Environmental accounts of the Netherlands 2013

Statistics Netherlands

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Explanation of symbols

.	Data not available
*	Provisional figure
**	Revised provisional figure (but not definite)
x	Publication prohibited (confidential figure)
–	Nil
–	(Between two figures) inclusive
0 (0.0)	Less than half of unit concerned
empty cell	Not applicable
2013–2014	2013 to 2014 inclusive
2013/2014	Average for 2013 to 2014 inclusive
2013/’14	Crop year, financial year, school year, etc., beginning in 2013 and ending in 2014
2011/’12–2013/’14	Crop year, financial year, etc., 2011/’12 to 2013/’14 inclusive

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

Publisher
Statistics Netherlands
Henri Faasdreef 312, 2492 JP The Hague
www.cbs.nl

Prepress: Textcetera, The Hague
Printed by: Tuijtel, Hardinxveld-Giessendam
Design: Edenspiekermann

Information
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Via contact form: www.cbs.nl/information

Where to order
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Fax +31 45 570 62 68
ISBN 978-90-357-1617-9
ISSN 2210-9749

60210 201401 C-174

Contents

Key figures

Environmental accounts, key figures [1]

	Unit	2001*	2005*	2010*	2011*	2012*	2013*
Economy							
Domestic product (gross, market prices, price level of 2010)	million euros	560,483	585,108	631,512	642,018	631,837	627,253
Final consumption expenditure households (price level of 2010)	million euros	275,230	280,842	282,510	282,967	278,891	274,494
Investments in fixed assets (gross, price level of 2010)[2]	million euros	126,646	121,569	124,649	131,583	123,660	118,747
Population	x 1,000	15,987,075	16,305,526	16,574,989	16,655,799	16,730,348	16,779,575
Employment	x 1,000 FTE	6,832	6,712	7,056	7,099	7,059	6,962
Environmentally adjusted aggregates							
Adjusted national income for depletion of mineral reserves (net)	%	.	.	1.7	1.8	2.0	2.1
Energy							
Net domestic energy use	petajoules	3,546	3,708	3,772	3,527	3,554	3,540
Energy intensity	MJ/euro	6.3	6.3	6.0	5.5	5.6	5.6
Extraction natural gas	billion Sm^3	68	73	86	79	78	84
Mineral reserves gas[3]	billion Sm^3	1,777	1,510	1,304	1,230	1,130	1,044
Valuation mineral reserves gas[3]	million euros			136,050	150,925	155,598	139,147
Water							
Groundwater abstraction[4]	million m^3	1,016	1,010	994	983	940	.
Tap water use[5]	million m^3	1,118	1,086	1,090	1,080	1,070	1,076
Tap water use intensity	litre/euro	2.0	1.9	1.7	1.7	1.7	1.7
Heavy metals to water[6]	1,000 eq.	.	52	41	39	42	.
Nutrients to water[6]	1,000 eq.	.	8,453	6,856	6,663	6,485	.
Materials							
Material consumption biomass	million kg	54,289	47,610	48,653	53,514	49,962	.
Material consumption metals	million kg	7,453	3,396	957	6,104	3,610	.
Solid waste production	million kg	64,013	61,610	59,024	.	.	.
Landfilled waste	million kg	4,907	2,137	1,527	.	.	.
Greenhouse gas emissions and air pollution							
Greenhouse gas emissions	million CO_2-eq.	243,495	240,557	242,628	229,103	228,332	228,425
Greenhouse gas emission intensity	CO_2 eq/1,000 euro	434	411	384	357	361	364
CFK emissions (ozone layer depletion)	thousand CFK12-eq.	246	173	137	133	125	124
Acidifying emissions	billion ac-eq.	27	26	20	18	18	18
Fine dust emissions	million kg	53	47	38	36	34	34
Policy instruments and economic opportunities							
Environmental taxes and fees	million euros	.	20,919	23,985	23,908	22,858	23,013
Share environmental taxes and fees in total taxes	%	.	16.8	16.7	17.1	16.9	16.5
Environmental costs	million euros	9,650	10,105	.	10,938	.	.
Labour input environmental goods and services sector	x 1,000 FTE	119	115	126	132	130	.
Value added environmental goods and services sector (basic prices)	million euros	8,073	9,231	12,778	13,491	13,239	.

1) Intensities in this table are based upon use or emissions of both households and industries.

2) Excluding non-profit institutions.

3) Balance as of 31 December.

4) 2001 figure is derived from a long term trend.

5) Tap water of drinking water quality (without industrial water).

6) Net approach.

Summary

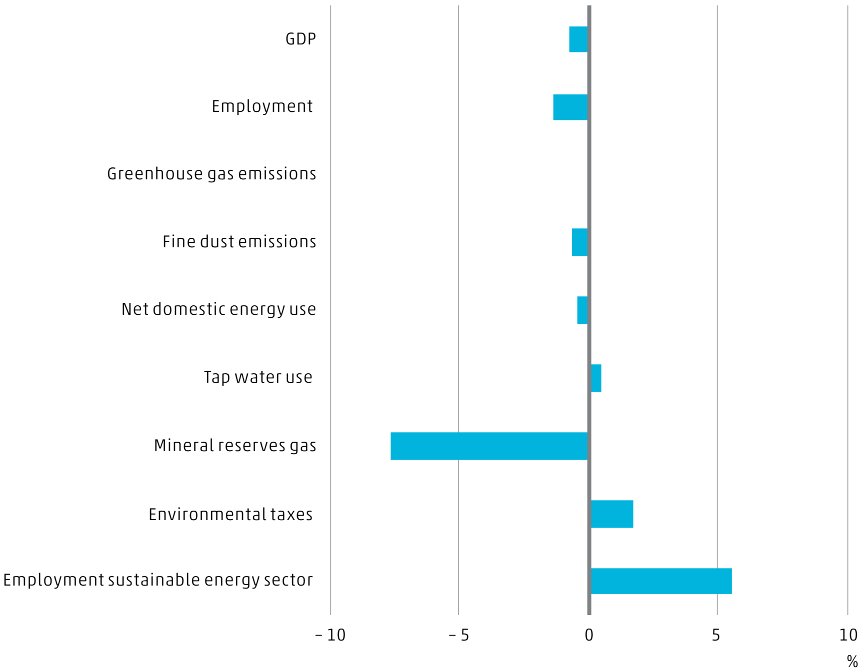
Net energy use remained stable in 2013

The net domestic energy use for the Dutch economy remained more or less stable in 2013, compared to 2012. Due to the cold winter, the demand for natural gas by households and services increased. This was offset by a decrease of energy use in the sectors manufacturing, electricity producers and construction. The production of electricity decreased further because electricity use was lower and electricity imports increased by 3.4 percent.

