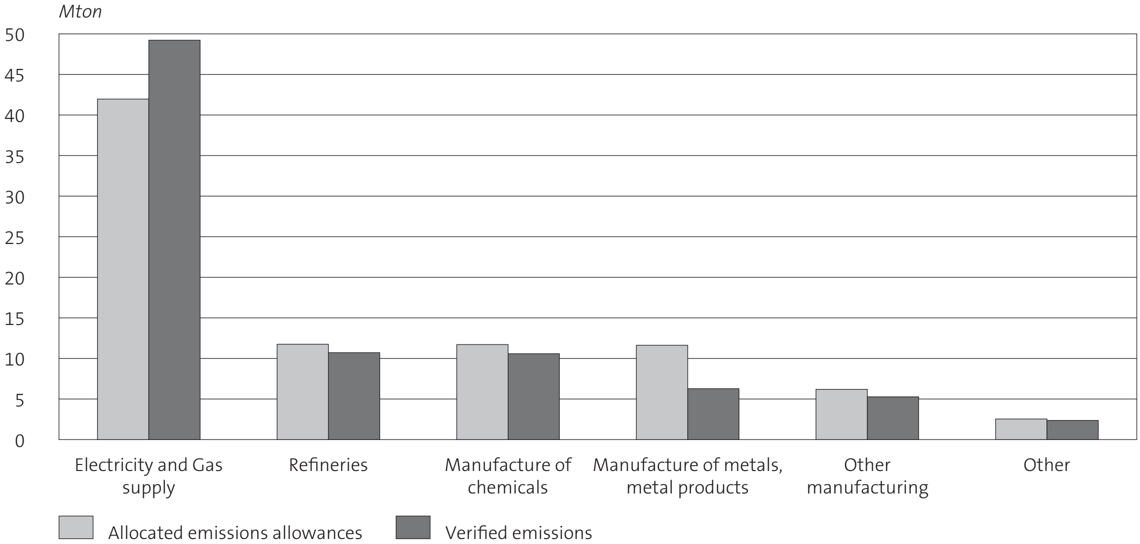


Source: Dutch Emission Authority, 2010B; Statistics Netherlands 2011.

The electricity and gas supply industry in 2010 was the only industry with a clear shortage of emission allowances (Figure 6.2.4). Their CO_2 emissions proved to be 17 percent higher than the allowances they obtained for 2010 based on the allocation procedure. Therefore they had to secure additional permits for at least 7.3 Mton of CO_2 emissions[8)]. Basic metal possessed more than half (62 percent) of the excess allowances among the industries with excess allowances. This large surplus in the metal industry is linked to 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 by an electricity company. 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.

8) 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.

6.2.4 Allocated emission allowances and actual CO_2-emissions ETS sector, 2010



Source: Dutch Emissions Authority, 2010A, 2011B; Statistics Netherlands 2011.

Credits account for 20 percent of the trade since the start of Kyoto

For policy purposes it is relevant to monitor the total amount of permits being 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 6.2.5 which shows stocks and flows of permits (allowances and credits) at the aggregated macro level. These aggregates build on highly disaggregated data at the level of individual accountholders and transactions. The opening stock represents all permits owned by Dutch residents on 1 January of the respective year. For instance the opening stock on 1 January 2005 was zero as allowances were grandfathered only in the course of the year. The closing stock represents permits owned on the 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 are due to surrender and grandfathering as well as market transactions. Surrender takes place in the year following the year in which the emissions actually took place. The balance sheet can also be broken down into institutional sectors or industries. However, the precise recording of permits in the national accounts is expected to be decided upon shortly.[9]

[9] Options that have been considered are recording of permits as financial assets, or as a combination of a non-produced non-financial assets and a financial asset.

6.2.5 Balance sheet of CO_2 permits[1)]

	2005	2006	2007	2008	2009	2010
	CO_2 permits (= tonnes of CO_2)					
1 Opening stock 1 st-January	-	80,055,818	77,954,443	86,087,847	87,856,973	100,974,058
2 Allocated free of charge (grandfathered)	86,093,888	86,949,294	87,233,598	76,801,532	83,703,076	84,974,375
3 Purchased - permits (allowances)	41,327,069	80,230,575	85,467,121	168,951,989	191,515,413	170,119,571
of which free permits[2)]	36,507,692	62,955,944	63,772,342	117,438,701	119,167,730	113,375,936
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
4 Purchased - credits				58,791,531	50,333,828	48,028,922
of which purchased				30,841,275	25,789,984	25,822,587
of which from domestic projects	-	-	-	-	-	-
of which from ROW				27,950,256	24,543,844	22,206,335
5 Sold - permits (allowances)	52,534,809	96,145,634	86,725,533	180,136,186	178,637,082	173,362,339
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
of which from ROW[4)]	9,989,047	24,493,359	20,740,811	53,061,903	70,361,051	59,753,088
6 Sold - credits				31,525,560	46,462,897	40,534,779
of which to other residents				16,539,418	23,754,984	22,524,463
of which to ROW				14,986,142	22,707,913	18,010,316
7 Losses (cancelled permits)[6)]	-	-	10	-	20	-
8 Surrendered, permits, credits, etc.	-	80,354,338	76,887,804	79,698,681	83,512,670	81,071,420
9 Closing stock 31 December	80,055,818	77,954,443	86,087,847	87,856,973	100,974,058	111,941,822

Source: Dutch Emissions Authority, 2011B; Statistics Netherlands 2011.

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 is Rest of the World. This covers purchased from and sold permits to non residents abroad.
5) Distinction between free and non-free permits in their initial allocation cannot be made. 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 (fines, etc.).

It should be emphasized that the system boundaries of the national permit registry do not exactly comply with the system boundary of the national accounts which is restricted to residents of the Dutch economy. Differences may arise because Dutch residents (traders or operators) may have an emission account in a registry abroad[10)]. The current opening and closing stocks in the balance sheet as well as the volumes of trade should therefore be considered as an underestimate. Permits held by Dutch residents abroad are, due to data limitations so far not included and would add to the stocks for the Netherlands. The allocation and surrender figures (by the operators) are exact though.

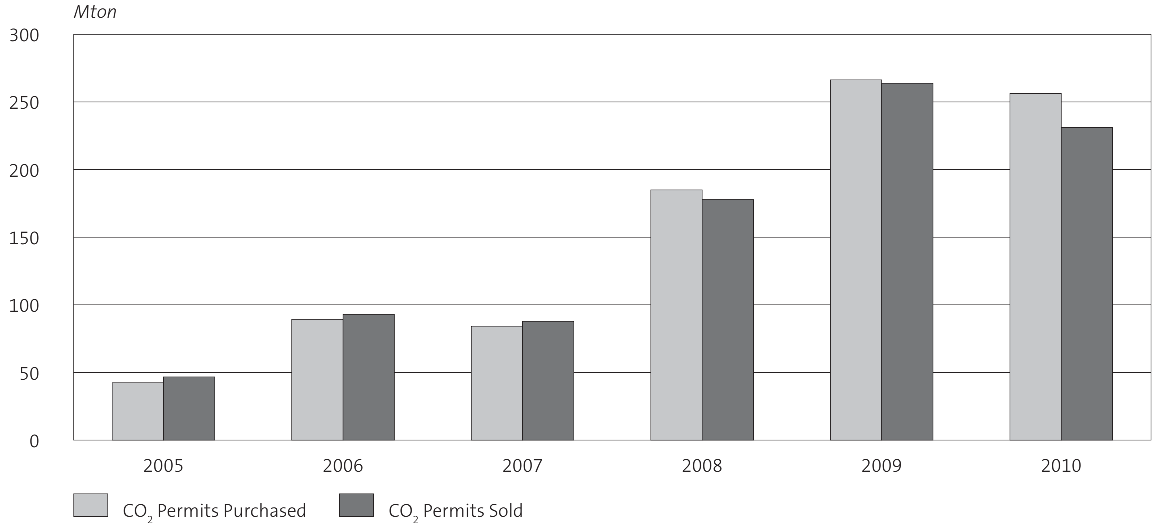
Volume of emission permits traded since 2005: down in 2010 after a peak in 2009

The volume of the trade in emission permits grew strongly until 2009. In 2010, however, this volume in permits sold on the market was less than in 2009 and accounted for 231 Mton CO_2. Part of the decline probably is explained by security issues with the register (fraude, theft, etc.). This is still 5 times more than in 2005 when trading started. The permits sold constituted 2.7 times the number of allowances originally grandfathered by the government at the start of 2010. This means that accountholders have traded and exchanged permits twice to 2.5 times in the course of the emission year until the moment of surrender. Part of this trade was with

10) The analogy can be made with residents that have bank accounts abroad.

parties abroad. The share of the transactions by residential units with foreign partners was 52 percent for purchase and 57 percent for sale transactions.

6.2.6 Volume of CO_2 permits traded via accounts in the Dutch CO_2 Emissions Trading Registry[1])



Source: Dutch Emissions Authority, 2010, 2011B; Statistics Netherlands 2011.
1) This is the figure for the AAU-EUAs, thus without the CERs or eventually ERUs.

The amount traded, in particular sold, by operators alone has proved to be more or less constant over time with an amount of permits sold annually that correspond to 20 – 46 million ton of CO_2. The permits purchased by operators started from close to zero in 2005 and varied in subsequent years between 3 (2008) and 31 million (2010).

The permits by resident are predominantly traded by persons holding accounts. In 2010 74 percent of the purchase and 71 percent of the sale of permits by Dutch residents was accounted for by the traders. Together with the foreign parties in the Dutch register, this was obviously more, as foreign account holders can only participate with a person holding account. In 2010 almost 90 percent of both purchases and sales for all account holders was done by traders. 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[11]).
Among the operators, the energy companies are responsible for 65 percent of trade.

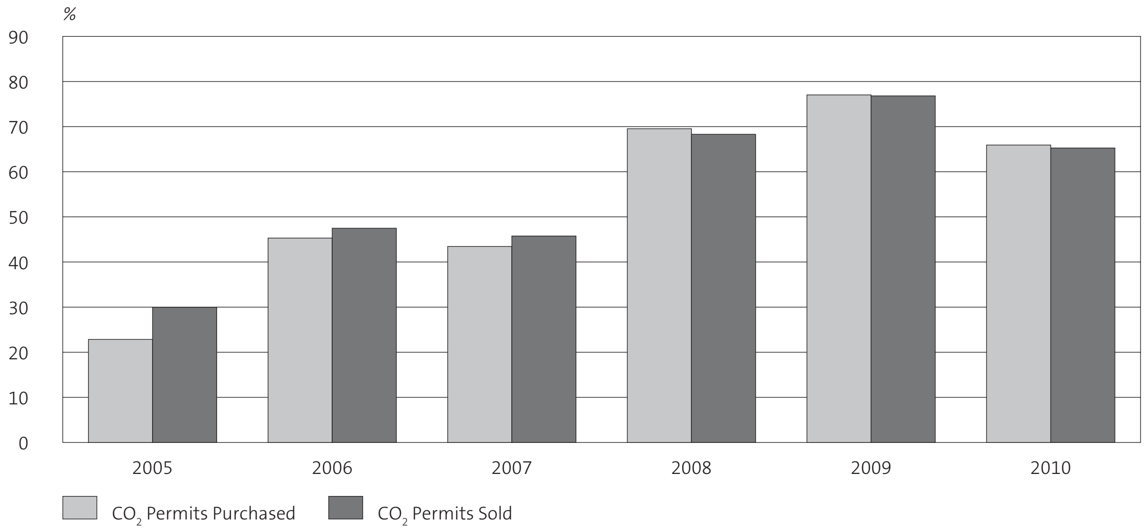
Emission trading in the Netherlands still largely by non-residents

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 the

11) 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.

emission trading. Not surprisingly perhaps, the share of non-residents in the trade volume has also steadily increased until 2009. However in 2010 the share stopped to grow, even a decline was observed, as is shown in figure 6.2.7. In 2010 the share of trade performed by non-residents fell to less than two thirds.

6.2.7 Share of non-residents in total trade of permits[1)]



1) This is the figure for the AAU- EUAs, thus without the CERs or eventually ERUs.
Source: Dutch Emissions Authority, 2011B. Statistics Netherlands 2011.

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 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 has fallen.

Regarding the trade in allowances, the number of allowances purchased in 2010 compare to the number of allowances sold, whereas in 2009 significantly more allowances were purchased, and in 2008 more allowances were sold than purchased. Each year since the start of the trade in 2008 more credits were purchased than sold. This is influenced by differences in conditions, opportunities and planned delivery of credits in contrast to allowances, which contribute to price differences as well.

Stocks of permits by residents are steadily growing as figure 6.2.5 shows. In 2010 the closing stock was overall up by 40 percent on 2005[12)]. Since 2006 the closing stocks each year were higher than year before. For the foreign account holders the closing stock has also grown since

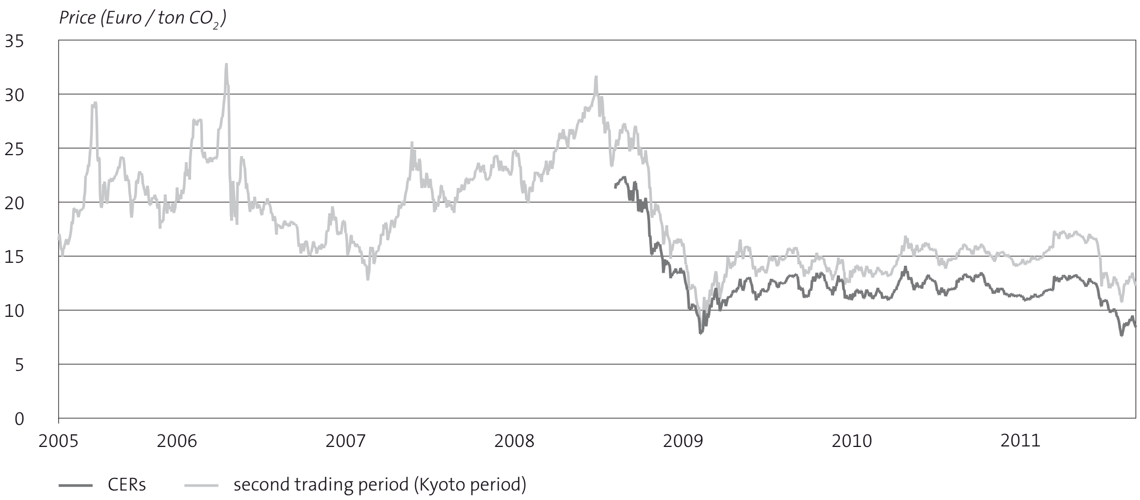
12) This holds for residents with operator and/or person account in the national register. A Limited number of residents has an account in a foreign register.

2005, particularly in 2010 when the closing stock was 2.5 times the opening stock. Closing stocks for electricity and gas supply and manufacturing have been reasonably constant since 2005. The observed growth in the overall closing stocks of permits predominantly stem from the sector public administration, social security and other government services and to a lesser extent and only recently from financial intermediation and other service activities.

Large price fluctuations in CO_2 permits

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 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. In February 2009 the allowance prices briefly stood at less than 10 euro per ton of CO_2. Due to the financial and economic crisis, production in several industries fell sharply and with it greenhouse gas emissions. Companies started to offer many permits on the market, which reduced the price. Early in 2009 prices recovered to around 14 euro per ton CO_2. From mid 2009 onwards, the price of allowances has remained reasonable stable at close to 14–15 euro. The allowance price, has not fully recovered after the economic downturn. As CO_2 emissions continue to grow, the price still remained at a lower level than expected. With the emission ceiling remaining the same, the scarcity has structurally diminished to below the level expected before the crisis started, at the end of 2008 [13].

6.2.8 Price of CO_2 allowances (EUA Futures Contracts) and CERs



Source: Point Carbon, Historic Data 2011

The price of CER emission reduction credits is closely related to the price of allowances and temporal changes point recurrently in the same direction over time. This close relationship is a reflection of the scarcity of permits in the market. The price of CER is a little lower due to differences in the conditions and opportunities for surrender. Allowances face fewer limitations

[13] AAU is an Assigned Amount Unit or Kyoto unit, permits that so-called Kyoto Parties get 'assigned'. EUA or better AAU-EUA is a European Union Allowance. These are permits that 'operators' that participate within the European ETS system for CO_2 get assigned and that can be traded. Of course the type of market, either spot or futures market, has an influence on the price.

which leads to a higher permit price of an average of 2.8 euro per ton CO_2. The relatively low CO_2 price 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 for CO_2.

Value of the permits initially grandfathered over a billion euro a year

Since the inception of the European emission trading system, practically all the CO_2 permits have been grandfathered – given for free predominantly based on historic emissions – by the Dutch government. In 2010, for the first time since the start of the EU ETS, some permits have been allocated through auctioning (4 million emission allowances in total), which implies additional costs to the ETS companies. These allowances are auctioned by the government and can be destined to either domestic operator or person holding accounts as well as to non-residents. In 2010 the largest part of the auctioned permits went to non-residents (Dutch Emissions Authority, 2011B).

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 large extent) to comply with the CO_2-emission target set by the government[14)]. The price of relevant 'futures' in 2010 moved between 13 and 17 euro per ton of CO_2 in 2010 on average. The CO_2-allowances grandfathered in 2010, a number that represent close to 85 Mton of CO_2, can hence provisionally be valued at over 1.26 billion euro in 2010. Likewise using an average permit price of 13.8 euro per ton of CO_2 in 2009, the value of the grandfathered permits was accounted for approximately 1.15 billion euro.

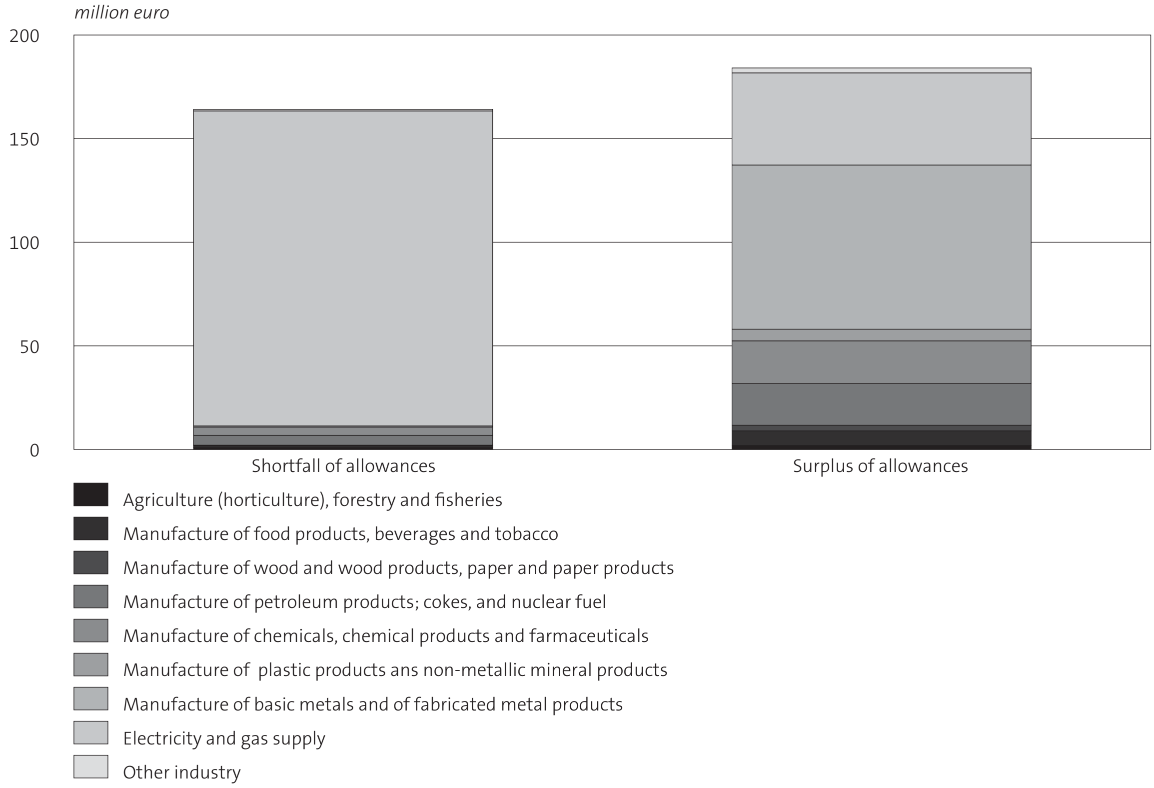
The energy sector had to secure permits for over 150 million euro for their emission in 2010

The energy companies, as operators with large amounts of CO_2 emissions, faced the biggest shortage of CO_2 permits based on the allocation procedure, corresponding to 7.26 Mton of CO_2 emissions in 2010. This figure corresponds with 66 percent of the total shortage of permits at the national scale for which additional permits had to be secured. Using the aforementioned daily carbon prices, a provisional estimate can be given of the costs to industries that faced a lack of allowances. The lacking allowances 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. Figure 6.2.9 shows the CO_2 permits that had to be secured by the energy supply industry in 2010 with a corresponding value of 152 million euro. 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 79 million euro.

14) These are rough estimates as they are solely based on the average price of futures of EUA-AAUs (allowances). 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.

6.2.9 Value of the lacking allowances and of the surplus of allowances with the operators, by industry, 2010[1)]



Source: Dutch Emission Authority, 2011A, 2011B; CBS, Environmental accounts 2011.

1) This presentation 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 with prices set beforehand). The results are therefore preliminary. An exact estimate of the actual price of the transactions undertaken is currently not available and therefore annual averages are used.

6.3 Environmental protection expenditure

Environmental protection activities aim to prevent the damaging consequences of human activities or acts on the environment. They include expenditures for measures to improve the quality of air, water (incl. waste water), soil and groundwater, waste and noise. Data on environmental costs and financing are available for the economic sectors government, enterprises and households. Enterprises at this moment includes agriculture, mining, manufacturing, energy and water supply, environmental services and the transport sector. For building and other services no data is available, but this is part of current research. The methodology for the compilation of environmental protection expenditure statistics can be found on the website of Statistics Netherlands[16]. The data on environmental expenditure can be found on StatLine, the electronic database of Statistics Netherlands.