Greenhouse gas intensity deteriorated in 2013

Greenhouse gas emissions in the Netherlands in 2013 did not increase on the previous year, whereas the economy contracted by 0.7 percent. The emission intensity, that is greenhouse gas emissions divided by GDP, increased for the second year in a row. The emission intensity has not improved since 2008. The relatively cold weather in 2013 is the main reason why the economic downturn was accompanied by an increase in emissions instead of a decrease. The carbon dioxide (CO_2) emissions barely changed. The emission of methane (CH_4) increased by 1 percent and that of nitrous oxide (N_2O) by 4 percent.

Changes in environmental and ecomomic indicators, 2012-2013



Rise in acidifying emissions in 2013

For the first time in years the total emissions of acidifying substances, expressed as acid equivalents, has increased, namely by 1 percent in 2013 compared to the previous year. Emissions of these substances have decreased by 33 percent since 2001. Acidification of the environment is caused by the emission and deposition of nitrogen oxides (NO_x),

sulfurdioxide (SO_2) and ammonia (NH_3). Acidification affects biodiversity and can cause damage to sensitive areas, such as forests and heaths. The agricultural and transport sectors are primarily responsible for acidifying emissions.
The total emission of fine dust fell by 1 percent compared to 2012. Since 2001, fine particle emissions have been reduced by 35 percent. This reduction was achieved mainly in the basic metal industry, refineries, the chemical industry and to a lesser extent in the metal and building materials industry. Households contributed to the decrease as well.

More environmental tax revenues in 2013

Total revenues from environmental taxes and environmental fees increased by 1.7 percent compared to 2012. The increase in environmental tax revenue is mainly due to the introduction of an additional increment on the tax on gas and electricity to finance renewable energy subsidies (in Dutch: *opslag duurzame energie*). Furthermore, fuel tax exemptions for companies were ended, especially the tax exemption on the use of coal by electricity companies. The share of environmental taxes as part of the total taxes received by the government has declined to 13.5 percent over the last two years.

Less employment in the Environmental Goods and Services Sector in 2012

Though production value in current prices in the Environmental Goods and Services Sector (EGSS) increased in 2012, both value added and employment declined. EGSS activities that saw a decrease in employment and value added include ‘Environmental technical construction’, ‘Energy saving, sustainable energy systems (incl. insulation activities)’ and ‘Industrial environmental equipment’. On the other hand, employment and value added increased for ‘Environmental inspection and control’ and ‘Organic agriculture’. In 2012 the value added generated by the EGSS was 2.1 percent of Dutch GDP and its contribution to total employment reached 1.8 percent.

Input-output analysis

The new SNA 2008 (UN, 2009) guidelines have led to changes in the recording of global manufacturing in National Accounts worldwide. The SNA 1993 stipulated that exports and imports of goods should be recorded at the time ownership passes from a resident to a non-resident unit, but allowed for several exceptions to the ownership principle in case of merchanting, goods sent abroad for processing, and goods shipped to a foreign affiliate (UN, 1993). With the SNA 2008 these exceptions have been dropped in favour of the application of pure ownership criteria. The SNA 2008 recommendations are largely motivated by the need to ensure quality of statistics in a globalising world. These recommendations not only have major implications for the supply and use tables of the National Accounts (from ‘gross’ flows of goods to ‘net’ flows of services in case of processing), but also for input-output (IO) analysis. Chapter 6 explains the theoretical consequences of the new SNA 2008 guidelines for IO analysis. Secondly, the paper quantifies the effect of the new SNA 2008 guidelines on footprint indicators by reversing the conceptual changes for global manufacturing in the Dutch 2010 after revision IO table and compares the outcomes. The main conclusions are that for the moment the effects are noticeable at the macro level but limited. At the meso level the outcomes differ significantly, especially for manufacturing industries. These results bode ill for the future in which globalisation will most likely increase, undermining the potential of environmentally extended input-output analysis.

Ecosystem accounts

Ecosystem accounts are a novel development within environmental accounting. The main idea is to provide a description of nature in terms of ecosystems that provide society with a range of ecosystem services such as crop production or carbon sequestration. In chapter 7 the results of a pilot study for two municipalities is reported: Roerdalen (in Limburg) and Rotterdam. The success rate of allocating land parcels to economic use categories is analysed through interlinking several spatially explicit data sets such as the land use register from the cadastre and the regional Dutch business register (called Regiobase). By enriching this spatially explicit land use map with additional information about modelled ecosystem services, it is possible to obtain a provisional allocation of the supply of ecosystem services to economic activities.