Environmental investments decreased in 2010

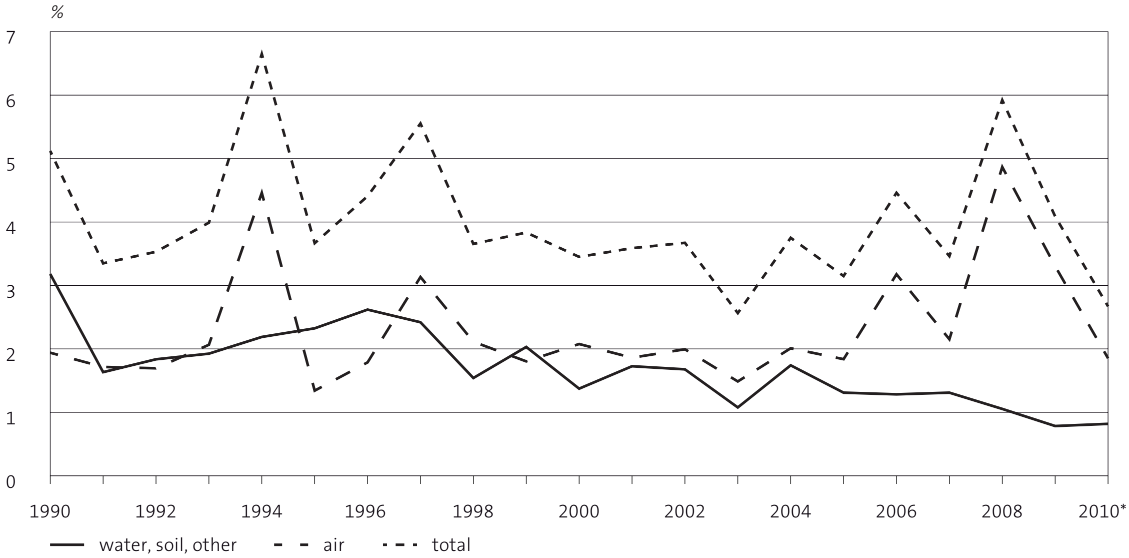
Environmental investments are capital goods intended to protect, restore or improve the environment. They do not repay themselves within three years. Examples are wastewater treatment plants and the construction of impervious surfaces. Also provisions for the production of renewable energy are included, such as windmills, solar panels and installations for biomass combustion.

Environmental investments by the mining, manufacturing, energy and water supply industries decreased from 490 million euro in 2009 to 310 million euro in 2010. So environmental investments are substantially lower than in the previous year. Also, their share with respect to total investments decreased from 4.1 percent in 2009 to 2.7 percent in 2010. In recent years much of the environmental investments were used for installations for renewable energy production. Nearly one third was related to the construction of windmills. In 2010 the investments of wind turbines fell by nearly 80 percent. Realising a new wind project is often a time-consuming process because of planning and procedures, arranging financing, construction and delivery. This drastic reduction in new wind turbine capacity is mainly due to the lack of subsidies for new windmills between August 2006 and April 2008. In addition, the economic recession probably had a negative impact on the investment climate (see also chapter 8).

The time series from 1990 to 2010 reveals a rather irregular picture with peaks in investments for certain years. In the nineties the share of air-related investments made up approximately half of total environmental investments. During the last five years air-related investments became more important. This clearly reflects the increasing importance of investments related to climate change relative to investments related to water, soil and noise.

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

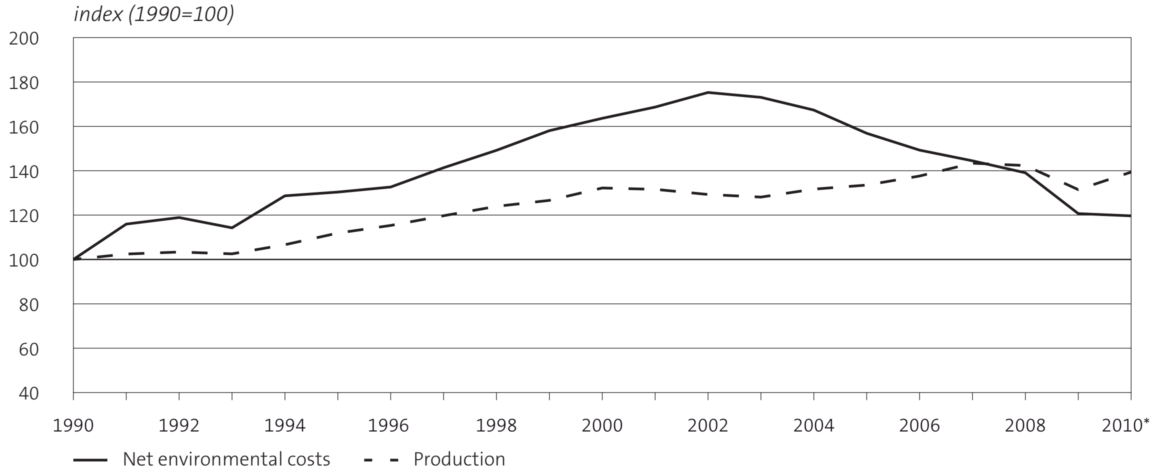
6.3.1 Share of environmental investments in total investments



Net environmental burden for companies lower due to higher subsidies

The net environmental costs after transfers are equal to the annual costs of environment-related activities which companies carry out themselves (capital costs, current costs for operation etc.) plus expenditure for environmental services plus environmental fees paid less environmental subsidies received. Between 1990 and 2002 the net environmental costs for mining, manufacturing, energy and water supply industries gradually increased. This increase was much higher than the increase in production. While net environmental costs increased by 75 percent, production increased only by 29 percent. The increase of the environmental costs in the nineties was mainly related to more stringent environmental measures imposed by the government. Since 2002 we see a gradual decrease of the net environmental costs. In 2009 and 2010 it is even less than the increase in production since 1990. There are two reasons for this decrease in net environmental costs. First, current expenditure for wages, energy etc. related with environmental expenditure decreased significantly in this period. The main reason, however, is the increased amount of environmental subsidies, which is mainly related to subsidies for the production of renewable energy (see also chapter 8).

6.3.2 Development of production and net environmental costs after transfers for mining, manufacturing and energy and water supply, fixed price level



6.4 Economic opportunities for the Environmental Goods and Services Sector

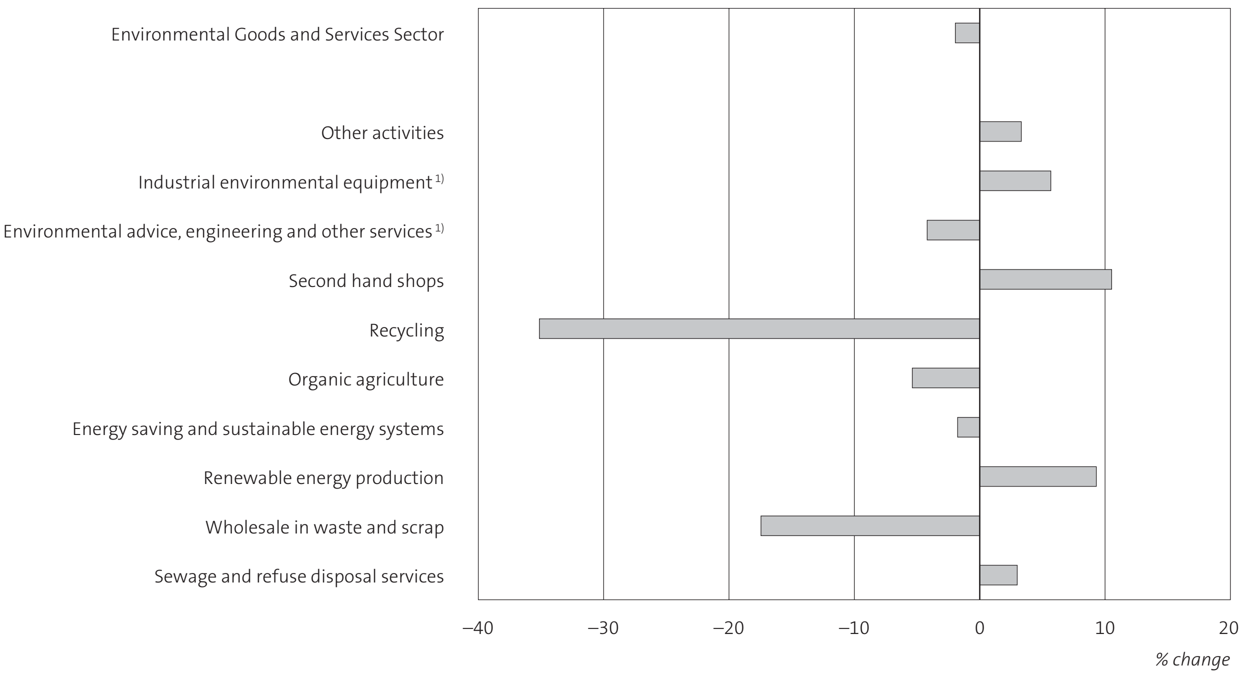
In order to reduce pressures on the environment that lead to resource depletion and deterioration, environmental measures are becoming more and more stringent. The economic consequences of environmental measures and environmental concerns are of great interest to policymakers. They approach these topics from two perspectives. On the one hand, their interest focuses on the financial burden that is placed on the polluting industries, as they have to invest in pollution abatement control in order to comply with environmental regulation. On the other hand, environmental measures will bring about new economic activities that may create new jobs and stimulate economic growth. Policymakers therefore need information on companies and institutions that produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration. 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. This 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 technologies, goods and services. Various activities fall under the definition of the EGSS. A quantitative overview of the EGSS for two years, 1995 and 2009[17)], is presented in this paragraph. 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 (van Rossum and Schenau, 2006; van Rossum and Kulig, 2008; van Rossum and van Geloof, 2009).

Stagnation in EGSS due to financial and economic crisis

The economy of the EGSS has come to a halt due to the financial crisis and the economic recession in 2009. Value added in current prices decreased by 1.9 percent in 2009 compared to 2008[18)]. Production in current prices has decreased too. Employment, on the other hand, has increased with two percent.

6.4.1 Change in value added for different acitivities in EGSS, 2008–2009



1) not related to energy saving and sustainable energy systems

Looking in more detail at the EGSS (see figure 6.4.1) one can see that recycling has been hit very hard in 2009. Value added decreased by 35 percent. The recycling industry received less waste in 2009 than in 2008, so this industry was not able to recycle as much waste as in previous years. Less supply of waste by other industries led to a decrease in recycling activity.

17) Figures for the complete time series (1995–2009) have been revised due to the set-up of a new population database. New companies have been identified as companies belonging to the EGSS. Time series have been been adjusted based upon these new insights.

18) One should be careful in drawing too strong conclusions from data on developments in economic variables in 2008–2009. Due to the set up of a new system for production statistics, first implemented for the reporting year 2009, the economic figures presented for certain activities in 2009 may not be completely comparable with the corresponding 2008 values. Complete comparability can therefore not been guaranteed.

Value added also decreased in the industry 'wholesale in waste and scrap'. Consumers and companies spent less money on durable goods. Especially big purchases, like new and second hand cars decreased in 2009. Consumers decided to postpone these expenditures. Wholesale in waste and scrap sold fewer second hand cars and traded less in waste metals both because of a lack of supply of materials and because of a lack of demand. Their role as an intermediate between sellers and buyers became under pressure due to the difficult market circumstances. Environmental advice, engineering and other services[19)] also showed a slight decrease in value added in 2009 compared to 2008. Although they increased production slightly, intermediate consumption increased more, so value added decreased. Value added of organic agriculture also decreased in 2009[20)]. Growth in the production area of organic agriculture had not been spectacular over the last previous years and this was also the case in 2009 (plus 2.7 percent). Price developments in agriculture in 2009 were very unfavourable for farmers in general. This is one of the reasons why value added became under pressure in 2009. 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.

Recycling industry has been hit hard by the recession in 2009

The activities 'sewage and refusal disposal services' and 'renewable energy production' grew in 2009. Sewage and refusal disposal services are not that much influenced by economic fluctuations. Waste and wastewater produced by households and industries still need to be disposed and cleaned. More renewable energy was produced in 2009 compared to 2008, especially due to more combustion of biomass in energy facilities, more wind energy production and more waste incineration. Second hand shops were able to increase their value added in 2009. Eye catching is the fact that production of second hand shops, excluding sales of antiques, increased in 2009 compared to 2008. Second hand retail trade of commodities increased, possibly due to the crisis where households have become more economical and spent more money on second hand goods and less on new ones (substitution effect).

Many activities contribute to value added EGSS

The EGSS contributed 13.2 billion euro to the Dutch gross domestic product and 137,000 full-time equivalents (FTE) to employment in 2009. Total production value equalled 32.4 billion euro (see figure 6.4.2).

19) Not related to energy saving and sustainable energy systems
20) It is assumed that price developments in production and intermediate consumption of total agriculture are representative for organic agriculture.

6.4.2 The Environmental Goods and Services Sector in the Netherlands, 2009

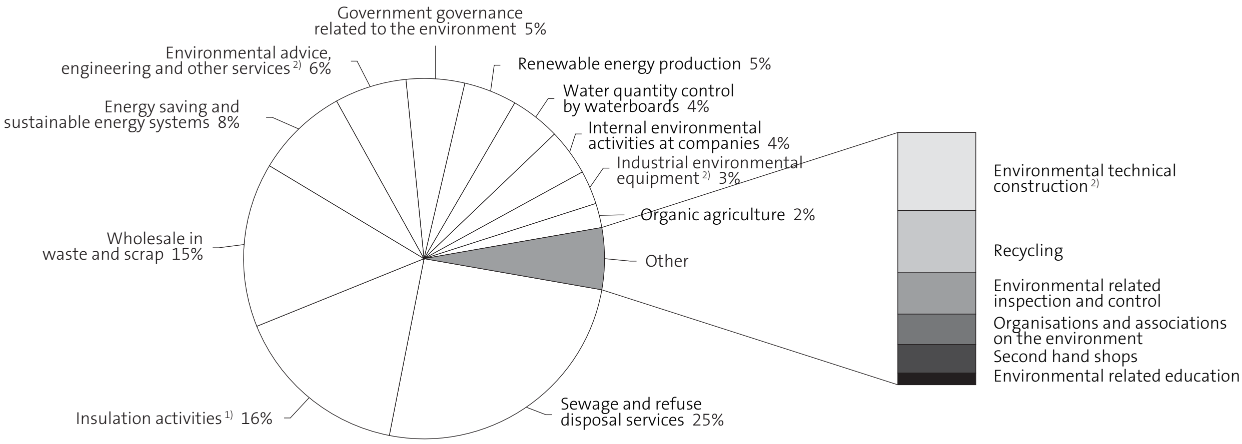
Activities	Production 1995	Production 2009	Value added 1995	Value added 2009	Employment 1995	Employment 2009
	billion euro				*man-years (x 1,000)*	
Sewage and refuse disposal services	3.8	9.2	1.5	3.4	20.7	28.0
Wholesale in waste and scrap	1.5	2.3	1.2	2.0	4.8	4.7
Environmental related inspection and control	0.0	0.2	0.0	0.1	0.1	2.4
Government governance related to the environment	0.7	1.6	0.4	0.7	6.9	8.1
Organisations and associations on the environment	0.0	0.2	0.0	0.1	0.9	1.9
Internal environmental activities at companies	1.3	1.4	0.6	0.6	10.5	5.1
Renewable energy production	0.1	1.0	0.1	0.6	0.4	2.3
Insulation activities 1)	3.2	5.0	1.3	2.1	27.6	32.6
Organic agriculture	0.1	0.9	0.1	0.3	0.9	2.3
Recycling	0.3	0.9	0.1	0.2	1.4	2.9
Second hand shops	0.1	0.3	0.0	0.1	2.1	5.1
Water quantity control by waterboards	0.5	1.2	0.3	0.6	3.6	3.8
Energy saving and sustainable energy systems	1.7	3.8	0.5	1.1	8.2	15.4
Environmental advice, engineering and other services 2)	0.6	2.2	0.3	0.9	5.5	12.5
Industrial environmental equipment 2)	0.9	1.3	0.3	0.4	4.2	6.3
Environmental technical construction 2)	0.3	0.9	0.1	0.2	1.4	3.2
Environmental related education	0.0	0.0	0.0	0.0	0.6	0.4
Total Environmental Goods and Services Sector	15.1	32.4	6.6	13.2	99.9	137.0

1) including installation of heating, ventilation, and air conditioning systems.
2) 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 25 percent of all value added of the EGSS is generated in this industry (see figure 6.4.3). 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 contribute 1 percent to total value added of the EGSS just like second hand shops selling used goods. 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.

An important 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 2009 was responsible for 13 percent of total value added created in the EGSS. Producers active in energy saving and sustainable energy systems (pre-exploitation phase) were responsible for 8 percent of total value added and producers of renewable energy (exploitation phase) were responsible for 5 percent of total value added. In 2011 an in depth study has been conducted on the sustainable energy sector. See box 1 for more information.

6.4.3 Distribution of value added EGSS over different activities, 2009



1) including installation of heating, ventilation, and air conditioning systems.
2) not related to energy saving and sustainable energy systems

Box 1- a study on the sustainable energy sector

On 10 June 2011 the study 'Economische radar duurzame energiesector' (in English: Economic radar for the sustainable energy sector) was published at the website of Statistics Netherlands (in Dutch). This study was commissioned by the Ministry of Economic Affairs, Agriculture and Innovation. The sustainable energy sector is part of the environmental goods and service sector, and consists of all companies and institutions that physically produce renewable energy (exploitation phase) as well as companies active in the value chains that come before it (pre-exploitation phase). Apart from renewable energy, the sustainable energy sector also includes companies and institutions that focus on energy saving activities.
There is a lot of interest for this particular sector because energy supply and consumption have been changing in recent years. In the near future, the demand and supply of sustainable energy will become increasingly important. Secondly, newly developed energy systems have little or no dependence on fossil fuels. Thirdly, sustainable energy contributes to securing supplies, diversification of energy supply, the reduction of greenhouse gas emissions and the creation of green jobs.
Strength of the methods used is that these are based on data already available at Statistics Netherlands in combination with expert knowledge from outside Statistics Netherlands. Therefore no additional administrative burden on business proceeding from this study. In addition, the concepts used are consistent with those used in the national accounts. This means that figures for the sustainable energy sector are comparable with the key macroeconomic indicators such as GDP and total employment.

Aim of this study was to set up a consistent economic monitoring system for the sustainable energy sector, benchmarking one year (2008) and to provide recommendations on key issues for the further development of the economic radar. These key issues include timely reactions to current issues with figures of other knowledge institutes and/or the associations, monitoring international investments, analysing ownership constructions and map developments in the use of fossil fuels in the economy.
This study describes the key indicators that were developed on the basis of the data available at Statistics Netherlands. Economic indicators were determined for various parts of the sustainable energy sector: value added, production, employment, exports, imports, investments and innovation. The sustainable energy sector is broken down into 16 product profiles and 7 process profiles. The various product profiles are 'solar PV', 'solar CSP', 'solar thermal energy', 'bio gas', 'bio mass (solid) & waste', 'bio fuels', 'bio refining', 'wind on land', 'wind at sea', 'heat & geo thermal energy', 'energy from water', 'energy saving', 'electric transport', 'smart grids', 'hydrogen technology' and 'CO2 capture and storage'. The process profiles are 'R&D', 'consultancy', 'transport', 'preparation/ raw material production', 'supply, assembly and construction', 'production of energy carriers', 'installation and maintenance'. In this study we determined economic figures for these different profiles.
The physical data about the production of renewable energy (Protocol monitoring renewable energy[21]) and the data derived from the 'Economic radar for the sustainable energy sector' can be very valuable in supplementing each other.

21) This protocol has been set-up in order to determine the share of renewable energy production in the Netherlands. The protocol prescribes the definition of renewable energy. Statistics Netherlands uses this protocol in order to compile statistics on renewable energy production.

box 1. Indicators for the sustainable energy sector, 2008*

Economic key indicators (rounded)	
Production (million euro	5.160
Value added (million euro)	1.710
Employment (labour volume in FTE's)	17.300
Innovation aspects pre-exploitation phase	
R&D as a percentage of production (%)	4
Percentage innovators (%)	54
International trade	
exports (million euro)	1.806
imports (million euro)	2.232
Investments pre-exploitation phase (million euro)	234

Source: Economische radar duurzame energiesector, june 2011

A few results of the study:
Share of sustainable energy sector in Dutch GDP was about 0.32 percent in 2008. Its share in total production is 0.45 percent and in total employment 0.25 percent. This is because the sustainable energy sector is relatively capital intensive. The sustainable energy sector employs relatively few people who each contribute quite a lot to the value added and production in the Netherlands with the help of the capital invested. Both production and value added per unit of labour volume in the sustainable energy sector exceed that of the economy as a whole.

Total export of goods by companies in the sustainable energy sector had a value of 1,806 million euro in 2008. The products 'solar PV' and 'energy saving' are mostly exported by wholesale and manufacturing. Bio fuels are mainly exported by wholesale. The total import of the sustainable energy sector is 2,232 million euro. The imports consist mainly of biofuels from the rest of the world. A part of these biofuels and biomass is sold on the domestic market, but an even larger part is re-exported. Also the product profile wind on land has a large share of imports, mainly due to the import of turbines from Germany and Denmark. Exploitation subsidies aiming to increase the share of sustainable energy in 2020 stimulate these imports. The sector as a whole had a negative balance of trade in 2008.

Approximately 54 percent of the large and medium-sized companies in the pre-exploitation phase of the sustainable energy sector, with 10 or more employees, indicated in the period 2006–2008 that they introduced new products or services (product innovation) or started using new methods (process innovation). About 30 percent of the companies indicated that they applied for a patent in the period 2006–2008. Spending on in-house R&D, by large and medium-sized companies in the pre-exploitation phase, averaged 3.9 percent of the production value. In comparison, spending on in-house R&D in the total Dutch economy averages about 1 percent.