Samenvatting

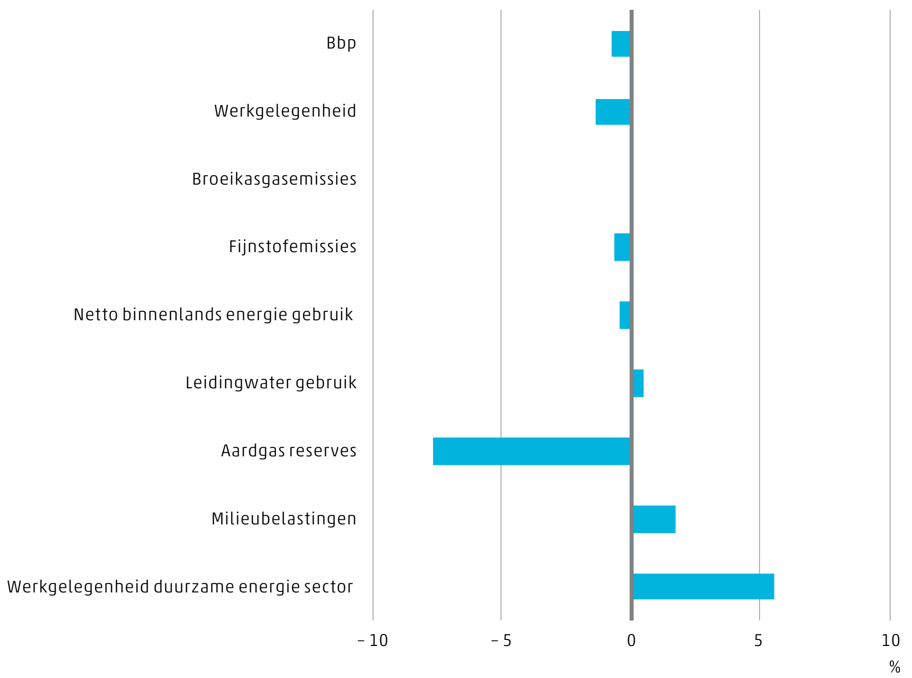
Netto energieverbruik stabiel in 2013

Het netto binnenlandse energieverbruik door de Nederlandse economie bleef in 2013 in vergelijking met 2012 min of meer stabiel. Vanwege de koude winter nam de vraag naar aardgas door huishoudens en dienstverlening voor ruimteverwarming fors toe. Deze stijging werd gecompenseerd door een afname van de energievraag in de industrie, elektriciteitsbedrijven en de bouw. De productie van elektriciteit nam verder af als gevolg van een lager energiegebruik en een toename van de import van elektriciteit van 3,4 procent.

Broeikasgasintensiteit verslechterd in 2013

De uitstoot van broeikasgassen in Nederland is in 2013 ten opzichte van 2012 praktisch gelijk gebleven, na een daling van bijna 1 procent in 2012. Dit terwijl de economie in 2013 kromp met 0,7 procent na een nog sterkere krimp in 2012. De emissie-intensiteit, de uitstoot van broeikasgassen gedeeld door het bbp, is hierdoor voor het tweede achtereenvolgende jaar gestegen in tegenstelling tot de dalende langjarige trend. Sinds het begin van de economische crisis in 2008 is de emissie intensiteit niet meer verbeterd. Dat de economische krimp in 2013 niet gepaard is gegaan met een daling van de emissies komt vooral door het koude weer in het begin van het jaar. De uitstoot van koolstofdioxide (CO_2) veranderde hierdoor per saldo nauwelijks. De emissie van methaan (CH_4) nam af met 1 procent en dat van lachgas (N_2O) nam toe met 4 procent.

Veranderingen in milieu- en economische indicatoren, 2012-2013



Toename van de uitstoot verzurende stoffen in 2013

Voor het eerst in jaren is de totale uitstoot van verzurende stoffen, uitgedrukt in zuur-equivalenten, toegenomen, namelijk met 0,6 procent ten opzichte van het jaar daarvoor. Sinds 2001 is de emissie van deze stoffen met 33 procent gedaald. Verzuring van het leefmilieu wordt veroorzaakt door de uitstoot van stoffen als stikstofoxiden (NO_x), zwaveldioxide (SO_2) en ammoniak (NH_3) naar de atmosfeer en depositie in water en bodem. Verzuring heeft invloed op de (bio)diversiteit en kan schade geven aan kwetsbare natuurgebieden, waaronder bos en heide. De landbouw- en vervoersector samen zijn verantwoordelijk voor bijna driekwart van het totaal aan verzurende emissies. De totale emissie van fijnstof in 2013 is met 1 procent gedaald ten opzichte van 2012. De fijnstofemissies zijn sinds 2001 met 35 procent afgenomen. Die reductie werd vooral gerealiseerd bij de basismetaalindustrie, huishoudens, aardolie-industrie, vervoer over land, chemische industrie en voedings- en genotmiddelenindustrie en in mindere mate bij de bouwmaterialen- en metaalproductenindustrie.

Toename van de opbrengsten uit milieubelastingen in 2013

Vergeleken met 2012 zijn de inkomsten uit milieubelastingen in 2013 met 1,7 procent gestegen. Dit kwam vooral door de introductie van de zogenaamde 'opslag duurzame energie' als onderdeel van de energiebelasting. Ook waren energiebedrijven vanaf 2013 niet langer vrijgesteld van de brandstofbelasting, met name wat betreft de inzet van steenkool in de elektriciteitsproductie. Het aandeel van de milieubelastingen in de totale belastingopbrengsten van de overheid is in de laatste twee jaar afgenomen tot 13,5 procent.

Afname werkgelegenheid milieusector in 2012

De milieusector heeft in 2012 te maken gekregen met de effecten van de economische crisis. De toegevoegde waarde en de werkgelegenheid daalden in de milieusector als geheel, vooral bij activiteiten op het terrein van de milieutechnische bouw, energie-besparing, duurzame energiesystemen (inclusief isolatie-activiteiten) en de productie van industriële milieuapparatuur. Aan de andere kant stegen de werkgelegenheid en de toegevoegde waarde bij de organische landbouw en de milieu-inspectie en controle. De toegevoegde waarde van de milieusector was in 2012 gelijk aan 2,1 procent van het bbp. De milieusector droeg in hetzelfde jaar 1,8 procent bij aan de totale werk-gelegenheid.