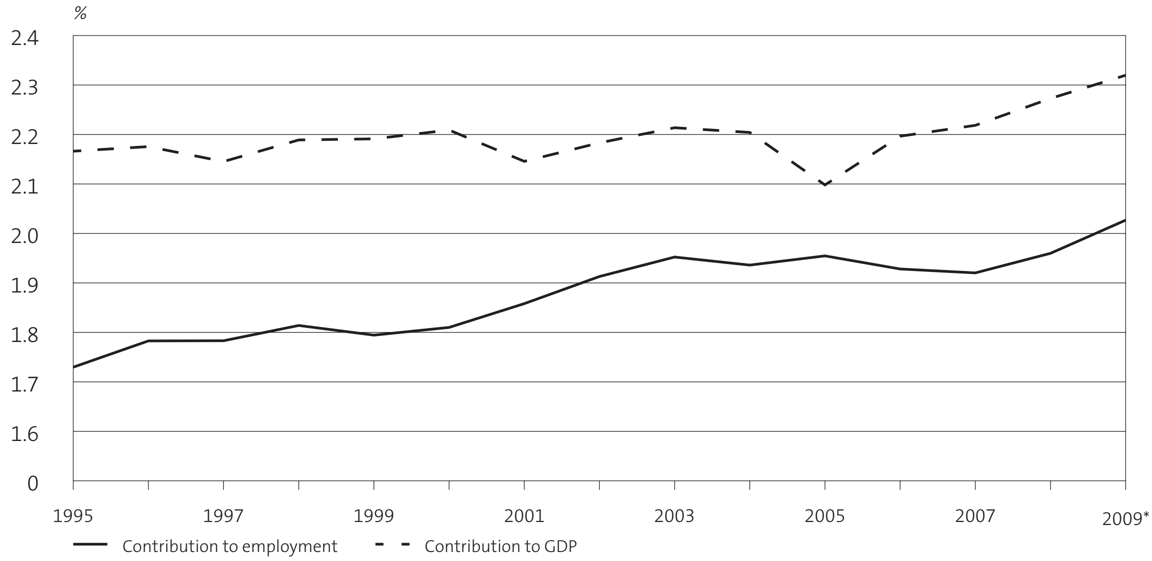
The Rijnmond region houses most companies in the pre-exploitation phase. The proximity of the port of Rotterdam undoubtedly plays a major role especially for wholesale in the sector. The value added of a company in Rijnmond is on average relatively small. There also seems to be a cluster of companies in the south east of the province Noord- Brabant belonging to the sustainable energy sector. The traditionally strong presence of electrical engineering and the technical university play a key role in this. There are also many companies close to the technical universities of Delft and Twente. Furthermore, the province of Limburg houses many sustainable energy companies. These companies play a large role in the total Dutch value added. In Limburg the pre-exploitation phase of the sustainable energy sector is best represented in the regional economy (mainly solar energy). About half a percent (measured in value added) of the economy is formed by these companies.

The study can be found on the website by clicking on the links.
Dutch report:http://www.cbs.nl/NR/rdonlyres/4B1C4BCB-CE97-482B-A8EB-7B9EA402E3B4/0/2011economischeradarduurzameenergiesector.pdf
English report (only summary): http://www.cbs.nl/NR/rdonlyres/01A2777A-BAA8-47A6-B0B9-AAC8A7A155AA/0/2011managementsummaryeconomicradarsustainableenergysector.pdf

Relative contribution of EGSS to GDP is quite stable over time

With a contribution of 13.2 billion euro to the gross domestic product (GDP) in 2009, the Dutch EGSS accounted for 2.32 percent of total GDP. In 2008 this share was equal to 2.27 percent (see figure 6.4.4). The decline in value added of the EGSS was smaller than the decline in GDP of the total economy, so relatively the EGSS has become more important for the Dutch economy. Generally speaking, this share remained more or less stable in the period 1995–2009, although one could discern an upward trend from 2005 onwards. With regard to employment, in terms of full-time equivalents, the EGSS had a share of 2.03 percent in total employment in the Netherlands in 2009. The relative contribution of the EGSS to total employment has increased quite convincingly over time.

6.4.4 Contribution of EGSS to GDP and employment



Theme articles

Economy of the North Sea

7

Economy of the North Sea

Experimental research

Economic analysis motivated by EU's Marine Strategy Framework

Acknowledgement:
This article is a joint product of Statistics Netherlands and the Ministry of Infrastructure and Environment (Directorate General of Public Works and Water Management, Centre of Water Management).

7.1 Introduction

There is increasing recognition of the capacity of the environment to render services (MA 2005; TEEB 2010). Within environmental accounting, ecosystem accounting is a relatively new but upcoming area. Ecosystem accounting entails describing the environment in terms of various ecosystems that deliver various types of services such as provisioning services in the form of supplying fish and oil, regulating services in the form of pollution breakdown, and amenity services as evidenced by tourism. Marine ecosystems provide many services to the economy (e.g. Murillas-Maza et al (2011); Lange, (2009)). This study is a first attempt to evaluate the economic contribution of the North Sea. In terms of ecosystem services, the focus therefore lies on the provisioning and amenity services. The economic valuation presented will facilitate the social and economic analysis of the use of the marine environment of the Dutch Continental Shelf (DCS) in terms of value added and employment and other key economic indicators. This study is motivated by the European Union's Marine Strategy Framework Directive.

"The aim of the European Union's ambitious Marine Strategy Framework Directive (adopted in June 2008) is to protect more effectively the marine environment across Europe. It aims to achieve good environmental status of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The Marine Strategy Framework Directive constitutes the vital environmental component of the Union's future maritime policy, designed to achieve the full economic potential of oceans and seas in harmony with the marine environment." .... "Each Member State must draw up a programme of cost-effective measures. Prior to any new measure an impact assessment which contains a detailed cost-benefit analysis of the proposed measures is required".
European Commission, 2010

Statistics Netherlands (CBS) has executed this study in commission of the Ministry of Infrastructure and Environment, more specifically the Centre of Water Management of the Directorate General of Public Works and Water Management (Rijkswaterstaat). The assignment to analyse the economic activities of the North Sea follows from a study on the economic description of river basins for the Netherlands (Brouwer *et al*., 2005; Statistics Netherlands, 2010a). In this study, the Netherlands is spatially divided in seven river basins. The economic and environmental figures for the river basins are used to evaluate measurements of the Water Framework Directive from the European Union.

For the analysis we have distinguished between activities of Dutch companies on the Dutch Continental Shelf (DCS), which is part of the North Sea, and activities taking place on land in areas related to the North Sea. These areas on land are Dutch seaports and the coastal zone. Part of the methodology used in the river basin analysis (Brouwer et al., 2005; Statistics Netherlands, 2010a) is adopted in this paper for the valuation of seaports and the Coastal zone.

A coherent description of economic activities related to the North Sea has been made for three reference years, namely 1995, 2000 and 2007. The economic figures presented in this paper include the variables production, intermediate consumption and value added. Also, two variables related to labour are presented: the number of employees and compensation of employees. All figures are in current prices, meaning that price inflation is included.

Economic figures have been compiled for three different categories. Firstly, the activities that take place directly at sea. These include oil and gas extraction, shipping, fishing, production of wind energy at sea and the extraction of sand (dredging). Economic activities related to the exploitation of the many cables and pipes under the DCS are not included. Secondly, economic figures have been compiled for activities on land related to the North Sea, particularly in seaports and along the North Sea coast. Here only some particularly relevant industries are taken into account. Lastly, spillover effects of the activities on the DCS, in seaports and in the coastal zone on the national economy are presented in this study.

Before presenting the economic activities in quantitative terms, paragraph 7.2 provides a brief description of the used concepts, which are consistent with the concepts of the Dutch National Accounts. This paragraph also discusses the geographical boundaries and the methodologies used to compile statistics for the relevant activities. In paragraph 7.3 the results of the study are presented, quantifying the economic importance of the North Sea for the Dutch economy. In the final paragraph the conclusions from this study are presented.

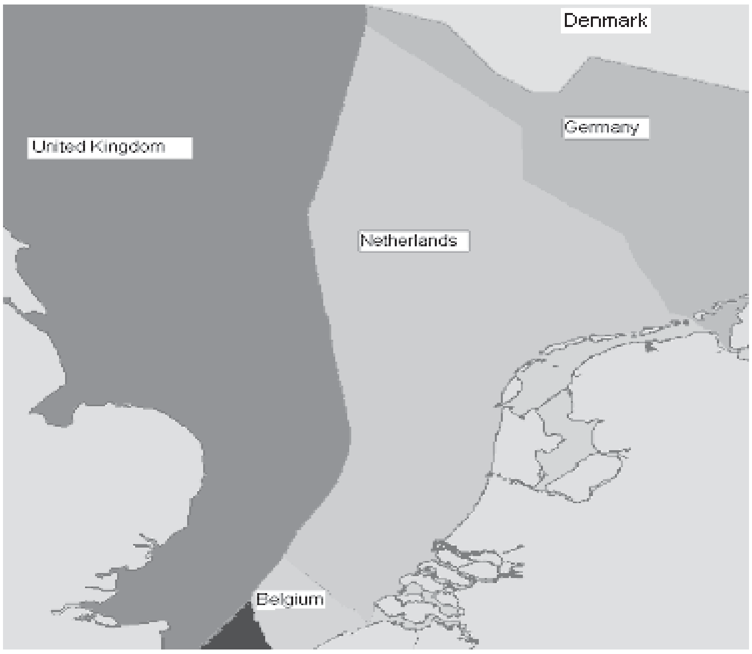
7.2 System boundaries, definitions and methodology for data compilation

The Dutch National Accounts are the main data source used in this study (Statistics Netherlands, 2010b). The system of national accounts shows a quantitative overview of the economic process of a country and its economic relations with the rest of the world. The core in the national accounts is a number of important economic indicators such as gross domestic product (GDP) and national income. Benefits of using figures from the national accounts are that all variables are linked together in a consistent way. The quality is improved because the definitions that underlie the system make it possible to confront different statistics. Also international comparability is an advantage because concepts and definitions are based on International guidelines provided by the United Nations, the European Union and other international organisations. The international standards are documented in the United Nations System of National Accounts (SNA) and the European System of Accounts (ESA).

Geographical boundaries

The North Sea is located on the European continental Shelf and bordered by Great Britain in the west and by Belgium, the Netherlands, Germany, Denmark and Norway in the East. The measurement of activities of Dutch companies on the North Sea in this study is limited to the Dutch part of the Continental Shelf (DCS). There is one exception, which is sea shipping. Sea shipping is taken into account completely, no matter where the ships are sailing. The DCS is the part of the North Sea, adjoining the Dutch coast, where the Netherlands claims exclusive rights to mineral resources. This Dutch part of the continental shelf in the North Sea is also regarded as part of the economic territory. Figure 7.2.1 shows a map of the DCS.

7.2.1 Map of the Dutch Continental Shelf



The Wadden Sea, located in the North of the Netherlands, is not included in the figures. The Netherlands have included the Wadden Sea under the Water Framework Directive and not under the Marine Strategy Framework Directive relevant for this study.

Methodology for activities at sea

The following activities have been included as activities at sea: oil and gas extraction, fisheries, sea shipping, wind power production and 'sand extraction'. Economic variables for these activities are compiled using all kind of different sources and methodologies. Very often data can directly be retrieved from the national accounts system. In table 7.2.2 an overview is given of the most important data sources and compilation techniques. See Vuik, van Rossum, and Pieters (2011) for a complete overview of the used compilation techniques.

7.2.2 Overview of data sources

Activity on sea	Sources	Published	Remarks
Oil and gas extraction	national accounts, regional accounts	yes	Figures for employment based upon data of SDOM [1]
Fisheries	national accounts and data frorm LEI [2]	yes	LEI figures have been used to split of Dutch Continental Shelf
Sea shipping	national accounts	yes	–
Wind power production	environmental accounts, EGSS statistic [3]	yes	Renewable energy statistics used in data compilation
Sand extraction	national accounts	no	Data not included in totals due to quality problems

1) State Supervision of Mines.
2) LEI forms part of Wageningen University and Research Centre.
3) Environmental Goods and Services Sector statistic.

Methodology for activities on land

We analysed two typical areas of interest for activities on land. These are the seaports in the Netherlands and the coastal zone. The activities in the seaports are indirectly dependent upon the presence of the North Sea. The companies located in those seaports have strong overseas connections with other economic actors abroad (import from abroad, export to foreign countries). We included the following seaports in this study: Rotterdam, Amsterdam, IJmuiden, Eemshaven, Delfszijl, Harlingen, Vlissingen, Moerdijk, Terneuzen, Drechtsteden, Den Helder. The geographical area of seaports has been defined with the use of the maps of the seaport authorities. Not all activities in the seaports were included in this study. We selected industries for which the proximity or accessibility to the North Sea is assumed to be a critical location factor. In seaports, manufacturing, transport, construction, oil and gas production and wholesale trade were taken into account.

The coastal zone has also been analysed in this study. Tourism is very important for the coastal zone and the presence of the North Sea stimulates tourism in this particular area. All zip codes which overlap with the coast line of the Netherlands are zip codes belonging to the coastal zone. The Frisian or Wadden islands are part of the coastal zone. Here also counts that not all activities in the coastal zone have been taken into account. Here we also have not included all activities in the coastal zone, only fishing, retail trade, restaurants/hotels, culture and sports activities.

The method used for estimating economic key figures for the areas of interest is based on the NAMWARib method that is used by Statistics Netherlands employs to calculate the economic figures for different subriver basins (Brouwer et al., 2005). NAMWARiB provides information about the interactions between the physical water system and the economy at a national and subriver basin scale. For the purpose of geographical research, the Netherlands is divided into COROP regions. The Dutch regional accounts of Statistics Netherlands annually present economic key figures (Production, Value Added, etc.) per COROP region. Our study allocates these COROP figures to the relevant seaports and to the coastal area.

In constructing statistics for the areas we used the business register. The business register provides information on individual companies: e.g. location (address), the number of employed persons and the type of industry (NACE class). Geographical data on the surface area are used for allocating the COROP figures to the areas of interest.

Two distinct methods (hereafter called scenarios) for measuring the activities in the area of interest are presented in this study. The first scenario (A) limits the surface of the coastal area and ports (i.e. the areas of interest) to the predefined geographical boundaries. The second scenario (B) shows the results of extending the areas of interest to complete zip code zones. Scenario A assumes a proportional geographical distribution of economic activities within a zip code zone. In step 2 surface area is used to allocate the figures of a zip code to a particular portion of the zip code. See Vuik, van Rossum, and Pieters (2011) for a complete overview of the methods used and the corresponding advantages and disadvantages of the methodology used.

Methodology for spillover effects on the national economy

Activities in seaports, coastal zones and at sea have spillover effects on the rest of the economy of the Netherlands and vice versa. Without the hinterland large ports would not be there. Only taking into account direct employment, production and value added would lead to serious underestimation of the importance/relevance of activities related to the North Sea, more specifically the Dutch Continental Shelf (DCS). The growing interconnectedness of economic activities leads to significant indirect or spillover effects on the rest of the economy. These indirect effects can be determined by calculating multiplier effects derived from input-output (IO) analysis (e.g. Miller and Blair, 2009). Multipliers can be useful instruments in economic analyses despite their limitations.

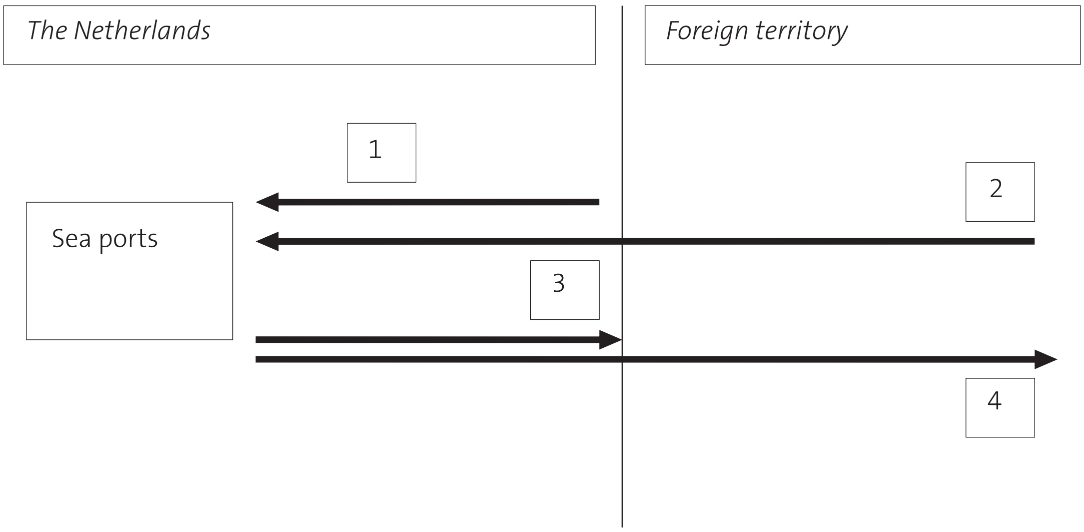
Input-output models are feasible instruments to trace the effects of changes in final demand through the economy over short periods of time, since they track the interconnections of production by industry at a detailed level. In this function, they are called impact models or multiplier models. A number of different types of multipliers can be generated by IO models (e.g. Eurostat, 2008; Miller and Blair, 2009).

In this study we use standard multiplier analysis to estimate indirect effects of seaports spillover to other regions in the Netherlands in order to quantify the (economic) impact of activities in seaports, coastal zones and at sea for the Dutch economy in general (CBS 2010). The results for the indirect effects are experimental and therefore more uncertain than standard statistics for direct employment, value added and production.

Multipliers can be calculated for all kind of variables. The employment-multiplier is equal to direct plus indirect employment divided by direct employment. The value added-multiplier is equal to direct plus indirect value added divided by direct value added. An employment multiplier of 1.5 indicates that 1 person employed in, for example the seaport, goes along with another 0.5 person employment elsewhere in the economy. So the spillover effect of one additional employed person in the seaport is equal to 0.5 person. A value added multiplier of 1.7 indicates that if seaports generate 1 euro value added directly this goes along indirectly with another 0.7 euro value added elsewhere in the economy.

The spillover effects of Dutch seaports affecting professional transport activities are not estimated by means of standard input-output analysis. The seaports have strong spillover effects to transport activities in the Netherlands. Dutch transport companies take advantage of the transfer of goods in the Dutch seaports. Transport companies transport goods to seaports and distribute goods from seaports into the main land of the Netherlands and even abroad. The Netherlands is known as a country with a strong transport industry. The seaports have spillover effects to three transport modules 'transport by railway', 'transport by road' and 'transport by inland shipping'. The additional effect is calculated by subtracting the direct transport activities in seaports from total transport activities. Data on transport statistics have been used in order to compile economic variables for the spillover effects under consideration. Data on transport performances (measured in tonne kilometres equivalents) have been collected for a few relevant municipalities/locations of interest. The transport activities from and towards these municipalities are monitored by these transport statistics.

7.2.3 Transport movements incorporated in the analysis



The transport performance for the Netherlands as a whole has been estimated. Using the national figure, we calculated the shares per municipality. For example, a large part of total railway (cargo) transport activities in the Netherlands are triggered from or to Rotterdam (incorporating transport movements 1+2+3+4 in figure 7.2.3). For every single municipality employment has been calculated by multiplying the share of transport activities in municipality x with the total employment number in the Netherlands of the transport activity under consideration. Figures for employment, value added, production and compensation of employees are based upon economic ratios such as value added per employee, production per employee and loan per employee. Employment related to transport by road, inland shipping and railway transport is estimated by using exactly the same method.

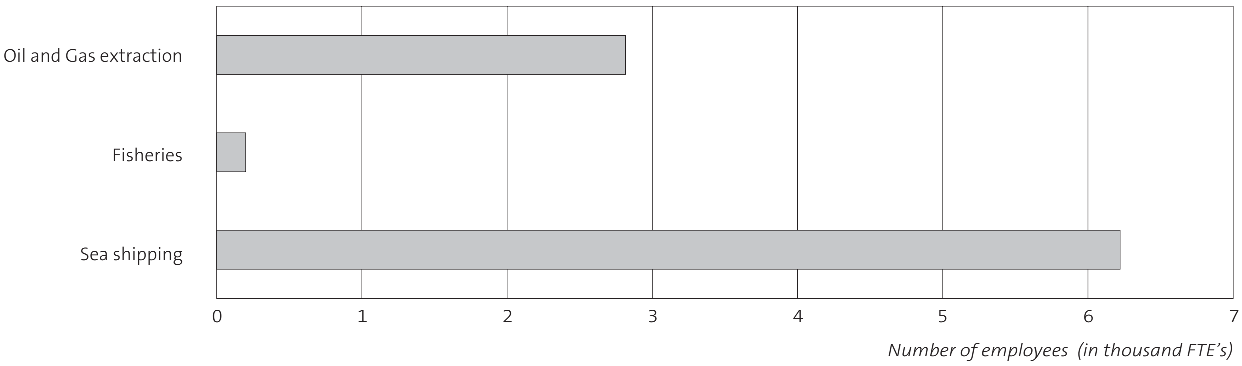
7.3 Results

The results of this study are presented in four parts. First we present the results of the direct activities for the Dutch Continental Shelf (part 1), followed by the results for the direct activities in the seaports (part 2) and the coastal zone (part 3). The results for the spillover effects are presented in part 4.

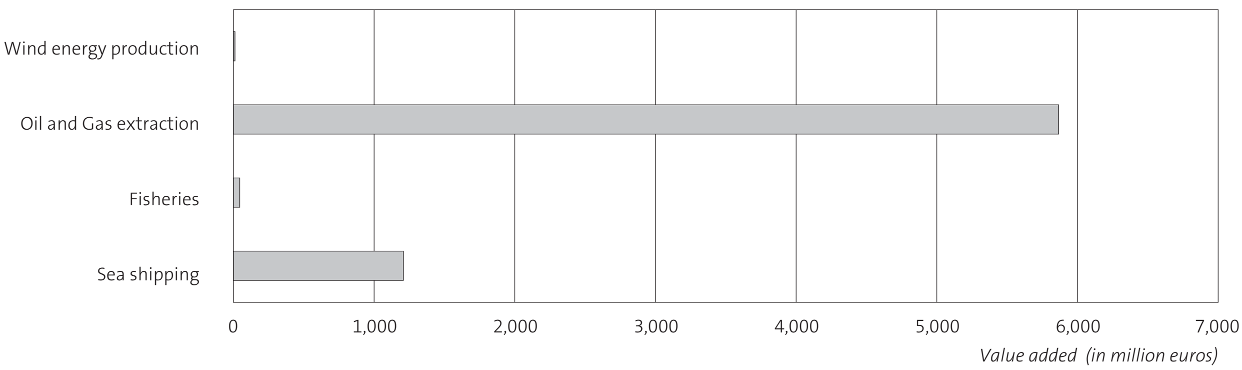
Dutch Continental Shelf (DCS)

The number of employees in full time equivalents (FTE) and the value added in 2007 for the activities on the Dutch Continental Shelf[1)] included in this study are presented in figures 7.3.1 and 7.3.2. Value added of the activities on the Dutch Continental Shelf equalled to 7.1 billion euro in 2007. Employment equalled 9.2 thousand FTE in 2007.