Input-output analyse

De nieuwe SNA 2008 (UN, 2009) richtlijnen hebben geleid tot veranderingen in de boekingswijze van 'wereldwijde productie' in de nationale rekeningen. Het SNA 1993 bepaalde dat de uitvoer en de invoer van goederen moeten worden geregistreerd op het moment dat het eigendom overgaat van een ingezetene naar een niet-ingezetene eenheid. Er waren echter een aantal uitzonderingen geformuleerd in het geval van transitohandel, veredeling en goederen die worden verscheept naar een buitenlands filiaal (UN, 1993). In het nieuwe SNA 2008 zijn deze uitzonderingen, in het voordeel van toepassing van het eigendomscriterium, vervallen. De aanbevelingen in het SNA 2008 worden ingegeven door de noodzaak om de kwaliteit van de statistieken in een globaliserende wereld te verbeteren. Deze aanbevelingen hebben niet alleen grote gevolgen voor de aanbod -en gebruik tabellen van de Nationale Rekeningen (van 'bruto' goederenstromen naar 'netto' stromen van diensten in geval van veredeling), maar ook voor milieu gerelateerde input-output (IO) analyses.

In hoofdstuk 6 worden de theoretische gevolgen van het nieuwe SNA 2008 voor IO-analyses besproken. Daarnaast wordt het effect van de nieuwe SNA 2008 richtlijnen voor footprint indicatoren gekwantificeerd en worden de uitkomsten vergeleken door de conceptuele veranderingen voor de wereldwijde productie terug te draaien in de IO-tabel. De belangrijkste conclusies zijn dat op dit moment de effecten slechts beperkt merkbaar zijn op macroniveau. Op mesoniveau verschillen de resultaten wel aanzienlijk, in het bijzonder voor de industrie. Deze resultaten voorspellen een niet zo'n rooskleurig beeld, aangezien de globalisering in de toekomst waarschijnlijk verder zal toenemen en hiermee op termijn het potentieel van milieu-gerelateerde input-output analyses kan ondermijnen.

Ecosysteemrekeningen

Ecosysteemrekeningen zijn een nieuwe ontwikkeling binnen de milieurekeningen. Het voornaamste idee is om een beschrijving van de natuur te bieden in termen van ecosystemen die de maatschappij voorzien van een scala aan ecosysteemdiensten, zoals de productie van gewassen of het vastleggen van koolstof. In hoofdstuk 7 wordt verslag gedaan van de resultaten van een pilot studie voor twee gemeenten: Roerdalen (in Limburg) en Rotterdam. Onderzocht is in hoeverre het mogelijk is landpercelen aan economische activiteiten toe te kennen door het koppelen van meerdere ruimtelijk expliciete datasets, zoals informatie van het Kadaster en uit de Regiobase. Een landgebruikkaart is een belangrijke bouwsteen in het ontwikkelen van ecosysteemrekeningen. Door het verrijken van deze ruimtelijk expliciete landgebruikskaart met aanvullende informatie (gemodelleerde) ecosysteemdiensten is het mogelijk om een experimentele toewijzing te maken van de productie van ecosysteemdiensten aan economische activiteiten.

1. Introduction

The System of Environmental-Economic Accounting (SEEA) is an international statistical system that brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy and the impact of the economy on the environment. This chapter introduces SEEA, its main building blocks and the relationship between environmental statistics and environmental accounts. In addition, a short outline is provided of the current publication.

1.1 Environmental accounting

The economy and the environment are intertwined. The economy depends on the environment as a source 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.

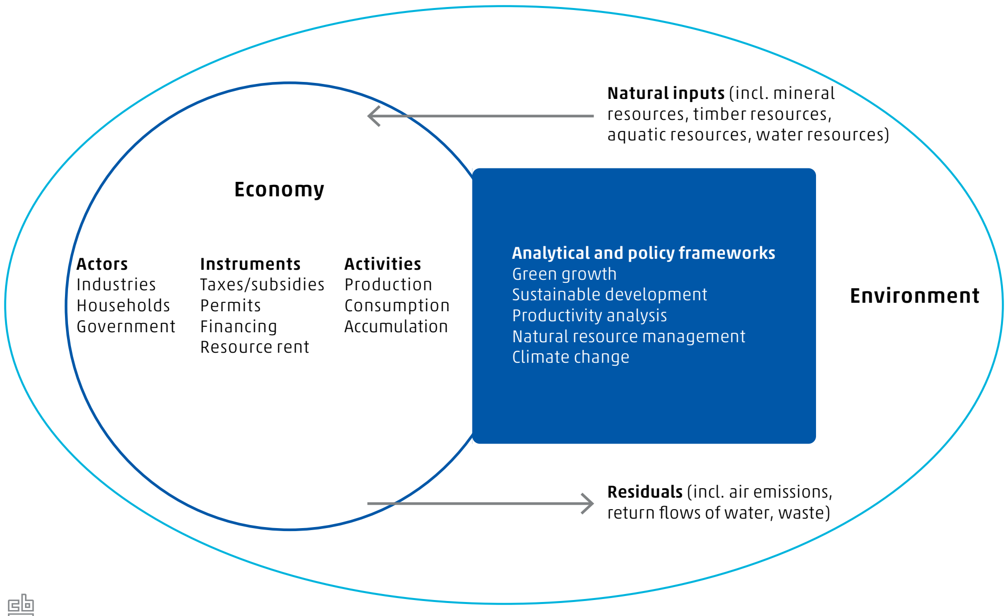
The System of Environmental-Economic Accounting (SEEA) is an international statistical system that brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy and the impact of the economy on the environment (UN et al., 2012;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

1.2 The SEEA conceptual framework

By using common concepts, definitions and classifications, the SEEA provides a transparent information system for strategic planning and policy analysis which can be used to identify more sustainable paths of development. Because the environmental accounts are

integrated with concepts from the National Accounts, environmental developments and macro-economic developments can be compared directly. Key indicators can be derived from the environmental accounts. These provide insight into sustainability with respect to environmental and economic developments. The integrated nature of the system makes it possible to quantify and analyse the underlying causes of changes in environmental indicators. The SEEA supports sustainable development and green economy policies and can be used to inform research and economic-environmental policies such as climate change mitigation, resource efficiency, natural resource management, evaluation of policy instruments and the development of the environmental goods and services sector.