7.3.1 Number of employees (FTE's) of the activities on the DCS, 2007



7.3.2 Value added of activities on the DCS, 2007



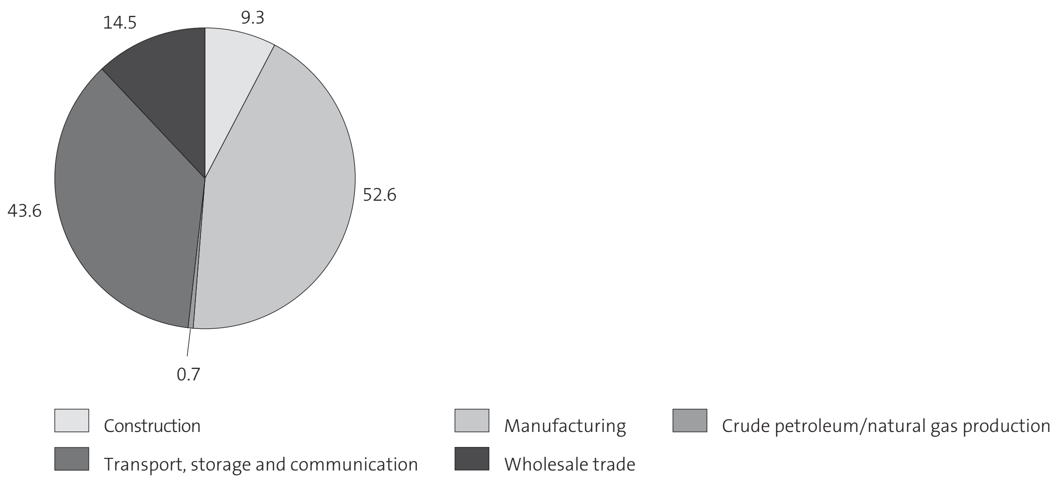
1) For sea shipping we used the total national figure so our estimate includes global movements of vessels operated by Dutch companies.

The activities 'sea shipping' and 'extraction of oil and gas' have a substantial economic impact. The largest number of employees (FTE) is in the sea shipping sector. This number includes persons employed on shore by companies that operate sea going vessels that transport goods or people internationally. The activities of companies active in extraction of oil and gas [2] create the biggest share of total value added on the DCS. This industry also includes companies providing typical services specialised for the sector, such as 'drilling companies'.

Seaports

In 2007 the estimated total number of employees (FTE) in seaports was 121 thousand [3]. Figure 7.3.3 shows that Manufacturing and Transport, storage and communication have the largest shares in employment of the industries selected. More specifically, most employees are employed in the industries 'Supporting transport activities', 'Manufacture of basic chemicals and man-made fibres' and 'Manufacture of basic metals'.

7.3.3 The share of the selected industries in the total number of employees (in thousand fte's) in seaports, 2007

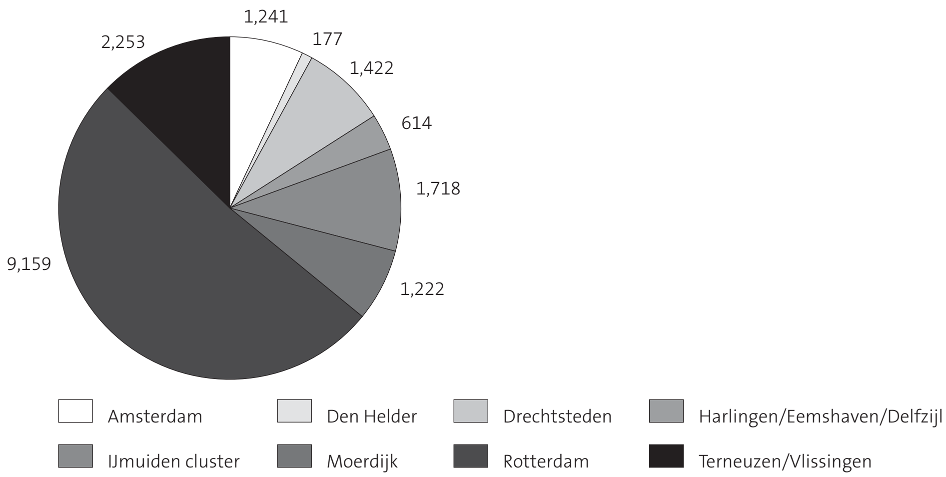


Total value added of the selected industries in the seaports in 2007 was equal to 17.8 billion euros. Figure 7.3.4 presents the geographical distribution of total value added in seaport locations. A little over half of total value added of the activities concerned is generated in the seaport of Rotterdam.

2) The figures on employment in oil and gas extraction includes employees active on sea (including contractors). Employees in offices on land that are dedicated to the planning, monitoring, etc of the offshore work are not included. This may cause a significant underestimation of the employment level. A figure of this employment is not (yet) available.

3) This figure includes sea shipping companies located in seaports.

7.3.4 The share of individual seaports in total value added (in million euros) of all seaports in 2007, selection of industries

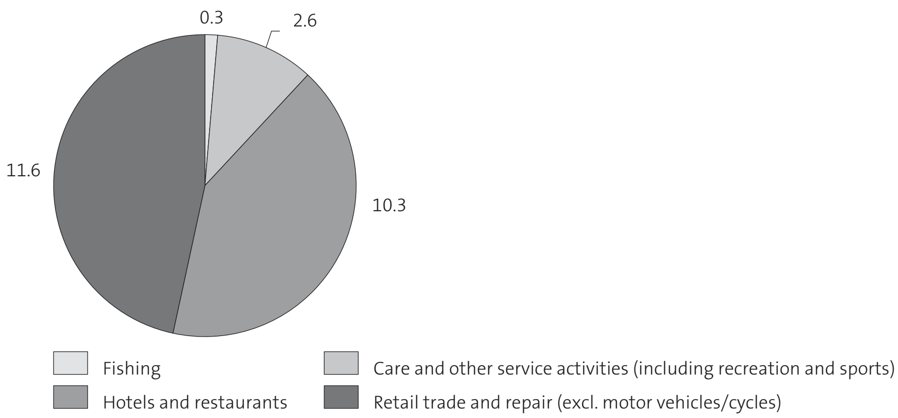


Coastal zone

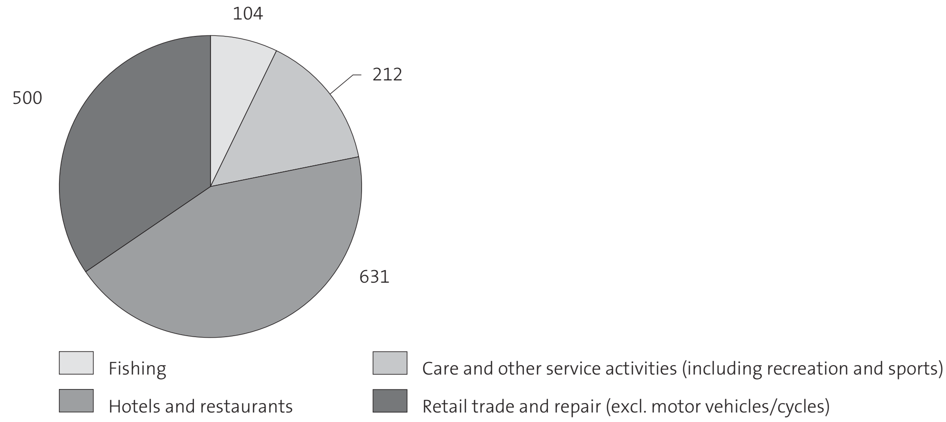
There were 25 thousand people employed (FTE) in the selected coastal zone industries in 2007. Most of these employees are employed in 'Hotels and Restaurants' and in 'Retail trade' as shown in in figure 7.3.5.

The selected activities in the coastal zone generated a value added of 1.4 billion euros in 2007. The distribution over the different selected industries is shown in figure 7.3.6. On average, the activities selected in the coastal zone are more labour intensive than the relevant selected industries in seaports. Five times as many employees (FTE) are employed in the seaports than in the coastal zone, while value added is more than 12 times larger in seaports.

7.3.5 The share of the selected industries in the total number of employees (in thousand fte's) in the coastal zone, 2007



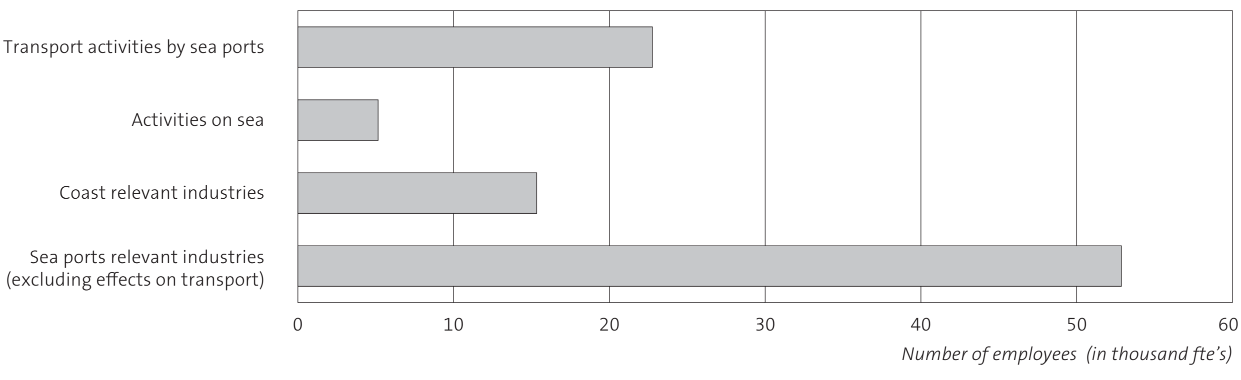
7.3.6 The share of the selected industries in the total value added (in million euros) in the coastal zone, 2007



Spillover effects of activities at sea and activities on land

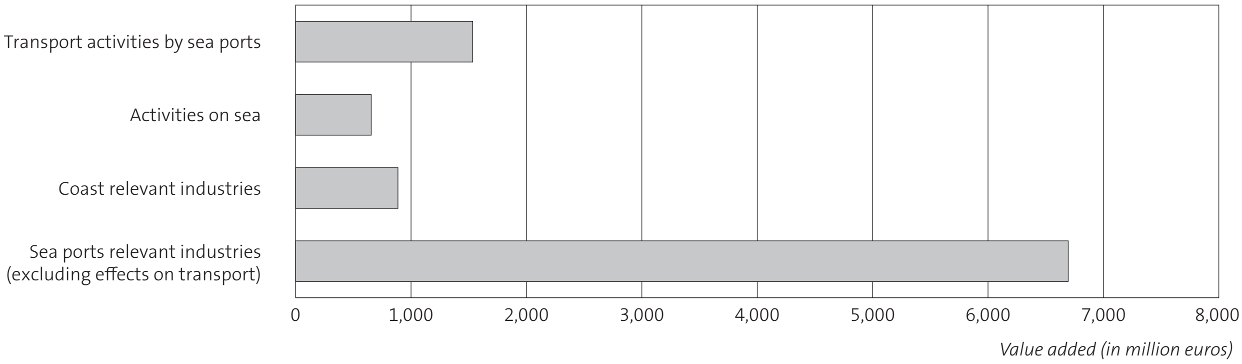
The economic activities at the North Sea, in seaports and in the coastal zone have spillover effects on the rest of the Dutch economy. This indirect effect on employment is quantified for 2007 in figure 7.3.7. The spillover effect of the selected industries in seaports on the transport industry is presented separately as this figure is based upon an alternative methodology as presented in paragraph 7.2. The activities in seaports indirectly result in 23 thousand extra employed FTE in the transport industry. This includes transport by road, transport by rail and inland shipping. The activities in seaports indirectly result in 53 thousand extra employed FTE in industries other than transport.

7.3.7 Spill over effect of selected activities on rest of economy, employment, 2007



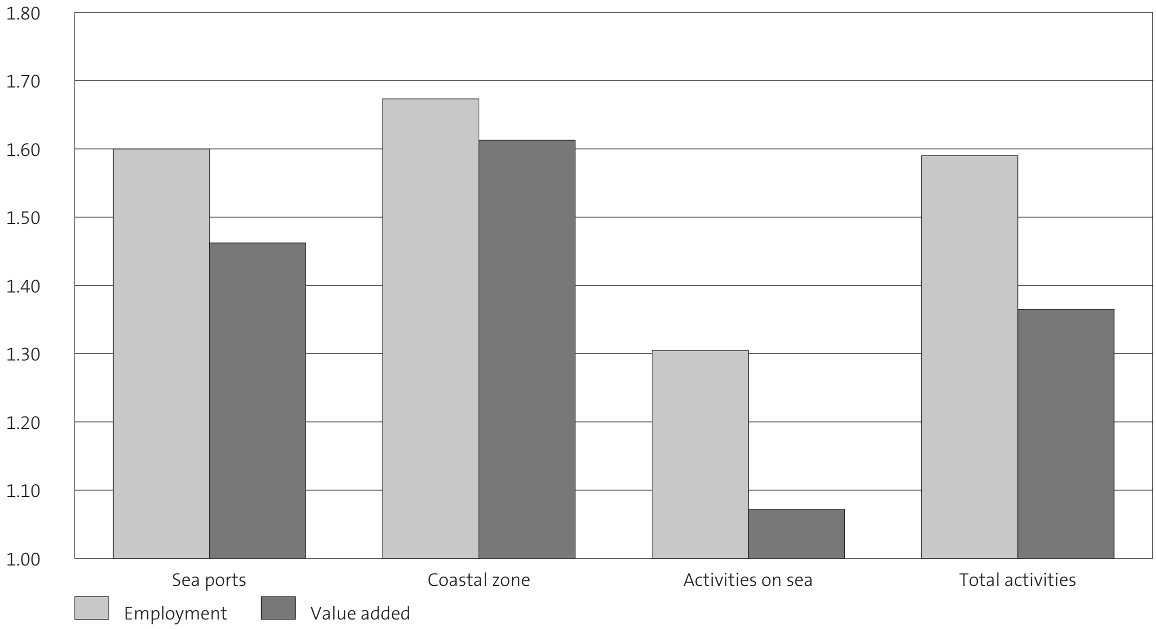
The effect of the selected industries on other parts of the Dutch economy has also been measured in value added. These results are presented in figure 7.3.8. The spillover effect of the seaports is very large measured in value added. The spillover effect of the seaports alone is bigger than the summed spillover effect of the activities on sea and in the coastal zone together.

7.3.8 Spill over effect of selected activities on rest of economy, value added, 2007



The multipliers presented in figure 7.3.9 express the relative impact of production of the economic activities selected in this study on the rest of the economy of the Netherlands in 2007. The employment multiplier is largest for the coastal zone. Ten employees active in the coastal zone trigger employment for approximately 7 people working elsewhere in the economy. For the seaports it holds that 10 employees active in those seaports trigger approximately 6 people working elsewhere in the economy. The activities on sea have the smallest employment-multiplier. For every 10 employees active at sea, approximately 3 people are active elsewhere in the economy.

7.3.9 Employment multipliers and value added multipliers, 2007



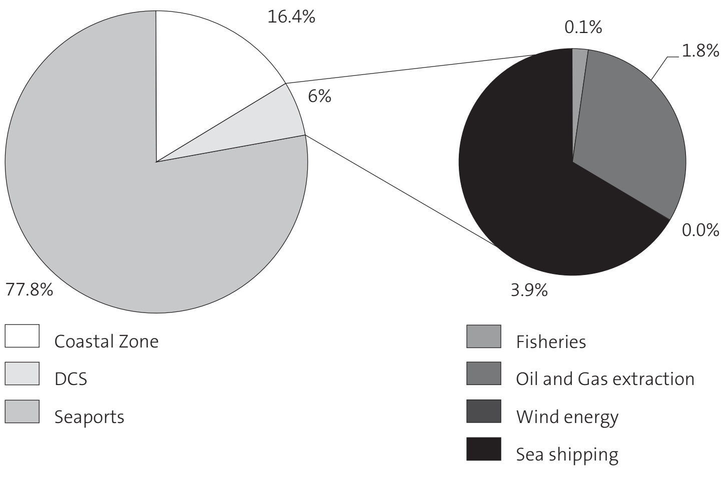
The employment multiplier for all activities at sea and on land relevant for this study was equal to 1.6 in 2007. This is lower than average for the Dutch economy, for which the employment multiplier is 1.8. The average value added multiplier was equal to 1.4 for the activities on the DCS, in seaports or in the coastal zone in 2007. This means that for every 10 euro value added created by North Sea related activities approximately 4 euros are created elsewhere in the economy. Like the employment multiplier, the value added multiplier of the selected activities is significantly lower than the Dutch average (1.6 in 2007).

Overview

The total number of employees (FTE) in selected activities, including their spillover effect to other parts of the economy, equalled to 246 thousand in 2007. Figure 7.3.10 shows the share of different activities in total employment including their spillover effects on the Dutch economy.

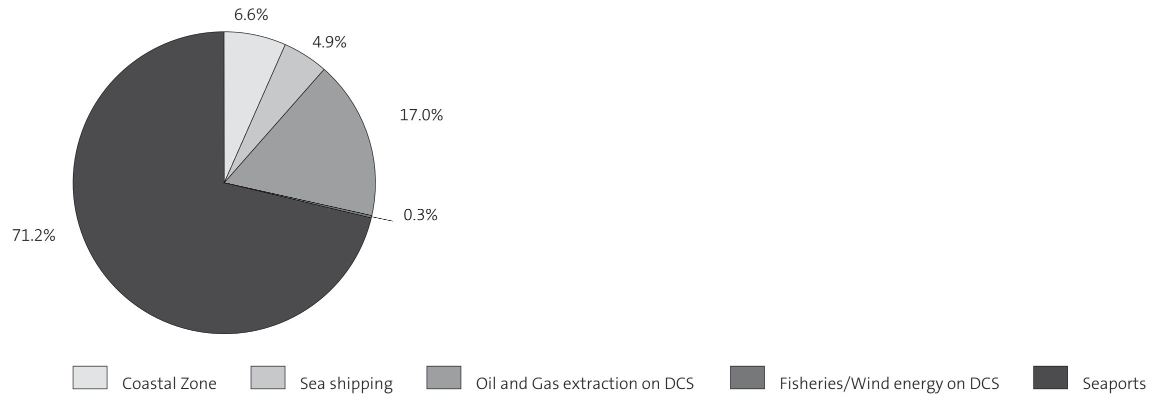
Nearly a quarter of a million employees (FTE) dependent upon North Sea economy

7.3.10 Share in employment, including spill over effect, 2007



Total value added in selected activities, including their spillover effect to other parts of the economy, was equal to 35.1 billion euro in 2007. The distribution of value added, including indirect effects, over different categories is presented in figure 7.3.11. The share in value added of activities at sea (22) is larger than their share in employment (6). The activities at sea are therefore characterised by a low labour intensity.

7.3.11 Share in value added, including spill over effect, 2007



The number of employees (FTE) decreased between 1995 and 2007 (see figure 7.3.12), whereas the total number of employees in the Netherlands grew in the reference period. Consequently, the share of the relevant activities in total employees in the Netherlands has decreased. In 1995 this share was equal to 5.0 percent, and in 2007 4.2 percent.

Contrary to employment, the other economic indicators[4)] increased in the time period analysed. The share in production of the relevant activities at sea and on land, including their spillover effect on the national economy, grew subsequently from 9.6 percent in 1995 to 10.0 percent in 2000 and 11.4 percent in 2007. The growth in value added of the selected activities was slower than the national average. The share in total GDP of the areas of interest was equal to 7.1 percent in 1995 and decreased to 6.4 percent in 2000. In 2007 the share in value added was 6.9 percent.

7.3.12 Development of employment and value added for selected industries related to the DCS and national figures for the Dutch economy

4) All monetary figures presented are in current prices, including (price) inflation.

7.4. Conclusions and recommendations

There were 246 thousand employees (FTE) working in activities related to the North Sea, (direct on the Dutch Continental Shelf, in seaports, in the coastal zone and their spillover effect on the national economy) in 2007. Value added had reached 35 billion euros, production 124 billion euros. The share in value added of the areas of interest and the selected industries equalled 6.9 percent in 2007 and has declined over the years. The relevant activities had a share of 4.2 percent in total employment of the Netherlands in 2007.

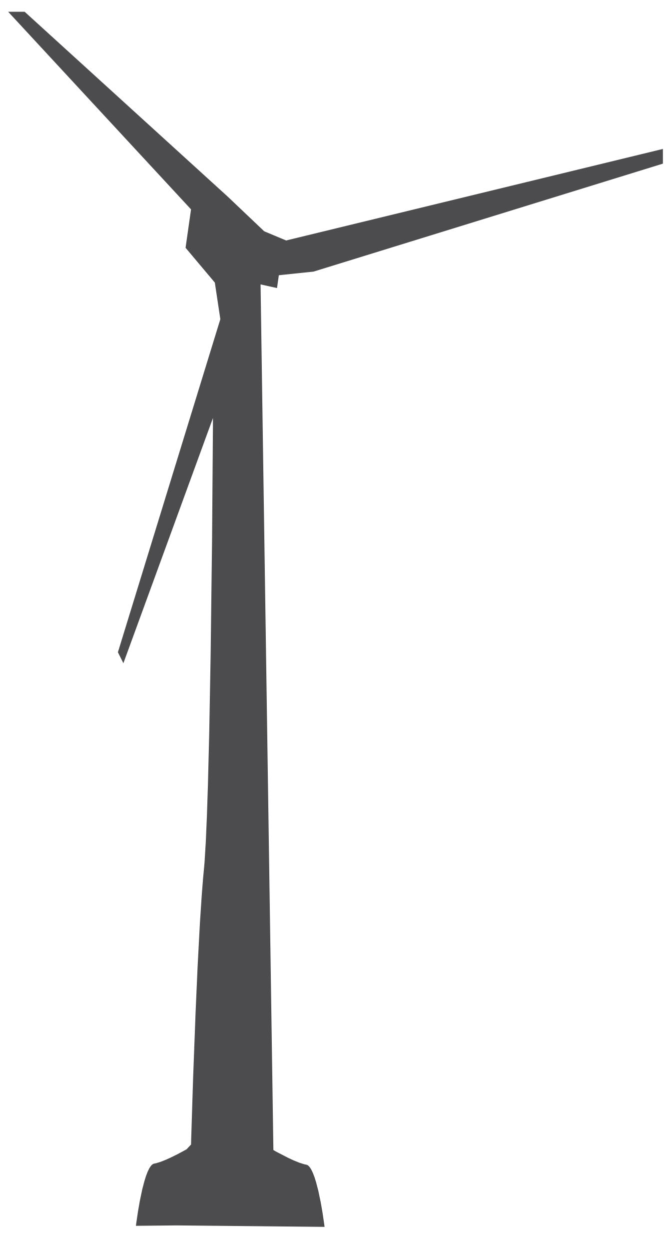
Relevant North Sea activities account for 4.2 percent of total employees (FTE)

The activities on the Dutch Continental Shelf, in seaports and in the coastal zone had an employment multiplier of 1.6 in 2007 which was significantly below the Dutch average of 1.8. This is partly due to the fact that the activities at sea have relative little interactions with other industries because they are located at sea. In addition activities at sea are relatively capital intensive and do not consume much input of goods and services for their production. Economic activities in seaports usually have strong relationships with foreign economies, importing crude oil or iron ore. Intermediate consumption consists largely of imported products because these specific materials (iron ore, base chemicals and crude oil) are not or hardly available in the Netherlands. Extra production of companies in the seaport does not lead, on average, to large spillover effects in the rest of the Dutch economy due to these import leakages.