1.2.1 The SEEA conceptual framework



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

SEEA building blocks

The SEEA comprises three categories of accounts:

1. Physical flow accounts

Physical flow accounts show the origin and destination of materials in the economy and/or the environment, in a similar way to the supply and use tables of the National Accounts. They take into account three types of material flows: natural inputs, products and residuals. Natural resources, such as crude oil, iron ore or wood, are the required

inputs for economic production processes and thus flow from the environment to the economy. Products are materials that are produced or purchased within the economy; for example, energy products, food products and chemical products. Residual flows are materials that flow from the economy to the environment. These include emissions to air (carbon dioxide, sulphur oxides, fine dust), emissions to water (heavy metals, nutrients), emissions to soil (nutrients, etc.) and the production of waste and wastewater. Physical flow accounts make it possible to monitor the pressures the national economy exerts on the environment, in terms of both inputs of natural resources and outputs of residuals.

2. Asset accounts

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

3. Environmental activity accounts

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

Environment statistics and environmental accounts

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

1.3 The Dutch environmental accounts

Statistics Netherlands has a long history in environmental accounting (de Haan, 2004). The bureau first presented an illustrative NAMEA (National accounting matrix including environmental accounts) in 1991. The original design contained a complete system of national flow accounts, including a full set of income distribution and use accounts, accumulation accounts and changes in balance sheet accounts. Statistics Netherlands has gradually extended the Dutch system of environmental accounts. In recent years accounts were developed for air emissions, water emissions, waste, energy and water, material flows, the environmental goods and services sector, and emission permits.
The Dutch environmental accounts are compiled following the general concepts, definitions and classifications as described in SEEA 2012 and the 2008 SNA. More specific information on the methodology can be found on Statistics Netherlands' website (www.cbs.nl). Specific methodological reports are available on some subjects. The data of the Dutch environmental accounts are published in StatLine, the electronic database of Statistics Netherlands.

This publication

The environmental accounts of the Netherlands 2013 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:

Natural inputs and resources
- Energy;
- Mineral reserves;
- Materials;
- Water use.

Residuals
- Emissions to water;
- Greenhouse gas emissions;
- CO_2 emissions per quarter;
- Other air emissions;
- Water quality.

Economic opportunities and policy instruments
- Environmental taxes and fees;
- Environmental goods and services sector.

The topics solid waste, environmental expenditures, environmental subsidies and emission permits are not included in this edition, because these accounts are being revised at the moment. The first update will take place when new results are available.

Part two presents three studies that provide a more in-depth analysis of their specific subjects. Chapter 5 provides an update of the green growth indicators for the Netherlands and the corresponding analysis. Overall, the Dutch economy generally has

become 'greener' since 2001. However, this development takes place gradually and is not yet observed for all aspects of green growth. Chapter 6 explains the theoretical consequences of the new SNA 2008 guidelines for IO analysis. Furthermore, the paper quantifies the effect of the new SNA 2008 guidelines on footprint indicators by reversing the conceptual changes for global manufacturing in the Dutch 2010 after revision IO table and compares the outcomes. Chapter 7 reports on the results of a pilot study, commissioned by the Dutch Ministry of Economic Affairs, whose main objective has been to investigate the possibility to develop natural capital accounts (more specifically ecosystem accounts) for the Netherlands. The research contributes to further testing the SEEA Experimental Ecosystem Accounting guidelines that have recently been developed.

The 2008 SNA revision and its impact on the environmental accounts

In 2014 the Dutch National Accounts have been revised following the international recommendations of the SNA 2008. This also has impact on the data of the Dutch environmental accounts. First of all, all environmental accounts were National Accounts data is used as input for compilation have been revised accordingly. This applies both to the physical (e.g. emission accounts, energy flow account) as monetary accounts (e.g. environmental taxes, EGSS). Second, results for analysis where monetary data from the NA accounts are compared with data from the environmental accounts have changed. This is for example the calculation of environmental intensities or the decoupling graphs. The impact of the SNA revision on IO analysis is described in one of the theme articles. Finally, revised data from the National Accounts were only available from 2001 onwards, so also the environmental accounts data are presented from that year onwards.[1)]

[1)] Longer time series will become available next year

2. Natural inputs and resources

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. In this chapter all important natural inputs for the Dutch economy are presented. First, two important energy related subjects are presented, namely the energy use by production and consumption activities and the remaining natural gas and oil reserves. Second, the water use of Dutch economic activities is presented. Finally, the inputs, throughputs and outputs of goods in the economy in material terms are described. These data support policies that deal with material use, dematerialization and material substitution.

2.1 Energy

Energy is essential to all economic activities as input for production processes and as a consumer commodity. As global demand for energy increases and non-renewable energy resources like crude oil and natural gas become scarce, energy prices increase to a point where they may hamper future economic developments. The impact of economic developments on the environment is related to the use of energy. Energy use is often directly linked to the emission of the greenhouse gas CO_2 and many other environmental pollutants. Improving energy efficiency and decoupling energy use from economic growth are important goals for green growth. The energy accounts represent a consistent framework in which energy data, both in monetary and physical terms, have been integrated into the national accounting framework. Physical energy flow accounts (PEFA) show all energy flows that occur within the economy, with the environment and with the rest of the world. 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 energy use is related to the creation of value added and how dependent the economy is on energy imports.

The methodology of the energy accounts is described in the report *Compilation of physical energy flow accounts in the Netherlands*.

Energy use in the Dutch economy has decreased slightly

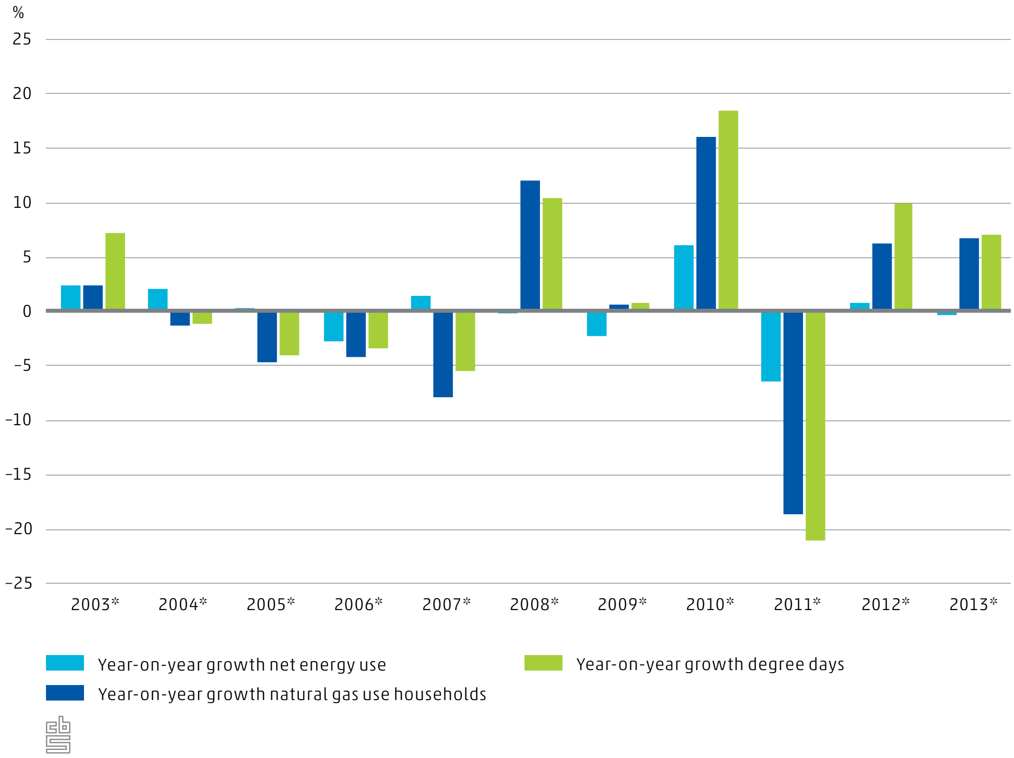
Net domestic energy use[1)] in the Dutch economy decreased by around 0.4 percent in 2013. This marginal decrease is remarkable given the relatively cold winter of 2013. This cold winter did cause the regular increase in the use of natural gas by households and the service sector, but this was compensated by a decrease in the construction, manufacturing and energy sectors.

The weather always has a substantial impact on the total net use of energy. Households and the service sector use more natural gas when a winter is relatively cold.

1) Net domestic energy use is equal to the total amount of energy used in an economy through production and consumption activities. This includes all final energy use for energetic and non-energetic purposes plus conversion losses.

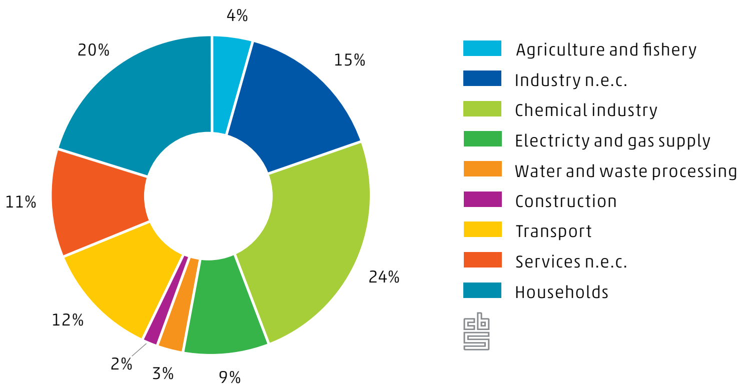
Figure 2.1.1 shows the net energy use developments of the total economy, the natural gas use of households and the development of the number of 'degree days.[2] The year 2013 was colder than 2011 and 2012, which translates into additional use of natural gas by households.

2.1.1 Changes in net energy use in the Dutch economy, the use of natural gas of households and the number of 'degree days'



The current distribution of net domestic energy use among industries and households can be seen in Figure 2.1.2 below.

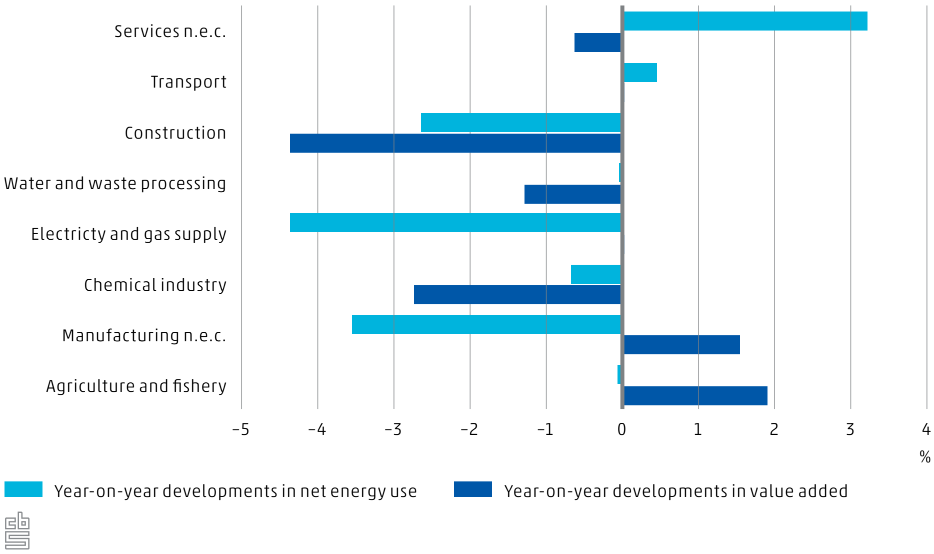
2.1.2 Net energy use in 2013 per sector



[2] Measure for the average outside temperature. If the average temperature on a particular day is x degrees below 18° C, that day counts as x degree days. If the average outside temperature exceeds 18° C, that day counts as 0 degree days.

Together the chemical industry, other manufacturing and electricity and gas supply use up around 50 percent. Households, services n.e.c. and transport also have a major share in Dutch energy use. Figure 2.1.3 below shows the 2012–2013 developments of net domestic energy use and value added of the various sectors of the Dutch economy. There are substantial differences between the sectors in terms of net year-on-year development of energy use.