The value added multiplier is 1.4 for 2007. This means that for every 10 euro value added created by North Sea activities approximately 4 euros are created elsewhere in the economy. Like the employment multiplier, the value added multiplier of the selected activities is below the Dutch average (1.6 in 2007). The value added multiplier for activities at sea (1.1) is even smaller. Oil and gas production is responsible for this small multiplier. Oil and gas production does not consume much goods and services in order to produce gas and oil. Not much intermediate consumption leads to small spillover effects. The results of this study are are experimental and therefore more uncertain than standard statistics on employment, value added and production. In order to construct the data in this study a few assumptions had to be made (see Vuik, van Rossum and Pieters (2011)).

Valuation of wind energy resources

8



Valuation of wind energy resources

Experimental research

8.1 Introduction

The issue of renewable energy is receiving more and more public attention. The debate on renewable energy is spurred by the fact that fossil fuels are becoming scarce and that their combustion produces CO_2 which contributes to climate change (IPCC, 2007). Renewable energy is a substitute for non-renewable energy. Renewable energy can be produced from many different sources, i.e. biomass, wind energy, hydropower energy, solar energy, geothermal energy and so on. These energy sources are considered more environmentally friendly than conventional, fossil based sources. For example, their use means fewer greenhouse gas emissions to air than their fossil counterparts. Secondly, these alternative energy sources are replenished constantly, in contrast to the fossil fuels. The problems related to scarcity of fossil fuels are expected to become more severe over time, especially for oil and for countries which are highly dependent on non-renewable energy resources. In reaction to this, governments are trying to develop and implement policies to reduce air emissions and to reduce fossil energy depletion. Many countries are in the process of transforming their energy policy to a more sustainable one.

In the System of National Accounts, fossil energy resources are recorded as non-produced assets in the national balance sheet. In order to comply with the general definition of an economic asset, natural assets must not only be owned, but must also be capable of bringing economic benefits to their owners, given the technology, scientific knowledge, economic infrastructure, available resources and set of relative prices prevailing on the dates to which the balance sheet relates or expected to do so in the near future (SNA2008 chapter 10168, UN, 2008). These requirements are generally met for fossil energy resources like coal, natural gas and oil. As a logical consequence, an increasing number of countries publish statistics on the public and private ownership of fossil natural energy deposits.

Biomass is the most important renewable energy source. Resources for energy from biomass, such as agricultural crops for bio fuels, forests for wood en several types of biogenic waste are already included in the system of national accounts, but not explicitly labelled as renewable energy source, because these resources can often be used for other purposes as well. However, other important renewable energy sources, such as hydro and wind are very often not recognized as assets on the national balance sheet. This is because the ownership criteria are not fulfilled (nobody “owns” renewable energy resources like wind or solar radiation)[1)]. This seems to be a serious omission since their share in total energy production is increasing. Fostering the exploitation of renewable energy resources is undoubtedly an important part of sustainable development policy strategies around the world. Balance sheets that are restricted only to non-renewable energy resources could lead to a serious underestimation of a country’s available energy resources. The handbook on the environmental accounts (SEEA 2003) provides a framework in which renewable energy resources are taken into account in a similar way as non-renewable energy sources (UN, *et al.*, 2003).

1) For hydropower the natural resource (water reservoir) is already clearly identified as a different asset from the fixed assets (e.g. the dam). It follows that water reservoirs which are specifically used for hydropower generation should in theory be classified as renewable energy assets.

The main purpose of this study is to valuate wind energy resources. The focus of this study is only on wind energy production because this is by far the most important technology (after the biomass technology) producing renewable energy in the Netherlands. In addition, all kinds of key economic information related to wind energy are presented, such as total production, value added, investments and subsidies. This chapter is set up as follows. In section two the conceptual background and the general methodology for the valuation of renewable energy resources is presented. In section three the results for different economic indicators are presented and monetary and physical balances for wind energy resources are introduced. In section four the main conceptual issues are discussed and, finally, conclusions are drawn. It should be stressed that the results presented in this chapter are experimental.

8.2 Concepts and methods

The methodology for compiling the different variables and the use of different data sources is discussed in Van Rossum and Delahaye (2010).

Valuation of renewable energy sources

The concepts and methods for valuation of renewable energy resources differs from those recommended for non-renewable energy resources in SEEA2012 (UN *et al.*, 2012, forthcoming). In short, the SEEA2012 states that because there is no physical stock of renewable energy resource (excluding biomass) that can be used up or sold, the measurement scope relates to the amount of energy that is captured given current levels of fixed assets and associated capture technology.

According to both SEEA and the SNA, any balance sheet item should be valued on the basis of representative market values. Such valuation relies on the availability of market prices for these items. Unfortunately, this valuation method is not broadly applicable to environmental resources as market price information is often not available. SNA's next-best option to market price valuation is by calculating the net present value[2)] of current and future income flows derived from the asset in question. Like any other natural resource, renewable energy resources provide capital services to their owner and their remuneration should be an element in the gross operating surplus of the energy producer. This income element addressing the value of the renewable energy capital service is called the *resource rent*. Due to their intrinsic nature, renewable resources such as wind can yield benefits forever – as long as the required infrastructure is in place. However, in order to value the asset, the future resource rents need to be discounted. Mathematically, it can be shown that the value of renewable resources equals the resource rent in year *t* divided by the discount rate in year *t*.

2) *Net present value* – Net present value is defined as the total present value of a time series of cash flows. Present value is the value on a given date of a future payment or series of future payments, discounted to reflect the time value of money.

The value of renewable energy resources greatly depends on the used discount rate. We used a nominal discount rate of 6 percent. This rate is used for cost-benefit analyses of renewable energy projects in the Netherlands (ECN, 2008). In discounting the resource rent we apply the real discount rate instead of the nominal discount rate. This means that we divide the resource rent by 4 percent instead of 6 percent (inflation is on average equal to 2 percent).

From a market-based to a social-based resource rent

Especially in wind production, the treatment of taxes and subsidies is of great importance. The resource rent is usually obtained from the gross operating surplus of renewable electricity producers which is equal to value added minus compensation of employees minus taxes plus subsidies on production. In a subsequent step the consumption of fixed capital is subtracted together with a return to capital on fixed assets.

The resource rent can be calculated including or excluding taxes and subsidies. We will refer to the former as the *social resource rent* while the latter is called the market-based resource rent. The rationale for the market-based resource rent is that it presents the pure return to the use of the asset in production without taking additional taxes and/or subsidies into account. The intuition behind the social resource rent is that it reflects the value of the resource taking societal preference (in the form of taxes and subsidies) into account. It would be closer to real business conditions and true profit for an entrepreneur.

The stock of renewable energy sources

There is a strong link between produced assets, such as windmills, and the renewable energy asset since the energy potential and, hence, the income source must be captured in some way. Therefore, the focus in this chapter is on accounting for the income earned from the captured energy from renewable energy sources. The monetary stock value of wind equals value of wind. The usable part of the stock of wind energy in the Netherlands is growing over time due to the large investments in windmills and the improved energy efficiency of these windmills. This stock can be calculated as follows (5 steps):

1. Determine initial megawatt (MW) taken into production in every single year from 1990 until 2010.
2. Determine stock of capital in MW using the perpetual inventory method for the whole time series (assumption: depreciation time is 15 years).
3. Multiply the capital stock in MW by the average production in GWh per MW in order to determine total production capacity in one year (in GWh).
4. Multiply this number by 15 (depreciation period) in order to determine production capacity over the life span of 1 windmill (in GWh).
5. Multiply this by 0.036 (conversion factor GWh to PJ) in order to calculate stock of wind in PJ.

To summarize, the physical stock of wind (in PJ) is derived from the stock of windmill capital in megawatt (Van Rossum and Delahaye, 2010). Subsequently the physical stock of wind is estimated by multiplying the capital stock by the production capacity over the life span of all windmills.

8.3 Results

Table 8.3.1 presents the evolvement of wind energy production over time from an economic and physical perspective. This overview table contains both monetary and physical data. which makes it possible to analyse and monitor the economy behind wind energy production in a consistent manner.

8.3.1 Indicators related to wind energy production

	unit		1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*
Monetary information															
Production	*mln euro*	A=K*L	2	12	34	35	42	62	84	107	178	241	340	345	289
Intermediate consumption [1]	*mln euro*	B	3	15	38	38	43	60	77	87	104	112	121	131	115
Value added	*mln euro*	C=A-B	–1	–3	–4	–2	–2	2	7	20	74	129	219	214	174
Net operating surplus [3]	*mln euro*	D=C-F	–4	–20	–44	–45	–54	–69	–82	–84	–52	–21	42	7	–33
Investments	*mln euro*		34	94	47	145	266	268	236	370	398	446	484	98	17
Capital stock	*mln euro*		43	320	436	542	761	959	1,106	1,372	1,644	1,941	2,248	2,139	1,949
Capital services	*mln euro*	E=F+G	6	36	66	75	98	128	155	187	225	266	312	335	324
Consumption of fixed capital	*mln euro*	F	3	17	40	43	53	71	89	105	126	150	177	207	207
Return to capital	*mln euro*	G	3	19	26	33	46	58	66	82	99	116	135	128	117
Resource rent (market based)	*mln euro*	H	–6	–39	–70	–78	–100	–127	–148	–166	–151	–137	–92	–121	–150
Subsidies [2]	*mln euro*	I	0	0	44	83	82	126	138	179	238	299	387	391	357
Resource rent (social preferences, subsidies included)	*mln euro*	J=H+I	–6	–39	–26	6	–19	–1	–10	13	87	162	295	270	207
Value of wind (market based)	*mln euro*		0	0	0	0	0	0	0	0	0	0	0	0	0
Value of wind (social preferences)	*mln euro*		0	0	0	144	0	0	0	322	2,166	4,040	7,367	6,749	5,167
Physical information															
Production	*GWh*	K	56	317	829	825	947	1,320	1,871	2,067	2,734	3,438	4,260	4,581	3,995
Investments	*PJ*		2	16	6	6	29	35	30	24	50	31	60	16	3
Depreciation	*PJ*		0	–1	–4	–4	–5	–7	–9	–11	–13	–15	–17	–21	–22
Energy resource stock	*PJ*		2	31	47	48	72	101	121	134	172	187	230	225	206
Avoided CO_2 emissions	*kton*		36	204	457	509	632	832	1,054	1,198	1,487	1,797	2,280	2,538	2,558
Price information															
Electricity price used in calculations	*euro/kWh*	L	0.035	0.036	0.041	0.043	0.044	0.047	0.045	0.052	0.065	0.070	0.080	0.075	0.072
APX price electricity	*euro/kWh*										0.062	0.045	0.074	0.042	0.049

[1] Labour is assumed to be outsourced to third parties.
[2] Not all subsidies are taken into accounts in the years before 2000 due to a lack of data.
[3] Subsidies not included.

The monetary data is split into three parts. In the first part, elements of the production accounts are discussed. In part two, different elements of the capital accounts are discussed and lastly, analytical calculations of resource rent, subsidies and the value of wind have been depicted. This table also contains information from a physical point of view. Production in GWh is shown for the whole time series. Also investments in, and depreciation of physical stocks of wind resources are included in order to have a complete integrated framework of monetary and physical statistics on wind energy production. The most important findings in table 8.3.1 are discussed below.

Production of wind energy declined in 2010

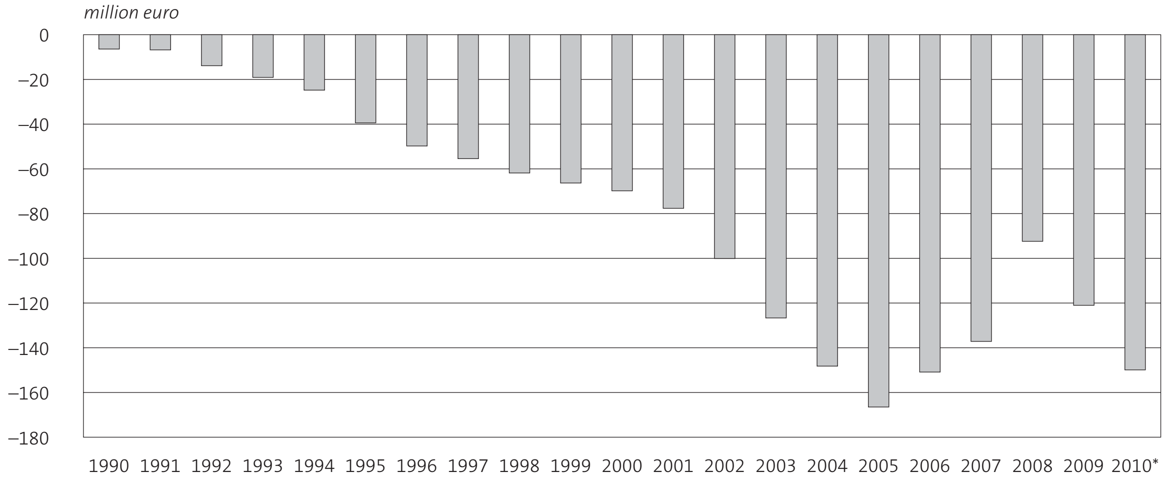
After years of increased *production* of wind energy, a decline is observed in 2010 (Statistics Netherlands, 2011). This decline can be explained by a very low wind supply. In 2010 the Windex (a measure of wind supply) was at its lowest ever estimated. This lack of wind was not compensated by *investments* in new windmills. Investments in windmills were at their all time low since 1990. Realization of a windmill project is very often a time consuming business due to planning sessions and legal procedures, the arrangement of financing, construction time and delivery time. The sharp decline in new windmill capacity can be attributed especially to a lack of subsidy arrangements for new windmills in between August 2006 and April 2008. The reduced production resulted in a decline in *value added* of wind energy producers.

Wind energy incurs losses without government support

Market-based resource rent negative

Market-based resource rent is equal to value added minus the cost of capital (i.e. capital services). In other words the resource rent is the difference between the value at which an output from a resource can be sold and its respective extraction and production costs. This market-based resource rent is negative for all years under consideration (see figure 8.3.2). This means that the value of wind is equal to zero. One could conclude that the producers of wind energy produce products (i.e. electricity) which are not profitable but indeed generate losses.

8.3.2 Market based resource rent, time series



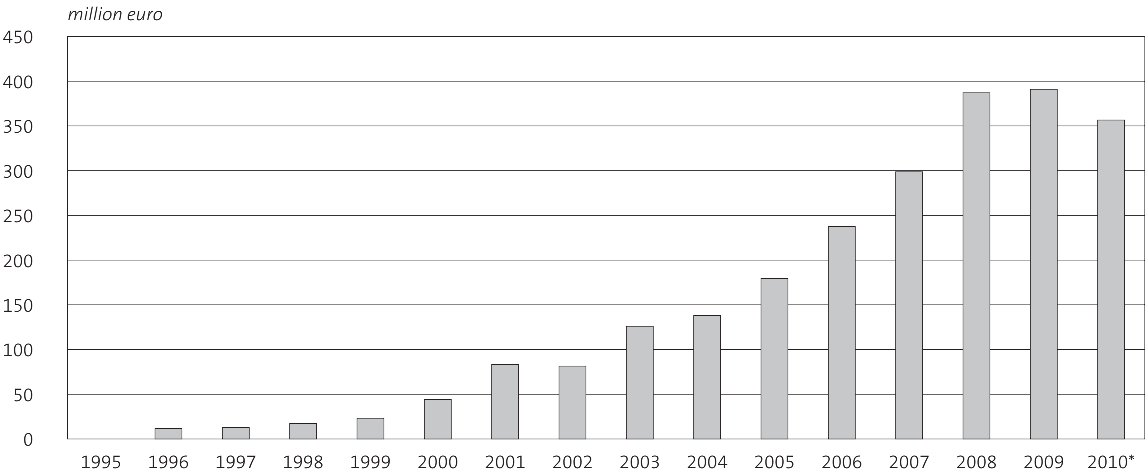
Social resource rent positive

In order to estimate a resource rent in which social preferences are incorporated, one could decide to add subsidies related to wind energy production to the market-based resource rent. For the SEEA, which wants to monitor and measure other phenomena than the SNA, it is advocated to monitor subsidies on products as well as other implicit subsidies (tax reductions related to investments) related to renewable energy production. This is because subsidies are an important financing item for renewable energy projects.

Government support necessary to change energy supply structure

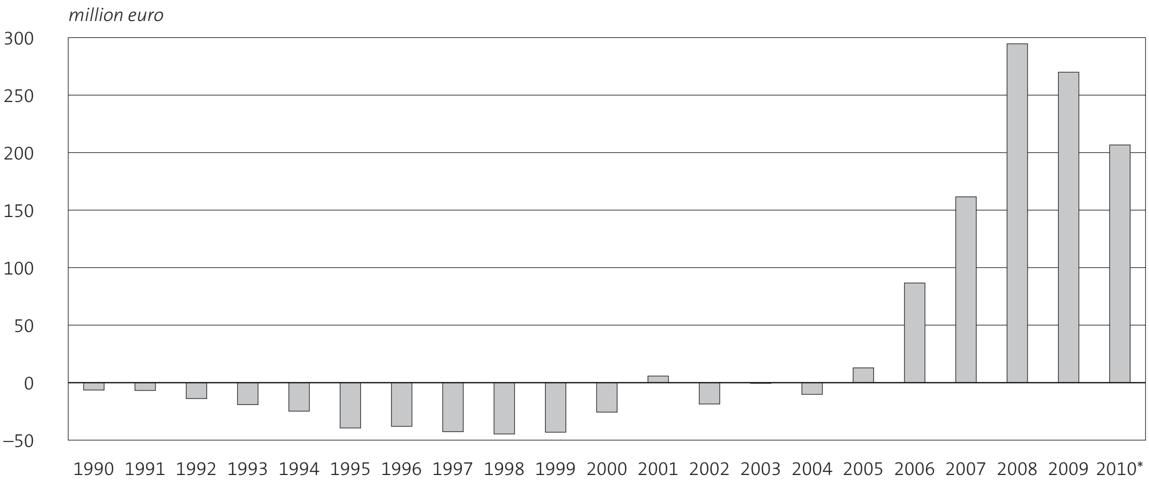
If one sticks to the valuation rules of the SNA, then the reduction in externalities, which is expressed in the valuation of means to produce goods and services, are underestimated. If one diverts from SNA rules, and takes subsidies into account, then the reduction in externalities will be expressed in the valuation of the means to produce goods and services and this valuation is closer to the social preferences regarding energy production (Van Rossum *et al*, 2009). These subsidies related to wind energy production are presented in figure 8.3.3. Although data on 2010 is still provisional, it appears that after years of increasing amounts of subsidies, a decline can be observed in 2010. This decline is mainly due to a reduction in payments for a regulation that is linked to the (reduced) production of renewable energy. This subsidy provides compensation for the unprofitable part of the investment for a period of 10 years (the MEP). The subsidy takes the form of a fixed premium paid on top of the price of wholesale electricity. Besides the MEP, regulations that are taken into account subsidize the difference between the cost price and the revenue from an onshore wind project (SDE), stimulate businesses to invest in renewable energy production (EIA) or provide a tax incentive scheme to encourage green initiatives (Green Funds Scheme). Also the payment reductions regarding the energy tax (REB) for wind energy production have been taken into account. However, between 1990 and 2000 not all subsidy schemes were included due to a lack of data. More on subsidies can be found in chapter 9.

8.3.3 Amount of issued subsidies related to wind energy



The social resource rent, estimated after added subsidies to the market-based resource rent is depicted in figure 8.3.4. Socially preferred resource rent is positive in the years after 2004. This is due to large amounts of subsidies provided to renewable energy producers. The decline of the social resource rent in the last year is directly a result of declining subsidies.

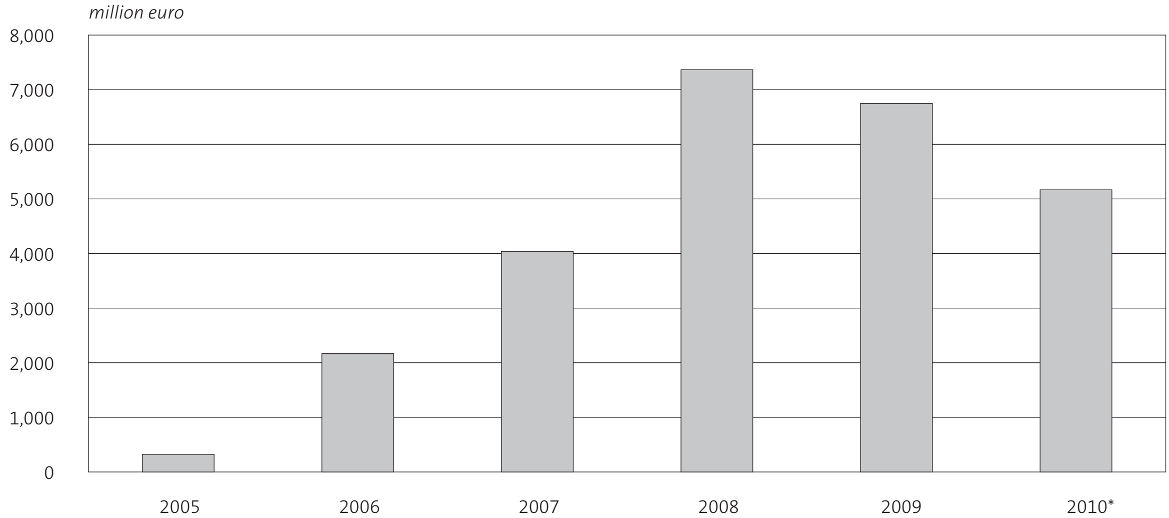
8.3.4 Resource rent in which social preferences are incorporated



Value of 'wind' declines after a peak in 2008

The valuation of wind energy resources, estimated by the resource rent in year *t* divided by the discount rate in year *t*, is shown in figure 8.3.5. Taking into account the different subsidies, reflecting social preferences for production techniques, leads to a valuation of more than 5 billion euro in 2010.