2.1.3 Changes in net energy use and value added (in constant prices) per sector over the period 2011-2012



Net energy use fell in each sector except services and transport. This came with a reduced value added for some sectors although manufacturing managed to increase its value added without increasing its energy use. So these sectors improved their energy efficiency in terms of value added per joule. Electricity and gas supply also managed to increase its value added per joule by reducing its net energy use while its value added remained constant. This can be explained by a development that started in 2011–2012, when traders in electricity increased their imports by 56 percent. In 2012–2013 imports saw a small increase of just 3 percent. Importing electricity in 2012 and 2013 was favourable because energy from Germany and Norway was available at low prices due to a large surplus in their electricity production. Because the electricity imports require no domestic use of energy, the net use of energy per euro of value added fell.

In contrast to the other sectors, value added fell faster than energy use in the chemical industry and the construction sector. Cold weather probably affected the value added of the construction sector more than its energy use did, while the chemical industry, which largely depends on oil products, faced higher oil prices which affected the value added negatively. In agriculture, most energy is used in horticulture, where the cold weather caused a higher use of natural gas. However this effect was negated by lower use of natural gas for electricity production as a result of the low electricity prices.

Net energy use on the same level as in 2001

The net domestic energy use of the Dutch economy in 2013 was approximately at the same level as in 2001. Accordingly, there is no absolute decoupling between energy use and economic growth with respect to this period. Net energy use rose in aviation, the chemical sector, waste management as well as in most service industries. Horticulture, fisheries, the manufacturing of food products, of textile and leather products, of other non-metallic mineral products, of paper and paper products, publishing and printing, and water transport saw their energy use fall. Households in total also used the same amount of energy as in 2001. So energy use is lower on a per capita basis.

Energy intensity decreased in the last decade

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 changes in the production process, for instance by energy conservation, by systematic changes in the economy, or simply by variation in temperature. The energy intensity of the Dutch economy is 12 percent lower than in 2001. When we correct this for changes in temperature, the efficiency gain is 13 percent. All sectors contributed to this improvement. In 2013, the energy intensity of the economy as a whole decreased by 1 percent.

2.2 Mineral reserves

The Netherlands has significant quantities of natural gas as well as some smaller oil deposits. Since the discovery of these natural resources in the fifties and sixties, they have been exploited for the Dutch economy. The extraction of natural gas makes a significant contribution to the Dutch treasury and GDP.

The reserves consist of the demonstrated and commercially producible quantities of natural gas and oil found in the Netherlands, plus the amount pending development. The opening stock of the reserves is 1 January and the closing stock is 31 December. Definitions and data are in accordance with the Petroleum Resource Management System which has been used by TNO since 2013. But for reasons of consistency with Dutch terminology, we have opted to use reserves rather than resources.
The reserves are not inexhaustible however. Although new reserves are discovered occasionally, about 75 percent of the initial gas reserves has already been extracted to our current knowledge. This chapter addresses the physical and monetary aspects of oil and natural gas reserves.

The methodology for the valuation and compilation of stock accounts for the oil and natural gas reserves is described in the report 'Valuation of oil and gas reserves in the Netherlands 1990–2005', but some assumptions were adapted in the ESA revision of the National Accounts. The most important change is that the unit resource rent is no longer averaged over 3 years, so that the time series better reflects annual price changes.

The physical data of the oil and natural gas resources can be found in the annual reports 'Natural resources and geothermal energy in the Netherlands' and in StatLine.

Production of natural gas decreased

In 2013, the production (gross extraction) of natural gas[3] from the Dutch gas fields amounted to 84 billion standard cubic metres (Sm^3),[4] compared to 78 billion Sm^3 in 2012. Total production was up 8 percent on 2012. The main explanation for this rise lies in increased foreign demand in physical terms: the exports of natural gas grew by about 10 percent, while domestic demand rose only by about 1 percent.

2.2.1 Physical balance sheet of natural gas

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
	billion Sm^3											
Opening stock	1,865	1,997	1,836	1,572	1,510	1,439	1,390	1,364	1,390	1,304	1,230	1,130
Reappraisal	248	–45	–59	–62	–71	–49	–26	26	–86	–74	–100	–86
new discoveries of natural gas	33	15	25	15	9	5	3	3	5	6	4	0
re-evaluation of discovered resources	287	18	–17	–46	–9	14	52	95	–5	–2	–25	–2
gross extraction	–72	–78	–68	–73	–71	–68	–80	–74	–86	–79	–78	–84
underground storage of natural gas[1]	–	–	1	0	0	–1	1	0	2	2	1	0
other adjustments	0	0	0	42	0	2	–2	1	–2	–2	–1	0
Net closing stock	2,113	1,952	1,777	1,510	1,439	1,390	1,364	1,390	1,304	1,230	1,130	1,044

Sources: TNO/Ministry of Economic Affairs, 1988–2014 and Statistics Netherlands (2013); http://statline.cbs.nl 'Natural gas and oil reserves on the Dutch territory'.

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

At the end of 2013, the remaining expected reserves of natural gas in the Netherlands were estimated at 1,044 billion Sm^3. Assuming that the net annual production remains constant at its 2013 level, the Dutch natural gas reserves are enough to last another 12 years.

Production of oil stable

The production of oil remained stable at 1.3 million Sm^3 in 2013. The total expected oil reserves were estimated at 47.1 million Sm^3 at the end of 2013. This is 2 percent lower than in 2012.