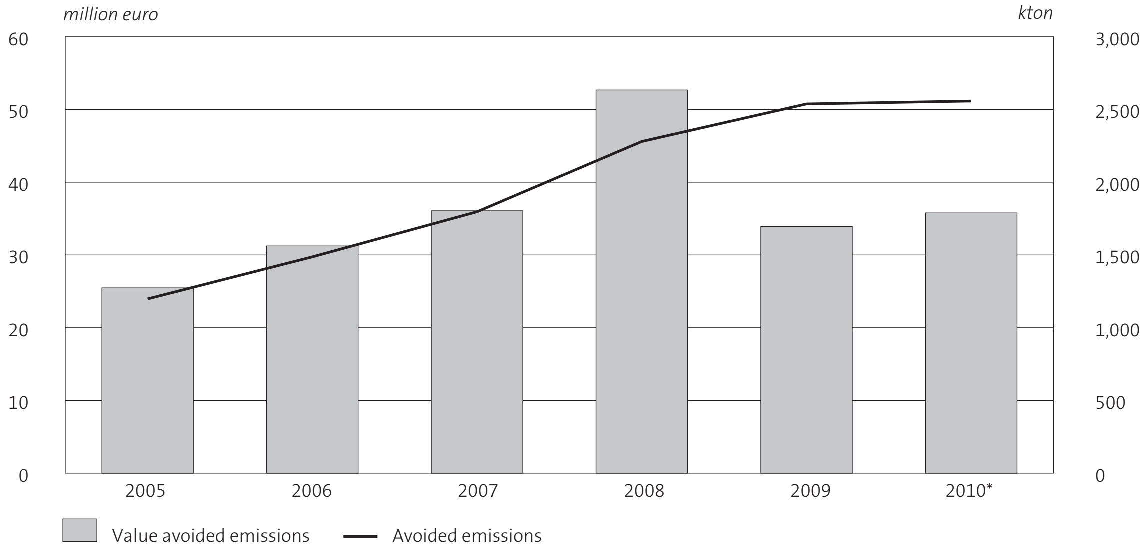
8.3.5 Value of wind (social preferences)



Avoided emissions form a substantial part of wind value

The value of wind energy can be further broken down into a value for avoided CO_2 emissions and into a value for other positive and negative externalities related to wind energy production such as the fact that wind energy production generates fewer NOx and fine dust emissions than conventional production techniques. These avoided CO_2 emissions have nowadays an explicit price in the economy due to implementation of the European Union Emissions Trading System (EU ETS). This is done because one can assume that the price of emissions (external costs) is already reflected into the basic price of electricity. The valuation based on a market-based resource rent fails to take externalities into account

8.3.6 Avoided CO_2 emissions, kton and mln euro



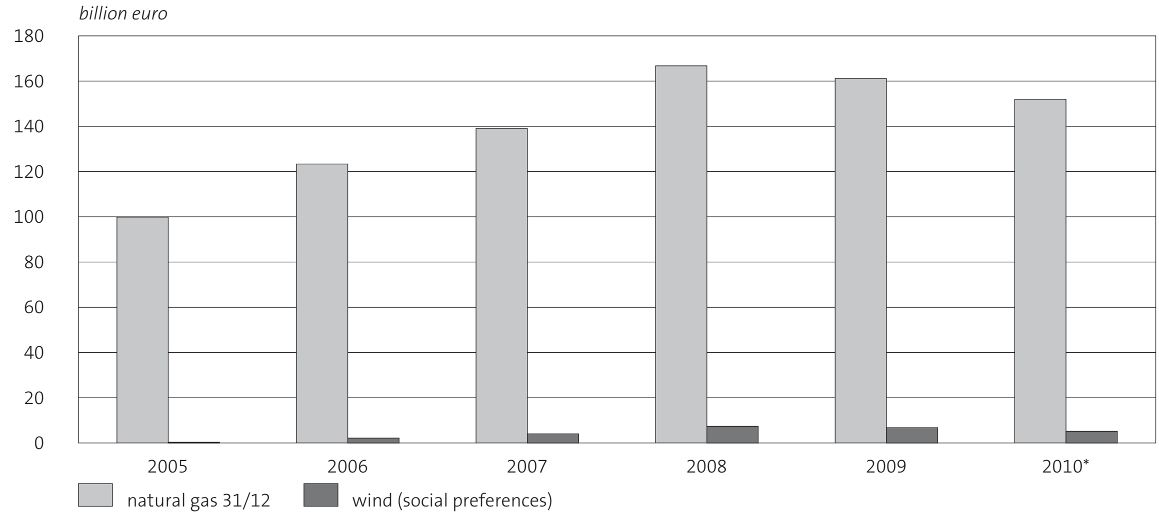
In 2010 the value of the avoided emissions amounted to approximately 36 million euro (see figure 8.3.6)[3]. Thus, 36 million of the more than 200 million euro resource rent (figure 8.3.4) is due to the avoided emissions related to wind energy production[4]. The remainder is explained by other positive and negative externalities.

The value of 'wind' is small in comparison to the value of natural gas

The value of wind (social preferences) is still very small compared to the value of natural gas (see figure 8.3.7). In 2010, the value of wind was only equal to 3 percent of the value of natural gas. In 2005 the value of wind was negligible to the value of natural gas. Balance sheets that are restricted to non-renewable energy resources lead to an underestimation of a country's available energy resources. By introducing renewable energy resources on the balance sheet, investments in windmills are well reflected in the balance totals (level of capital) for total energy resources.

3) Price of emission right is based upon data of ECX (so called EUA Futures Contract (EU Allowances)), average year price based upon day prices.
4) It is assumed that the European Union Emissions Trading System (EU ETS) sets reasonable prices for emissions taking into account the level of initiated emission rights.

8.3.7 Comparison value of natural gas and wind



Stock of wind energy resources in decline

As mentioned in the introduction of this chapter, renewable natural energy resources other than biomass are not generally recorded as assets on the national balance sheet. This seems to be a serious omission since their share in total energy production is increasing. Fostering the exploitation of renewable energy resources is undoubtedly an important part of sustainable development policy strategies around the world. Although investments have been high in recent years in order to reduce energy dependency and depletion of non-renewable energy reserves, in 2009 and 2010 a sharp reduction can be absorbed (see table 8.3.8). As a result the stock of wind energy resources is in decline.

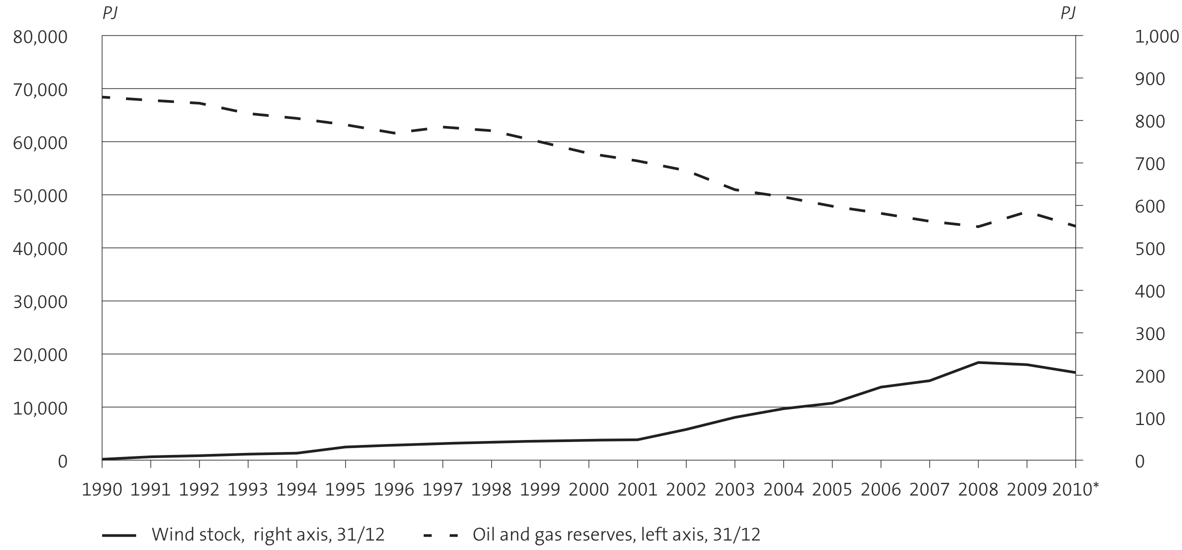
8.3.8 Physical balance for wind

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*
Physical balance for Wind	*PJ*															
Stock value 1/1	16	31	36	39	42	45	47	48	72	101	121	134	172	187	230	225
Depreciation	–1	–2	–3	–3	–4	–4	–4	–5	–7	–9	–11	–13	–15	–17	–21	–22
Investment	16	7	6	6	7	6	6	29	30	30	24	50	31	60	16	3
Stock value 31/12	31	36	39	42	45	47	48	72	101	121	134	172	187	230	225	206

* Provisional data.

The stock of oil and gas reserves in Netherlands declines over time (see figure 8.3.9). On the other hand, the usable part of the stock of wind energy in the Netherlands is growing over time due to investments in windmills and the improved energy efficiency of these windmills. Figure 8.3.9 shows the development of the stock of wind in PJ. The percentage shrinkage of oil and gas reserves is smaller than the growth in the wind reserves in PJ. In absolute levels, however, the increase in wind stock cannot compensate for the decrease in the stock of oil and gas reserves. Total energy reserves (oil, gas and wind) in PJ therefore decrease over time (see figure 8.3.9, in terms of primary energy units, before conversion). Taking into account the fact that transformation of gas into electricity is accompanied by energy losses; the picture is slightly brighter but is still far away from compensation.

8.3.9 Oil and gas reserves (proven) and wind



8.4 Discussion

Capture of wind versus wind potential

The discussion in this chapter primarily focuses on accounting for the income derived from energy captured from renewable energy sources. Given the nature of these sources, however, it may be reasonable to seek answers to the question how large the *potential* renewable energy source might be and hence determine required levels of investment in capture technology, etc. While important, these matters were beyond the scope of this study. Only those renewable energy sources that are an input in the energy production process are taken into account in the valuation process. In other words, the total potential of renewable energy resources is not measured in this study.

Market-based resource rent and social-based resource rent

Wind energy production goes along with less negative externalities (for example emissions of CO_2) than conventional production technologies. This is one of the reasons why the government decided to subsidise production of wind energy. For every externality, positive or negative, holds that the SNA approach for valuation is narrow. Capital producing ‘grey’ electricity is valued equally as capital producing ‘green’ electricity (assuming the same costs, etcetera). SNA simply does not recognize the value of clean air because clean air is no asset in the SNA. The market-based approach for valuation of wind is consistent with these SNA concepts (and the value equals zero). One can however try to value the means to produce more environmentally friendly goods and services. In theory, one could value a capital input, here wind, that is capable of producing the same goods and services in a more environmentally friendly way. Subsidy schemes exist because the government tries to internalise the negative external effects related to conventional energy production. One could assume that the subsidies reflect the reduction in external costs due to fewer emissions. Adding those subsidies to the resource rent calculation leads to a positive resource rent for recent years. One could state that this alternative resource rent (socially preferred resource rent) reflects both the benefits for renewable energy producers and society as a whole. This positive resource rent results in positive monetary values for wind energy resources.

One could also argue that only part of the subsidies should be attributed to the energy resource ‘wind’ and not total subsidies. It could be argued that subsidies for wind energy production are there because of multiple reasons, not only because of fewer emissions. For example, the government wants to be less dependent upon foreign countries for its energy. Or the government wants to stimulate innovation and employment in the pre-exploitation phase of the wind energy sector. Maybe the subsidies are only there because the government tries to reach certain targets set by Europe or the UN (the Netherlands agreed to reach these targets) . Devoting all subsidies to the value of ‘wind’ may therefore be a bit controversial because in the end those subsidies only partly reflect the intrinsic value of wind.

Negative external effects of wind energy production are, in theory, also discounted in the value of wind. For example visual pollution of the skyline is an often heard objection to the building of windmills. Assuming that the government internalises these negative external effects in setting reasonable subsidy levels, then this negative external effect is well reflected in the value of wind. If this is not the case, these costs should reduce the social value of wind energy resources.

Level of subsidies

Some studies argue that subsidies for renewable energy production were too high in order to be efficient (CE, 2007; ESB, 2007). This indicates that subsidies were too high to compensate for the extra costs of renewable energy production. One could state that due to these high subsidies the value of wind is overestimated. These subsidies were, according to mentioned studies, too high because of the design of the subsidy scheme. Overestimation and consequently re-evaluation is not uncommon for assets in general. The ‘internet bubble’ and the credit crisis are examples where in the first place assets were overestimated in the first place (for example stock certificates of internet companies and banks). Due to market failure and/or government failure (too little regulation) the values of these financial assets were too high in first instance. After some time, the markets re-evaluated these financial assets because they had better or more information than before. Valuation is dependent on available information at a particular time and based upon a particular institutional framework (for example taxes and subsidies). Once subsidies for wind energy production decrease over time, based upon another subsidy scheme design of the government, the asset 'wind' will be re-evaluated too. Taking into account this parallel with other assets, 'wind' is not really a special asset. In fact it has characteristics similar to other assets.

The value of wind: accounting for fluctuating production and prices

In this study the value of wind in a particular year is based upon the resource rent of that particular year. Therefore, the value of wind depends on the production of wind and the price of electricity in a particular year. Production, in physical terms, can fluctuate over time due to less or more supply of wind. In order to avoid strong fluctuations, the value of wind can be based on the average resource rent of a small time period preceding the reporting year (for example three or four years). This calculation method will result in less impact on the value of wind due to volatility in production and or in prices of electricity. So far this option has not been investigated.

International comparability

Wind power is very important in the Netherlands. Other renewable options, especially hydro power are in Europe and around the world far more important than wind power. It would be very interesting to compare the estimate of the value of renewable energy in this report with estimations made in other countries. Still, in practice, not many countries have experience in valuating renewable energy resources. Concepts and computation methods should be harmonised over time. So far, SEEA 2012 gives some guidance on how to deal with these issues in theory. In this respect, international cooperation could be very useful.

8.5 Conclusions

All indicators presented provide a comprehensive overview and insight into the economy behind renewable energy production. Although some assumptions were needed to set reasonable levels for certain variables, the developments are based on strong indicators reflecting real developments. The most notable finding is that, due to a very low wind supply and a decrease in newly build windmills, after years of increased production of wind energy, a decline in production is observed in 2010.

The market-based resource rent for wind energy production is negative. This means that the market-based value of wind for the Dutch economy is equal to zero. From a narrow economic point of view this indicates that economic agents are producing goods and services which generate losses instead of profits. Still these agents do produce wind energy. This is fostered by the existences of all kind of subsidy schemes for renewable energy production.

These subsidy schemes exist because the government tries to internalise the negative external effects related to conventional energy production. Adding subsidies to the resource rent calculation leads to a positive resource rent from 2005 onwards. This alternative resource rent (socially preferred resource rent) reflects the benefits related to renewable energy production for both the renewable energy producer and the society as a whole. In the future, the market-based resource rent may be positive. Scarcity of fossil fuels and more strict emission rights systems will push electricity prices up and thereby in the end also the resource rent. Possibly, also the cost for wind energy will go down due to innovation and economy of scale.

The value of 'wind', derived from the resource rent, declined after a peak in 2008. In 2010 the value of wind was estimated at around 5 billion euro. The value of wind is still very low in comparison to the Dutch natural gas resources. Despite this, this study provides a methodology to record both renewable and non-renewable energy sources as assets on the national balance sheet.

The energy balances show that the increase in wind stock cannot compensate for the decrease in the stock of oil and gas reserves. Therefore, total energy reserves (oil, gas and wind) in PJ decrease over time.

This study only focuses on wind energy but once other renewable energy resources are more prominent in the Dutch economy, like solar radiation or geothermal energy, these energy resources could be monitored using the same methodology.

Estimating the size and beneficiaries of environmental subsidies and transfers

9

€

Estimating the size and beneficiaries of environmental subsidies and transfers

Experimental research

9.1 Introduction

Environmental subsidies are an important economic instrument for achieving national environmental policy objectives. Subsidies 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 or manage resources more efficiently. 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 by economic agents, such as the MEP, 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, and by the London Group on Environmental Accounting, as part of the revision of SEEA.

In this chapter we present experimental results for a time series of environmental subsidies and other transfers for 2005–2009, and the allocation of these subsidies/transfers to industries according to NACE class as well as to environmental domain. This attempt opens up opportunities to connect the figures on subsidies to a number of economic and (physical) environmental data and indicators to monitor progress at the industry level in reducing emissions, costs and increasing cost-effectiveness and/or raising resource efficiency and at the level of environmental domains. It should be stressed that the results in this chapter are still experimental.

This chapter is structured as follows: Section 9.2 discusses definitions, scope and recording issues. Section 9.3 discusses the methodology that we used as well as data sources. Section 9.4 describes the results in detail. In Section 9.5 conclusions are drawn, and an outlook is provided on future research.

9.2 Concepts and scope

Definitions and delineations

The scope and definition of subsidies has changed considerably in the Dutch policy context during the last decade, which can be illustrated by the subsidy overview that is compiled every couple of years by the Ministry of Finance[1]. While according to the 2003 overview (Ministry of Finance 2002) subsidies totalled 17.5 billion euro, the scope was broadened for the 2006 overview – which was called 'instruments overview' – that identified close to 1000 instruments with a total value of almost 150 billion euro. In the most recent overview for 2010 (Ministry of Finance 2010) the definition of subsidies was narrowed again to the definition used in the General Administrative Law Act (in Dutch: *Algemene Wet Bestuursrecht*) which resulted in a total amount of subsidies of about 6 billion euro, covering about 600 subsidy schemes.

The precise definition and scope of environmental (or environmentally motivated) subsidies has also been debated at length in the statistical community, and constituted one of the revision items of the SEEA. In our research we have used international recommendations (United Nations et al 2012) as much as possible. The definition and scope of environmental subsidies/transfers has the following characteristics:

- The scope is broader than subsidies per se (as defined in the National accounts – see text box), that are restricted to enterprises as beneficiaries. Therefore we use "transfers" (in Dutch: "*overdrachten*"), which includes the following types of transfers as defined in the 2008 SNA: subsidies, social benefits to households, other current transfers, investment grants, and other capital transfers. Differences are to be expected with the definition used in the policy context, which is more legalistic than economic.
- The qualifier "environmentally motivated" implies that we include only transfers with environmental protection or resource management as their main purpose. Environmental protection includes all activities directly aimed at prevention, reduction and elimination of pollution or other degradation of the environment. Resource management covers activities aimed at reducing the extraction of natural resources, the reusing and recycling of natural resources, the replenishment of natural stocks of resources, and the general management of natural resources. Hence, the inclusion of resource management broadens the scope compared to activities described in the Environmental Protection Expenditure statistic (EPE), which till recently, focused exclusively on environmental protection. In practice we also include multi- purpose subsidies, e.g. for 'sustainable development', as long as 'environment' or 'resource management' is one of the main purposes. For instance we fully included energy subsidies, which are often given to serve multiple goals. There are basically two considerations for this: it is analogous to the approach taken in environmental taxes, where energy taxes are fully included as environmental taxes; alternatives, such as the application of an environmental share based on the total set of objectives of a given policy, usually lack an objective basis and would add to arbitrariness.
- Environmental transfers can occur between all sectors in the economy (UN 2012). We have chosen to delineate transfers as all payments from the central government sector (in Dutch: "Rijk")[2] to all

[1] Based upon the article "Definitieverschillen ontnemen zicht op ontwikkeling subsidies"; www.sconline.nl accessed March 2010.
[2] "Het Rijk" is in fact a subset of central government i.e. sector S1311 which again is a subset of sector S13. It consists broadly speaking of all Ministries and Agencies. When we use central government in this chapter we mean "Rijk".

other sectors and the rest of the world, excluding transfers that remain internal to the government sector. Monetary flows from the European Union (EU) are also clearly of interest as well. Sometimes co-financing by the Dutch (central) government is involved. In practice these flows run partly through national Ministries, which carries the risk of double counting. In principle, flows from the EU have not been included.

Transactions, transfers and subsidies.

Transactions are defined in the SNA as actions undertaken by mutual agreement between two institutional units.
A transfer is a transaction in which one institutional unit provides a good, service or asset to another unit without receiving from the latter any good, service or asset in return as a direct counterpart. Transfers may be either current or capital. A capital transfer is one that is linked to the acquisition or disposal of an asset, either financial or non-financial. Current transfers consist of all transfers that are not transfers of capital. (SNA 2008; Chapter 8) Transfers are therefore a subset of transactions.

Transfers are classified according to the D-classification (Distributive transactions) of the SNA. Within the scope of environmental transfers are D3 Subsidies; D6 Social contributions and benefits; D7 Other current transfers and D9 Capital transfers. Subsidies are defined as current unrequited payments that government units, including non-resident government units, make to enterprises on the basis of the levels of their production activities or the quantities or values of the goods or services which they produce, sell or import. (SNA 2008; Para 7.98). Subsidies are therefore a subset of transfers.

The focus on the central government was chosen for two reasons. First, this is where most transfers originate, that subsequently trickle down. Second, from a practical point of view, it significantly narrows the number of agencies that need to be observed. It is virtually impossible to assess detailed records of all provinces and municipal bodies that generate transfers. Excluding transfers internal to the government sector was done primarily to have a concise focal point for our research, as this is a first attempt to obtain a breakdown by NACE. The choices for these delineations (in terms of sector of origin and sectors of destination), obviously has direct implications for the total size of environmental transfers and the allocation to NACE and domain that results. For example, our results differ from the Environmental Protection Expenditure statistic for transfers by the central government as this includes transfers to all sectors including to provinces and municipalities, for instance in the domain water (e.g. transfers for wastewater treatment).

Implicit subsidies
Very important instruments in the Dutch policy context are the implicit subsidies (in SEEA context also called 'off budget subsidies'; see for example Palm et al, 2009) such as tax exemptions for environmental investments, investments in renewable energy or reductions in wealth tax for green investments. In case of implicit subsidies, no actual transactions take place and hence the flow is not recorded in the national accounts or government finance statistics (in the latter only as pro memoria item). In order to make a statistic that is relevant for Dutch policy users, implicit subsidies need to be covered, however, as separately identifiable information.

Environmentally damaging subsidies
Central for determining environmentally motivated subsidies is the motive behind a specific subsidy scheme. This is however different from assessing the effect a subsidy / transfer may have on the environment. There is growing and recurrent policy interest, both internationally within the context of the emerging green growth / green economy agenda (OECD 2011) and the EU Roadmap to a Resource Efficient Europe (EC 2011) and within the Dutch policy context (e.g. PBL 2011; Van Beers 2007) in the measurement of environmentally damaging (or harmful) subsidies (EDS). The EU Roadmap lists as one of its milestones, that EDS will be phased out by 2020. Significant measurement challenges in this area remain, and the revised SEEA does not

include a definition of EDS. In this chapter, we will discuss EDS only in the context of implicit subsidies.

Basis of recording and classification

Consistency with the national accounts requires that transfers should follow an accrual basis of recording, i.e. be recorded in the actual year the transfer takes place. In practice, this raises several problematic issues. First, reporting by agencies that execute subsidy programs primarily focuses on commitments (subsidies that have been granted or intended payments), as key measure of their performance rather than on actual payments. Our research has shown that there are large discrepancies between intended and actual payments (realisations). These differences have to do with the scope (sometimes intended lifetime payments versus actual annual payments) and the timing of the payments. As a result the commitments made in a given budget year often exceed the actual amount paid out. Sometimes advances are paid first, which only after several years are settled, for instance after monitoring has taken place. As a result there are sometimes lags of several years between the actual payment of certain subsidies and the year when the commitments were made. This would introduce a mismatch between the time these commitments were made, and the resulting economic activities. It is therefore best to base the analysis on annual statements (realisations) rather than budgeted amounts[3]. The second difficulty is that most available data (microdata and annual report) follow a cash basis of recording, and not an accrual basis as required by the SNA. This issue, however, is less important than the first issue, and we generally follow the second best solution of recording on a cash basis, as only this type of data is available.

The breakdown by 'environmental domain' is based on the Classification on Environmental Protection Activities and Expenditure 2000 (CEPA 2000) used by Eurostat for the classification of environmental protection activities. In addition, the recently developed classification for 'Resource Management', CReMA, is also included and applied.

[3] When writing the report for Eurostat (Graveland et al 2011) we faced the difficulty that our microdata were not available on a cash basis but only on a commitment basis. This problem could luckily be solved this year as we obtained direct payment records from the main subsidy agencies.

9.3 Data sources and methods

Overview of methods

There are, roughly speaking, three approaches for compiling an account for environmental subsidies/transfers:

1) *Cross classify National accounts data on subsidies, social benefits, transfers etc. to environmental purpose*

In 2011 Statistics Netherlands started to compile a statistic which details governmental expenditures according to the Classification of the Functions of Government (COFOG) as part of its government finance statistics. Although this is an important step forward, the level of detail (currently) falls short of the policy and research interest that a statistic on environmental subsidies/transfers tries to serve. Although the scope of COFOG class 5, environmental protection, is close to the scope of environmental protection activities classified by CEPA, it is not possible to disaggregate towards CEPA classes on the basis of 2-digit COFOG. Moreover, resource management activities are scattered across several COFOG categories, and are included within categories of predominantly non-environmental transfers. It is therefore not possible to obtain a comprehensive estimate of environmental transfers on the basis of COFOG data as such. Also, although a breakdown by institutional sector is available, a breakdown by NACE is not. The advantage of SNA-based COFOG data is that it provides a detailed breakdown by type of transactions (the so-called D classification of the SNA, e.g. D.3 being subsidies or D.92 Investment grants).

2) *An analysis of government budget lines and/or annual statements (realizations) of relevant government agencies.*

The second approach is in depth analyses of the central governments' budget lines and accounts (realisations) for environmentally motivated expenditures and subsidies. This approach underlies to a large extent the compilation of the Environmental Protection Expenditure statistic. In some European countries an exclusive authority or agency takes responsibility for the financial management of central Government and its agencies, and makes analyses, and sometimes even forecasts, of central Government finances. This is not the case in the Netherlands. The main drawback of the budget analysis approach is that an analysis of annual statements often does not provide enough detail to decide whether something is a subsidy or not. Moreover, a breakdown of beneficiaries by NACE is not possible. The advantage of this approach is that one can easily asses whether a transfer has an environmental purpose, due to the available description of the program and/or its embedding in budget items higher up the hierarchy. For this purpose also the 'Overzichtsconstructie milieu', OCM (several years) by the Ministry of the Environment has been used. This is an Annex to the Ministry of Environment's budget in which they account for environmentally motivated expenditures including those budgeted by the central government as a whole.

3) *Microdata concerning actual payments of transfers*

The third approach is a "bottom-up" approach based on microdata. This is arguably not the easiest route, as it requires much effort in collecting and analysing data. However, it has two important advantages over the other methods. In addition to a breakdown by domain, type of transaction, and name of subsidy scheme, it is possible to obtain a detailed breakdown by beneficiaries (industries and households). Furthermore, there is the prospect that a database can be constructed that integrates data at the micro level about subsidies received with other economic microdata, which would allow for all sorts of applications, such as econometric analysis. The disadvantage of the microdata method is that it is very labour intensive, and that it is not always possible to obtain comprehensive microdata which covers all subsidy schemes (often different schemes may be recorded in different databases, with often different level of detail). In addition, the microdata do not necessarily match published data in annual reports.

Although our aspiration was to follow the microdata approach, in practice we have resorted to a combination of budget analysis (the second approach) and microdata (the third approach), which could be termed a "hybrid approach". This approach entails using the budget data as totals, which are further disaggregated according to NACE and domain based on keys obtained from underlying microdata that we obtained from agencies in charge of individual subsidy schemes. For the purpose of comparison, and as a plausibility check of our results, we will also present results based on COFOG data (the first approach) in Section 9.3.

The hybrid approach

The process followed in the hybrid approach consists of the following steps:

1. First an inventory was made of relevant ministries, government agencies, and other institutes that may provide subsidies. Second, a list of relevant subsidy schemes for the years 2005 – 2009 was compiled. In order to do so, we used existing information within EPE statistics, information found on government websites as well as existing inventories of subsidy schemes. This resulted in a gross list of subsidy programs per agency in charge of these programs.
2. Subsequently the gross list was 'scored' on several criteria: 1) whether the subsidy scheme was 'environmentally motivated'. 2) it was assessed whether the scheme in fact classifies as a transfer/ subsidy. 3) the environmental domain. Often this procedure necessitates confrontation with the (legal) text of each subsidy scheme as well as internet searches. The result is a selection of environmental transfers. We decided to fully include or fully exclude individual subsidy schemes, and not to apply environmental percentages or shares. This assessment procedure may look somewhat labour-intensive, but as most subsidies usually run for several years this 'scoring' effort is normally required just once. This means, that each subsequent year only the newly established subsidy programs need to be assessed.
3. These 'scores' were subsequently checked and discussed with relevant experts in the agencies.
4. Annual statements were obtained (called "consolidation schemes") from the various agencies in charge of the identified subsidy programs. In the Netherlands, most environmental subsidy schemes are managed by one main agency, *'Agentschap NL',* which manages subsidy schemes for several ministries. Another important agency is *Dienst Regelingen* under the Ministry of Agriculture. The Ministry of Finance as well as the tax authorities and *'Agentschap NL'* provided information on the implicit subsidies. The consolidation schemes provide information on actual payments on various schemes that can be matched with the inventory list.
5. As much microdata as possible was obtained on the identified subsidies on a cash basis. Fortunately, some of the largest subsidy schemes were allocated already to NACE within the regular work program on EPE. For some measures the allocation to industry (NACE) is already done by the executing agency.
6. Those schemes that were not classified according to NACE and for which microdata were obtained, were linked to the business register from Statistics Netherlands, in order to establish a breakdown by NACE. About half of the beneficiaries, corresponding to roughly two thirds of the total subsidy sum,

could be linked directly to different industries (NACE-classes). In a next step, the connection to the business register was manually improved. For this improvement a procedure of attribution has been developed.

7. For certain subsidy schemes the allocation to receiving industry could not be done via links with the business register. Most importantly, this was the case for a scheme which provides funding for exhaust filters for particulates, (in Dutch: *"roetfilters"*). Hereto, additional assumptions were made after consultation of relevant experts. To obtain an industry breakdown and distribution over households, we used the levels of fuel use per transport mode, vehicle category and fuel type, in order to estimate relevant keys. These data are obtained from the transport module that we use in compiling the air emission accounts module.
8. The budget data from step 4 that have not yet been disaggregated are disaggregated according to NACE and domain based on keys for each year that are obtained from underlying microdata in step 6 and 7. Occasionally, the name and aim of the budget was used in the allocation procedure as well.

9.4 Results

We would like to stress that our main results presented here still have an experimental status. We will start by showing the results of COFOG based data, which allows us to get an overview of the importance of transfers in total government sector expenditures. This is followed by the results for environmental transfers based upon the hybrid approach. We will also discuss results for implicit subsidies and implicit EDS.

Transfers for environmental protection only 0.4 percent of total government transfers

Table 9.4.1 gives a general overview of total expenditures and transfers by the Dutch government sector in 2009, according to purpose based upon COFOG[4)]. We see that transfers make up more than half of the total expenditures, with social transfers as the largest category. Subsidies, as defined in the national accounts, constitute a mere 3 percent of total government expenditures.

4) Transfers in Table 9.4.1 are defined slightly broader than in the definition provided in Section 9.2 as also the category D2 taxes on production and imports is included. For COFOG category 5 this has however no practical implications as D2 is zero.

9.4.1 Total government expenditure and transfers by purpose (COFOG), 2009

	Total expenses	Total transfers	Social transfers	Subsidies	Income transfers	Capital transfers
COFOG	*million euro*					
General public services	32,725	6,941		241	5,195	1,505
Defence	8,627	211		21	154	36
Public order and safety	12,450	217		120	90	7
Economic affairs	35,639	9,458		5,788	490	3,180
Environmental protection	**10,641**	**654**		**95**	**155**	**404**
Housing and community amenities	5,152	931		60	48	823
Health	46,905	41,468	40,456	968	32	12
Recreation, culture and religion	10,726	2,224	-	333	1,578	313
Education	34,086	3,357	1,756	332	78	1,191
Social protection	97,473	84,089	82,660	933	459	37
Total	**294,424**	**149,550**	**124,872**	**8,891**	**8,279**	**7,508**

Source: Statistics Netherlands (2011a).

When we look at the individual purpose categories, transfers for environmental protection i.e. COFOG category 5, amount to 654 million euros in 2009. 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.

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

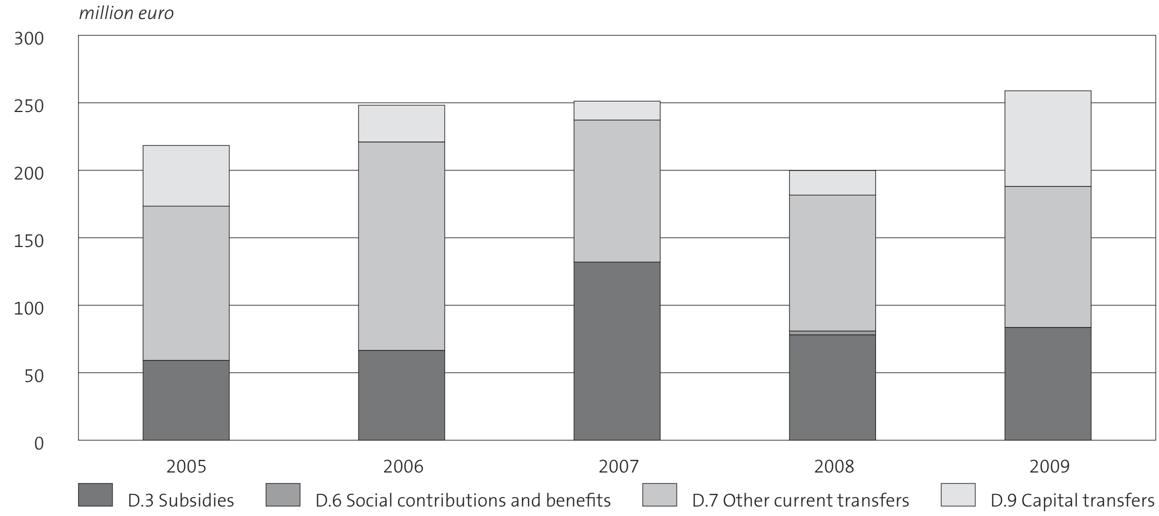


Table 9.4.2 shows a time series of COFOG 5 transfers broken down by type of transfer (the D-classification of the SNA), for the central government ("Rijk") sector to non-government sectors. Table 9.4.2 therefore has a more narrow scope than Table 9.4.1 as it considers only the central government and it excludes other government sectors as recipients, in order to allow for a comparison with results obtained by the hybrid approach later on. Other current transfers make up on average almost 50 percent of transfers over the considered time period. Subsidies account for about 36 percent, followed by capital transfers which are on average 15 percent. The amount of COFOG 5 transfers expressed in current prices varies between 200 (in 2008) and 259 million euro (in 2009).

Environmental transfers constant fraction of government expenditure between 2005 and 2009

Environmentally motivated transfers are broader than the environmental protection transfers – COFOG 5 –described in the previous section, as we include also transfers aimed at resource management. At the same time, as explained in Section 9.2, we restrict its scope by excluding transfers that remain internal to the government sector (e.g. transfers for wastewater treatment). Table 9.4.3 gives an overview of the main environmentally motivated transfers for the period 2005–2009, based on the hybrid methodology described in Section 9.3. The annual amount of transfers provided, varies between 764 and 1,058 million euro for 2005–2009. Expressed as percentage of central government expenditure[5] environmental transfers are more or less constant at 0.6 percent.

9.4.3 Environmentally motivated subsidies/transfers by subsidy scheme

	2005	2006	2007	2008	2009
	million euro				
Subsidy scheme					
MEP/SDE	532.3	629.6	455.3	628.4	676.5
ProMT	4.5	5.5	4.8	5.3	6.8
SMOM	5.1	7.4	6.7	7.2	9.1
Diesel particulate filters	0.0	0.7	151.1	72.3	26.5
EOS/NEO	8.0	16.5	29.0	45.7	61.9
Renewable energy (other than MEP)	21.7	11.6	8.7	4.5	29.9
Demolition of cars and vans	0.0	0.0	0.0	0.0	35.0
Other A-NL (Agentschap NL)	63.5	72.1	57.2	36.8	53.0
Sustainable fisheries	3.3	30.4	0.8	20.5	5.0
Sustainable production methods	0.0	1.8	13.8	25.4	24.9
SN/SAN	94.4	122.5	124.3	129.7	128.8
Other LNV (min. of ognic)	31.2	0.4	1.6	0.9	0.8
Total	763.9	898.6	853.3	976.6	1,058.2
Percentage of total expenditure by central government	0.58%	0.64%	0.57%	0.61%	0.61%

Not all subsidy/transfer schemes are labelled individually, “Renewable energy”, “Other LNV” and “Other A-NL” include multiple schemes. “Other A-NL” includes several schemes that target air quality and mitigate climate change. As the figures in Table 9.4.3 indicate, some schemes have a more temporary character (e.g. demolition of cars and vans[6]) than others (e.g. MEP/SDE). In 2009 several new schemes were put in place in order to benefit the environment and provide a stimulus for the economy during the global economic crisis (for example, the demolition of cars scheme and a scheme for sustainably heating houses).

[5] Statline table ‘Rijk; sector overheid, ESR transacties’; total current and capital expenditures.
[6] The objective of the demolition of cars scheme (In Dutch: *“sloopregeling personen en bestelauto’s”*) was to put in place an incentive for car owners to trade in old model cars for newer models that are less polluting.

Electricity companies benefit most from environmental transfers

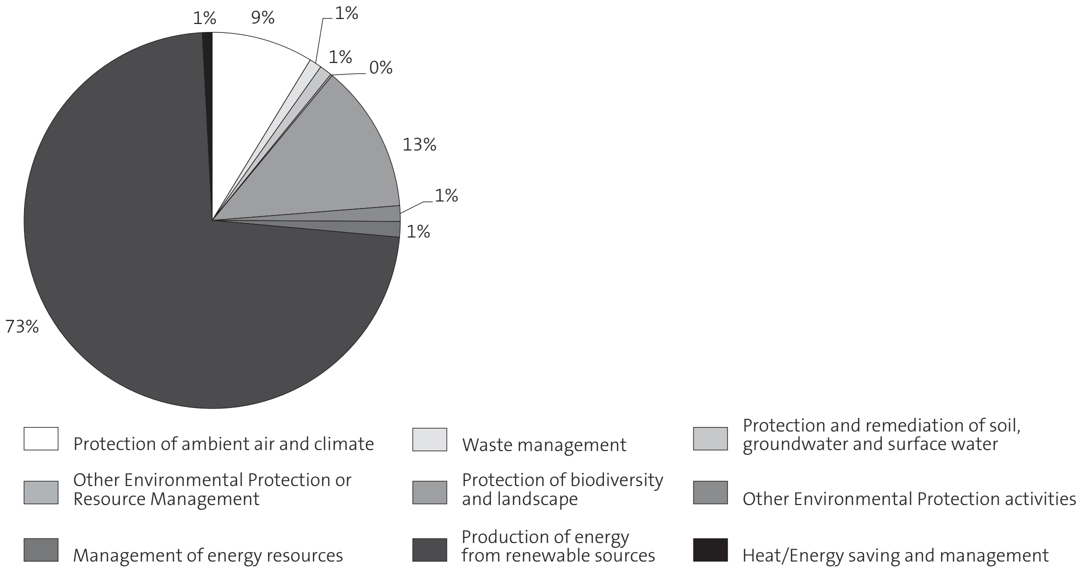
Table 9.4.4 shows the distribution of the environmental transfers over different industries (NACE classes) and households. The “Electricity and gas supply” industry receives most environmental transfers. This is mainly due to the MEP/SDE scheme and other schemes to facilitate a transition towards more sustainable energy supply. The second largest beneficiary is agriculture, forestry and fisheries. This is because of the schemes for renewable energy and for sustainable fisheries and production methods. In 2009 households received 50 million euro of environmental subsidies and transfers. These include subsidies for solar panels and diesel particulate filters.

9.4.4 Environmentally motivated subsidies/transfers allocated to industry and households

	2005	2006	2007	2008	2009
	million euro				
NACE					
Agriculture, forestry and fishing	152.2	205.4	221.1	294.6	246.2
Mining and quarrying	0.0	0.0	0.0	0.0	0.4
Manufacturing	0.0	6.6	20.5	18.9	16.3
Electricity and gas supply	467.8	532.1	337.2	458.4	526.2
Water supply and waste management	5.8	11.4	20.6	18.7	33.6
Construction	2.1	3.0	2.7	4.9	6.3
Wholesale and retail trade	7.1	10.7	26.7	14.5	13.3
Transportation and storage	0.7	3.3	91.6	44.8	22.0
Accommodation and food serving	0.0	0.0	0.1	1.7	0.2
Information and communication	0.0	0.3	1.7	2.2	3.2
Financial institutions	9.2	13.1	15.0	14.9	16.0
Renting, buying, selling real estate	0.0	0.3	0.4	1.0	6.2
Other specialised business services	4.3	18.0	36.0	43.8	55.6
Renting and other business support	0.0	13.1	30.1	11.8	9.3
Public administration and services	97.8	61.8	11.3	9.5	17.1
Education	1.2	2.3	3.7	8.2	11.7
Health and social work activities	1.0	1.2	1.8	1.3	2.0
Culture, sports and recreation	8.3	10.1	9.5	11.9	12.5
Other service activities	6.3	5.7	9.5	9.0	9.2
Extraterritorial organisations	0.0	0.0	0.0	0.0	0.0
Households	0.0	0.1	13.6	6.5	50.6
Total	**763.9**	**898.6**	**853.3**	**976.6**	**1,058.2**

The environmental motivated transfers may also be categorized into different environmental domains as presented in Figure 9.4.5, based upon the Eurostat classification of Environmental protection Activities and Expenditure (CEPA 2000) and the Classification of Resource Management Activities (CReMA). The objective for more than 70 percent of transfers is the Production of energy from renewable resources and energy savings (CreMA category 13) followed by the Protection of biodiversity and landscape with 13 percent (CEPA category 6) and the Protection of ambient air and climate (CEPA 1) with 9 percent.

9.4.5 Environmental subsidies/transfers allocated to domain, 2009



Several domains such as protection against radiation and management of minerals obtain little or no transfers.

Exemptions for environmental investments form the largest share of implicit subsidies

Table 9.4.6 provides an overview of the environmentally motivated implicit subsidies. The data are obtained from the annual Budget (Ministry of Finance 2006–2010; in Dutch *'Miljoenennota'*), which has an annex with an overview of implicit subsidies (in Dutch: *'belastinguitgaven'*). 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. A description of the various schemes is given in Annex I[7].

7) The figures presented in Table 9.4.7 for environmental investment exemptions (MIA, VAMIL and EIA) differ from the EPE figures. This is because in the EPE the focus lies on estimating net costs for industries. The EPE method calculates an average advantage during the service life of the asset invested in, which is considered as subsidised capital costs. The results are influenced by the parameters and assumptions used, however. We have chosen to use the figures from the Ministry of Finance.

9.4.6 Environmentally motivated implicit subsidies

	2005	2006	2007	2008	2009
	million euro				
Wage taxes (reductions in)					
WBSO	36	38	38	43	66
Environmental investments (tax exemptions)					
VAMIL	–130	34	50	23	35
EIA	117	286	160	116	88
MIA	60	94	94	50	65
Forestry related	6	6	11	9	9
Wealth taxes (reductions in)					
Forest and nature landscapes	4	4	4	5	5
Green investments	103	115	131	157	150
BPM verhicle tax (reductions in)					
Energy efficient vehicles (e.g. electric / hybrid)	25	14	14	5	16
Diesel cars with PM filter	15	29	39	0	0
Excise duties (reductions in)					
Biofuels	0	50	0	0	0
Inheritance tax (exemption)					
Nature landscapes	0	0	0	3	4
Total	**236**	**670**	**541**	**411**	**438**

Source: Ministry of Finance, 2006–2010.

It should be stressed that Table 9.4.6 provides a slightly aggregated picture, as from year to year individual tax schemes are sometimes renamed, especially with respect to energy efficient vehicles, which have therefore been grouped together. Sometimes, schemes have a very short life time, for instance in case of the bio fuel scheme, which was already suspended after one year (2006).

As Table 9.4.6 shows, the total environmentally motivated implicit subsidies are volatile, ranging from 236 million euro in 2005 to 670 million in 2006. This is primarily due to the VAMIL scheme, which was negative in 2005. This can be the case if investment in the whole economy shows a significant declining level (see Annex I). Exemptions for environmental investments form the largest share of implicit subsidies, totalling 45 percent in 2009, followed by reductions in wealth taxes. According to EPE calculations, beneficiaries of exemptions in environmental investment in 2009 are primarily agriculture (more than 50 percent), followed by electricity supply (8 percent) and the chemical industry (6 percent). Implicit subsidies concerning green investments show a steady increase until 2008, when the economy went into a recession.

Largest environmentally damaging implicit subsidies for air and water transport

Table 9.4.7 provides an overview of implicit subsidies with environmentally damaging effects. It is based on a (provisional) evaluation of implicit subsidy schemes included in the Budget, taking into account some recent studies (PBL 2011; CE Delft and Ecofys, 2011).

9.4.7 Environmentally damaging implicit subsidies

	2005	2006	2007	2008	2009
	million euro				
Excise duties (reductions in)					
Horticulture	131	149	156	169	86
Water transport	76	76	77	110	802
Air transport	127	129	131	133	922
Tariff differentiation tractors and mobile equipment	130	130	132	120	208
Motor vehicle tax					
Exemption vehicles > 25 years	88	92	94	102	141
Total	**421**	**427**	**434**	**465**	**2,073**

Source: Ministry of Finance, 2006–2010.

The largest implicit subsidies arise in international air travel due to the exemption of kerosene from excise duty and in water transport due to the exemption of 'red' diesel / (heavy) fuel oil from excise duty. These exemptions are grounded in international and European legislation in order to ensure a level playing field, so the Dutch government does not have the liberty to impose tariffs. In 2009, the Ministry of Finance changed its methodology for estimating the value of implicit subsidies for air and water transport, which resulted in a significant upward revision by more than 600 percent. The 2009 estimate is based on the actual implicit subsidies inherent in all kerosene that is bunkered at Dutch territory, while for previous years, an estimate was made of the expected increase in revenues in case the exemption would be suspended (apparently allowing for changes in behaviour) (Ministry of Finance 2011).

Cars older than 25 years are exempted from motor vehicle tax (road tax). This can be interpreted as an environmentally damaging subsidy (EDS) given that old-timers on average have significant higher emissions than new cars. This regulation is expected to change on 1 January 2012, to the extent that the vehicle tax exemption will be frozen, implying that no vehicle built after 1 January 1987 will qualify for tax exemption. Horticulture is a small scale energy intensive sector. Therefore, the costs of energy taxes are a large part of the exploitation costs. This sector therefore gets a reduction in excise duties.

The overall results indicate that for 2005–2008 implicit EDS account on average for 0.3 percent of total expenditures by the central government sector. Although in 2009 the EDS estimate would be 1.2 percent. We should be cautious however. These are underestimates of total EDS as they only cover implicit subsidies that are included in the official overview of implicit subsidies by the Ministry of Finance, while studies on the subject suggest that various other implicit subsidies exist. Moreover, there are also various regular environmental transfers that could qualify as EDS.

A recent overview (PBL 2011) puts the total amount of environmentally damaging subsidies between 5 and 10 billion euro. The authors stress, however, that the exact size is difficult to estimate and very much depends on the choice of definitions and calculation methodology. The reason they obtain such a large figure is that it includes additional implicit subsidy schemes compared to Table 9.4.7. For example, implicit subsidies inherent in the Dutch system of digressive tariff differentiation for energy taxes, which implies that larger users pay less tax. Another implicit EDS included is the exemption for value added tax (VAT) on air tickets, as well as the low VAT tariff on meat and dairy products (6 rather than 19 percent). Also the grandfathering (for free) of emission permits allowances is included in this overview.

Total environmentally motivated transfers much smaller than estimates of EDS

When we sum the environmentally motivated transfers (Table 9.4.3) and the implicit environmentally motivated subsidies (Table 9.4.6) we obtain an amount that ranges over the period 2005–2009 between 1 and 1.6 billion euro, or between 0.8 and 1.1 percent of total expenditures by the central government sector. When we compare this with the PBL estimates of EDS, it would imply that EDS would outnumber total environmental transfers as estimated in the current chapter by several factors.

9.5 Discussion and conclusions

Judging whether a payment qualifies as an environmental motivated transfer is very difficult in practice for a number of reasons: there may be multiple objectives at stake; it is unclear whether something is a transfer or a transaction; or, the description of the expense is limited. Graveland et al (2011) lists a number of examples such as agricultural subsidies and so-called securities and guarantees that we found particularly difficult to classify. Consultation with relevant agencies often provides some clarification, but usually experts are primarily knowledgeable about their own subsidy scheme and have difficulty scoring programs not familiar to them.

We have also encountered several difficulties when using microdata and annual reports. First, the names of subsidy schemes change very frequently (sometimes even from year to year). There is no uniform coding system in use by which one can identify whether a certain expense fits within one scheme or another, which increases the risk of double counting. Another difficulty is that the same agency often uses various databases internally to record subsidies that follow different formats and classifications. Also, the recording basis is not always clear (cash; commitment, transaction, preliminary or definitive status etc.) Due to ongoing reorganisations, the format of annual reports and the agency in charge changes frequently. This complicates the applications of the hybrid approach. As a result of these difficulties, the estimates of total environmental transfers as well as the disaggregating towards CEPA/CReMA presented here are subject to significant uncertainty.

The transfers for environmental protection (COFOG 5) – the first approach – can be interpreted as an independent estimate of environmental transfers. According to Costantino and Falcitelli (2009) environmental protection transfers – COFOG 5 – should be equal to the totals on all CEPA classes, as their scope is identical. As resource management transfers are not included in COFOG 5 we should only compare CEPA totals. On average for the time period considered we obtain that CEPA estimates are about 14 percent higher than COFOG 5 estimates. For instance in 2009, environmental transfers included in CEPA categories are 265 million euro, while the COFOG based estimate is 259 million euro. The difference could be due to the fact that schemes with multiple purposes have been classified differently. For instance, the choice between CReMA category 13 'management of energy resources' and CEPA category 1 'Protection of ambient air and climate' is sometimes hard to make, as in many cases these objectives are combined in a single scheme. An incentive to reduce the consumption of fossil fuels aims to contribute to energy savings as well as to lower emissions of green house gasses. Moreover, not necessarily all expenditures classified as COFOG 5 have environmental protection as their prime purpose. In several occasions it is combined with other primary objectives such as enhancement of economic development or either development in a broader sense. Future research is required to investigate these differences further.

In terms of the hybrid methodology used, the microdata at the level of beneficiaries when summed match reasonably well with the annual statements of the subsidy providers. The connection with the business register is good for data obtained from Agentschap-NL, which we have been able to improve manually. For microdata from Dienst Regelingen, the connection is worse, as expected, due to the fact that agriculture is not well represented in the Dutch business register. This also confirms that most of these transfers are going towards agriculture. For the largest subsidy scheme, MEP, the disaggregation to industries is only available for NACE rev3, which we provisionally allocated towards NACE rev 4. This will improve in the future. Overall, we are confident of our breakdown to NACE.

In this chapter we have excluded transfers that remain internal to the government sector, primarily for practical reasons. There may be however an underlying theoretical issue of scope. One could argue that an account that includes all environmental transfers, groups together transfers that are of a different nature, that one may want to distinguish. For instance, transfers for waste water treatment between the central government and local government are different from a subsidy scheme for solar panels, although both are clearly environmentally motivated transfers. The former are regular transfers that occur every year, while the latter are usually of a temporary nature, and subject to competition. Moreover, regular transfers often result in services that are indirectly paid for by households in the form of fees and levies, as cost-recovery is usually in place. Also, in case of subsidy schemes, the government increasingly demands something in return. This is not a (private) good or service (and not a transaction), but could be conceived of as a public service, for instance reduced air emissions in case of subsidies for renewable energy. These issues of scope warrant further reflection, and discussion with users.

In the future, it seems promising to further explore synergies with the compilation process of government finance statistics. For instance, in addition to a COFOG qualifier for budget lines, at the same time budget lines could also be cross-classified according to CEPA/CReMA as part of the government account compilation processes. This could potentially lead to an integration of three approaches that we described in Section 9.3, and allow for a consistent breakdown of environment transfers by domain, by sector, by transaction type, and by NACE. Regarding the implicit subsidies, more research is clearly required, primarily in terms of methodology for assessing EDS amongst environmental transfers.

Statistics Netherlands participates in an OECD / Eurostat taskforce on environmentally related transfers and subsidies that hopefully will result in more detailed guidelines. The results presented in this chapter will feed into this work. This will enhance international comparability of results. This is necessary if an account for environmental transfers and subsidies becomes part of the EU legal base for environmental accounting in the future.

Annex I: 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 uneconomic, 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 CO_2 emissions (gram per kilometre

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

References

Adriaanse, A (1993). Environmental Policy performance Indicators. *SDU Publishers. Den Haag.*

Baas, K. and C. Graveland (2011). Water abstraction and use at the river basin level, Final Report on EU Water Statistics Grant. Statistics Netherlands. *The Hague/Heerlen, 2011. Discussion paper (201113). ISSN: 1572–0314.*

Beers, C. van, J.C.J.M van den Bergh, A. de Moor en F.H. Oosterhuis (2007). Determining the environmental effects of indirect subsidies: Integrated method and application to the Netherlands. *Applied Economics, vol. 39, pp. 2465–2482.*

Brouwer, R., S. Schenau, R. van der Veeren, 2005, Integrated river basin accounting in the Netherlands and the European Water Framework Directive. *UNECE Statistical Journal ECE 22, 111–131. Available at : http://iospress.metapress.com/content/aqlb27drhnn243fn/*

Brouwer, R. (2006). Toekomstige beleidsvragen en hun implicaties voor de ontwikkeling van een intergraal water-en-economie model. *WEMPA report-01, IVM, Amsterdam.*

CE (2007). Overwinsten bij de subsidieregeling Milieukwaliteit Elektriciteitsproductie (MEP), een analyse van omvang en achtergrond. *Delft.*

CE Delft and Ecofys (2011). Overheidsingrepen in de energiemarkt.

Costantino, C., Falcitelli, F. (2009). Natural resource use and management expenditure accounts. *Istat.*

Cross, P. and Ghanem, Z. (2006). Multipliers and Outsourcing: how industries interact with each other and affect GDP, Canadian Economic Observer. Available at: http://www.statcan.gc.ca/pub/11-010-x/00106/9000-eng.htm GDP, Canadian Economic Observer. *Available at: http://www.statcan.gc.ca/pub/11-010-x/00106/9000-eng.htm*

Delahaye, R. and L. Nootenboom (2008). Economy-wide material flow accounts in the Netherlands. Eurostat paper. Available at: *http://www.cbs.nl/nl-NL/menu/themas/macro-economie/methoden/dataverzameling/overige-dataverzameling/default.htm*

Drissen, E., Hanemaaijer, A., Dietz, F. (2011) PBL-nota Milieuschadelijke subsidies.
Dutch Emissions Authority (2009). Jaarverslag 2008 (Annual Report 2008). *De Nederlandse Emissieautoriteit (NEa). Den Haag. Juni 2009.*

Dutch Emissions Authority (2011a). Jaarverslag 2010 (Annual Report 2010). *De Nederlandse Emissieautoriteit (NEa). Den Haag. Juni 2011.*

Dutch Emissions Authority (2011b). Personal communication and exchange of data with the Dutch Emissions Authority. The Dutch Emissions Authority, The Hague.

Dutch Emissions Authority (2010a). Jaarverslag 2009 (Annual Report 2009). *De Nederlandse Emissieautoriteit (NEa), Den Haag. Juni 2010.*

Dutch Emissions Authority (2010b). Overzicht CO_2-emissierechten 2008–2012. (Overview CO_2-permits 2008–2012). *De Nederlandse Emissieautoriteit (NEa), Den Haag.*

ECN (2008). Technisch-economische parameters van duurzame elektriciteitsopties in 2008–2009. Conceptadvies basisbedragen voor de SDE-regeling.

ESB (2007). Subsidie op groene stroom kan doelmatiger. *Den Haag.*

Edens, B., Delahaye, R., Van Rossum, M. Schenau, S. (2011). Analysis of changes in Dutch emission trade balance(s) between 1996 and 2007. *Ecological Economics 70 (2011) 2334–2340*.

European Commission/Eurostat (2001). Environmental taxes – A statistical guide. *Luxembourg*

EC (2007). Limiting global climate change to 2 degrees Celsius – The way ahead for 2020 and beyond, COM (2007) 0002 final. Europese Commissie (EC), Brussel.

European Commission (2010). Working Group on Economic and Social Assessment: Economic and social analysis for the initial assessment for the marine strategy framework directive: a guidance document. *21 December 2010. More information at: http://ec.europa.eu/environment/water/marine/index_en.htm*

European Commission (2011). Roadmap to a Resource Efficient Europe. *Com(2011) 571, Brussels*.

Eurostat (2008). Manual of Supply, Use and Input-Output Tables. *Eurostat methodologies and working papers*.

Eurostat (2009). Handbook on Environmental Goods and Services Sector, Luxembourg. Available at: *http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-09-012*

Graveland, C. (2006). Dutch Waterflow Accounts, with preliminary results for 2003 and 2004. Eurostat paper. Available at: *http://www.cbs.nl/nl-NL/menu/themas/macro-economie/methoden/dataverzameling/overige-dataverzameling/default.htm*

Graveland, C., B. Edens, W. Tebbens (2011). Environmental Subsidies and transfers, Final Report EU Grant. *CBS, Den Haag / Heerlen*.

Haan, M. de (2004). Accounting for goods and for bads – measuring environmental pressure in a national accounts framework. *PhD thesis, Universiteit Twente, Enschede*.

IPCC (1996). Revised 1996 IPCC guidelines for National greenhouse gas inventories.

IPCC (2007). Fourth Assessment Report, Climate Change 2007. *Cambridge, Cambridge University Press*.

Lange, G.M., Jiddawi, N. (2009). Economic value of marine ecosystem services in Zanzibar: Implications for marine conservation and sustainable development. *Ocean & Coastal Management, Volume 52, Issue 10, October 2009, Pages 521–532*.

LEI (2006). Regionale anticipatie mestbeleid op Kaderrichtlijn water. Den Haag. Available at: *http://www.lei.wur.nl/NL/publicaties+en+producten/LEIpublicaties/?id=678*

LEI (2009), Biologische internationale handel. Den Haag, Rapport 2009-003; ISBN /EAN: 978-90-8615-330-5; Task Force Marktontwikkeling Biologische Landbouw/Biologica, Biomonitor Jaarrapport 2009, NPN drukkers, Breda

Meer, R. van der, and H. van der Veen (2011). Water use in agriculture 2001–2009, at river basin level (in Dutch: Watergebruik in de agrarische sector 2001–2009, naar stroomgebied). *Landbouw-Economisch Instituut (LEI), Den Haag*. *Projectcode 2275000343. July 2011*.

Millennium Ecosystem Assessment. (2003). Ecosystems and Human Well-being: A Framework for Assessment. Island Press. *Washington, D.C., USA*.

Miller, R.E., Blair, P.D. (2009) Input-Output Analysis. Foundations and Extensions. *Cambridge University Press 2009*.

Ministry of Finance (2002). Subsidie Overzicht Rijksoverheid 2003.

Ministry of Finance (2006). Instrumenten Overzicht Rijksoverheid (IOR) 2006.

Ministry of Finance (2010). Subsidie Overzicht Rijksoverheid 2010.

Ministry of Finance (2005–2011). Nota over de toestand van 's Rijks Financiën ('Miljoenennota'), Bijlage, Overzicht van de belastinguitgaven.

Murillas-Maza, A., Virto, J., Gallastegui, M.C.,González, P., Fernández-Macho, J. (2011). The value of open ecosystems: A case study for the Spanish exclusive economic zone. *Natural Resources Forum 35 (2011) 122–133*.

OECD (2011) Green Growth Strategy. *Paris.*

Palm, Viveka, Maja Cederlund, Nancy Steinbach, Anda Marina Georgescu, (2009). Unresolved issues: SEEA transfers related to the environment. *Document to the 15th London Group meeting on Environmental Accounting in Wiesbaden (Germany), 30 November – 4 December 2009. LG/15/16/1. Statistics Sweden / Eurostat*.

PBL (2008) Kwaliteit voor later. Ex ante evaluatie Kaderrichtlijn Water. *Planbureau voor de Leefomgeving, Bilthoven*.

PBL (2010). Evaluatie van een IPCC-klimaatrapport: Een analyse van conclusies over de mogelijke regionale gevolgen van klimaatverandering. *Rapportnr. 500216001*.

Rossum, M., van and Schenau, S. (2006). Economic indicators for the Eco-Industries, 2003. Statistics Netherlands, The Hague. Available at: *http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/5BA60F9CF89919A5E0440003BA9321FE*

Rossum, M. van and Kulig, A. (2008). Economic indicators for: resource management activities in the Dutch environmental goods and services sector. *Statistics Netherlands, The Hague. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/NL%20494%20EGSS.pdf*

Rossum, M. van and van Geloof, I. (2009). Economic indicators for the Dutch Environmental Goods and Services Sector, Time series data for 1995–2007. *Statistics Netherlands, The Hague, available on request.*

Rossum, M. van and van de Grift, M. (2009). Regional analysis: Differences in emission-intensity due to differences in economic structure or environmental efficiency? *Journal of Sustainable Development, Vol 2, No 3*.

Rossum, M. van, M. de Haan and S. Schenau. (2009). Renewable energy resources in the SEEA. *Paper prepared for the London Group meeting, Canberra*.

Rossum, M. van and R. Delahaye (2010). On the valuation of wind energy resources, the economy behind wind energy production. The Hague. Available at: *http://www.cbs.nl/NR/rdonlyres/6917809F-C552-4C01-968B-6533E1215979/0/2011reportrenewableenergyfvupdate1.pdf*

Schenau, S. (2010). The Dutch energy accounts. Available at: *http://www.cbs.nl/nl-NL/menu/themas/macro-economie/methoden/dataverzameling/overige-dataverzameling/default.htm*

Schenau, S. Delahaye, R. Edens, B. van Geloof, I, Graveland, C. and van Rossum, M. (2010). The Dutch environmental accounts: present status and future developments. *Available at: http://www.cbs.nl/nl-NL/menu/themas/macro-economie/methoden/dataverzameling/overige-dataverzameling/default.htm*

Statistics Netherlands (2010a). Environmental accounts of the Netherlands 2009. Den Haag/Heerlen. Available at: *http://www.cbs.nl/nl-NL/menu/themas/macro-economie/publicaties/publicaties/archief/2010/2010-milieurekeningen-pub.htm*

Statistics Netherlands (2010b). Milieurekeningen methoden. Available at: http://www.cbs.nl/NR/rdonlyres/457A00DC-FFE5-4DD2-A747-BA62199A38E6/0/2010Milieurekeningeninternetmethoden.pdf

Statistics Netherlands (2011a). StatLine. Available at: *http://statline.cbs.nl/statweb/* CBS, Den Haag / Heerlen.

Statistics Netherlands (2011b). StatLine: Windenergie op land; productie en capaciteit per provincie. *CBS, Den Haag / Heerlen*.

Statistics Netherlands (2011c) Economische radar duurzame energiesector. Available at *http://www.cbs.nl/NR/rdonlyres/4B1C4BCB-CE97-482B-A8EB-7B9EA402E3B4/0/2011economischeradarduurzameenergiesector.pdf* ; English report (only summary): *http://www.cbs.nl/NR/rdonlyres/01A2777A-BAA8-47A6-B0B9-AAC8A7A155AA/0/2011managementsummaryeconomicradarsustainableenergysector.pdf*

TEEB (2010). The economics of ecosystems and biodiversity. Mainstreaming the economics of nature. A synthesis of the approach, conclusions and recommendations of TEEB. *Available at: www.teebweb.org*

TNO/EL&I (2011). Delfstoffen en Aardwarmte in Nederland. *Jaarverslag 2010, The Hague, June 2011*.

TNO/Ministry of Economic Affairs (1987–2010). Delfstoffen en Aardwarmte in Nederland. *Annual reports 1987–2010, The Hague*.

United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, World Bank (2003). Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003, *Final draft circulated for information prior to official editing, http://unstats.un.org/unsd/envaccounting/seea.asp*

United Nations, CEC-Eurostat, IMF, OECD, UNO, World Bank (2009). System of National Accounts 2008. *Brussels/Luxembourg New York, Paris, Washington D.C.*

United Nations et al, System of Environmental Economic Accounting 2012. *Forthcoming*.

UN (2011) Draft chapters of SEEA for global consultation. *Available at: unstats.un.org/envaccounting*

Veldhuizen, E., C. Graveland, D. van der Bergen en S.J. Schenau (2009). Valuation of oil and gas reserves in the Netherlands 1990–2005. *Statistics Netherlands, The Hague/Heerlen*.

Vewin (2007). Waterleidingstatistiek 2006. Vereniging van waterleidingbedrijven in Nederland.

Vewin (2008). Waterleidingstatistiek 2007. Vereniging van waterleidingbedrijven in Nederland.

Vewin (2010a). Drinking Water Fact sheet 2010. Association of Dutch Water Companies (Vewin). *Rijswijk. The Netherlands. 2p*.

Vewin (2010b). Dutch Drinking Water Statistics 2008. The water cycle from source to tap.
Association of Dutch Water Companies (Vewin). Rijswijk. The Netherlands. 85p. Vewin no. 2009/95/6259.

Vewin (2011a). Drinking Water Fact sheet 2011. Association of Dutch Water Companies (Vewin). *Rijswijk. The Netherlands. 2p*.

Vewin (2011b). Personal communication. Association of Dutch Water Companies (Vewin). *Rijswijk. The Netherlands*.

Vuik, J., van Rossum, M., Pieters, A. (2011), Economic description of the North Sea for the Netherlands. Available at: *http://www.cbs.nl/NR/rdonlyres/7E26B72C-7BB0-4D6C-85DB-9A5EB7CCDCE8/0/2011rapportnorthsea2011pdatev2.pdf*

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^+.

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.

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.

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 37 -39). 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 transfer – Transfer with environmental protection or resource management as main purpose. A transfer is a transaction in which one institutional unit provides a good, service or asset to another unit without receiving from the latter any good, service or asset in return as a direct counterpart. Transfers may be either current or capital. Within the scope of environmental transfers are D3. Subsidies; D 6 Social contributions and benefits; D7 Other current transfers and D9 Capital transfers.

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 taxes – a tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment (European commission – Eurostat, 2001). Environmental taxes are levied to discourage people from undertaking activities that pollute 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.

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. The classification categories referred to are based upon the McKelvey Box system as explained in SEEA 2003.

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 2003 – System of Integrated Economic Environmental Accounting 2003

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.

Subsidies – Current unrequited payments that government units, including non-resident government units, make to enterprises on the basis of the levels of their production activities or the quantities or values of the goods or services which they produce, sell or import. (SNA 2008; Para 7.98). Subsidies are therefore a subset of transfers.

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.

Acknowledgements

Authors

Sjoerd Schenau
Roel Delahaye
Bram Edens
Isabel van Geloof
Cor Graveland
Maarten van Rossum
Joram Vuik

With the contribution of

Kees Baas, Anne Boelens, Ellen Brinksma, Rita Gircour Ba, Jay Kang, Hielke Koppert, Niek Muminovic, Leslie Nootenboom, Kees Olsthoorn, Albert Pieters, Jaap van Riessen, Reinoud Segers, Otto Swertz, and Erik Veldhuizen.