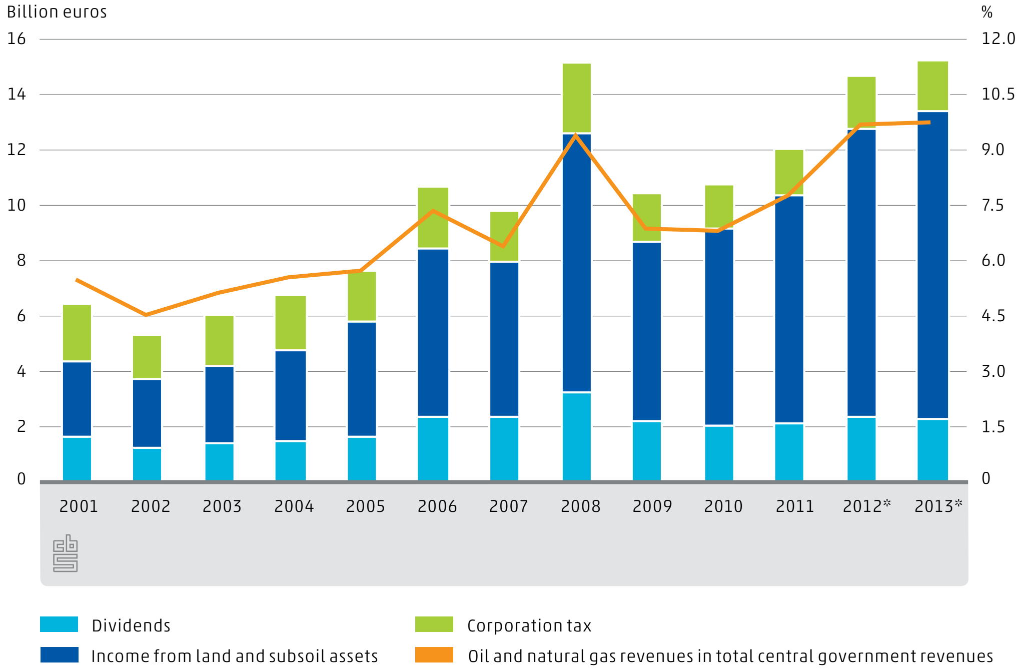
Highest government revenues from oil and natural extraction on record

Around 80 percent of the resource 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. The government revenues consist of dividends, corporation tax and income from land and subsoil assets in the form of concession rights. In 2013 government revenues from oil and gas amounted to 15.2 billion euros, the highest amount since extraction began in the late 1960s. It is an increase of 4 percent

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

compared to 2012 and equal to a 9.7 percent contribution to central government revenues. It is the highest relative contribution on record due to a combination of high natural gas revenues and a shrinking government budget. The benefits from oil and gas extraction have contributed an average of 7.1 percent to the total revenues of the Dutch central government since 2001.

2.2.2 Oil and natural gas revenues and their share in central government revenues



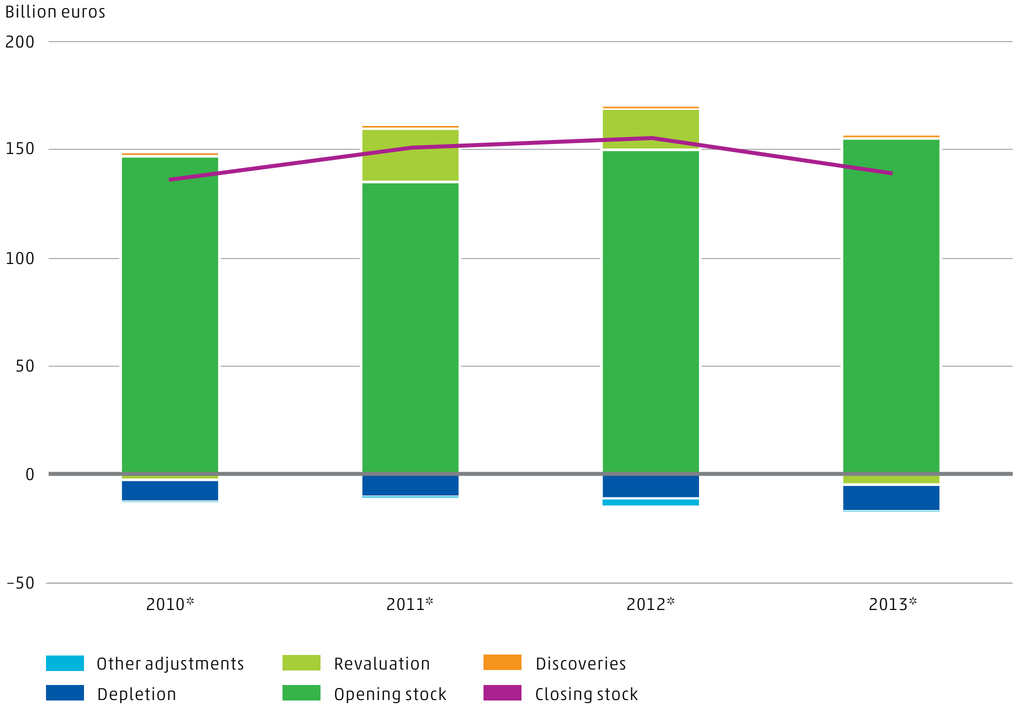
Source: Statistics Netherlands (2014); http://statline.cbs.nl Table 'Overheid; inkomsten en uitgaven'.

Value of gas reserves decreased by 10 percent

At the end of 2013, the value of the producible reserves of natural gas amounted to 139 billion euros.[5)] This is a decrease of more than 10 percent compared to 2012 when the reserves were estimated at 156 billion euros. Figure 2.2.3 shows the importance of revaluation and depletion in explaining the changes in value over time. Revaluation, which reflects price changes for natural gas, caused a downward adjustment of 5 billion euros in 2013, whereas it had caused an upward adjustment of 18 billion euros in 2012. Depletion occurs as a result of extraction at the expense of the reserves. In 2013 depletion amounted to more than 11 billion euros, up 5 percent on 2012. Finally, we see that discoveries only play a minor role in value terms. By comparison, the value of oil reserves amounted to 8 billion euros at the end of 2013.

[5)] In the absence of market prices, the value of oil and gas reserves has been derived with the net present value methodology in which assets are valued as discounted streams of expected resource rent. With the SNA revision, in addition to recalibration of the source data, the method used to value natural gas has been updated.

2.2.3 Decomposition of changes in the value of natural gas

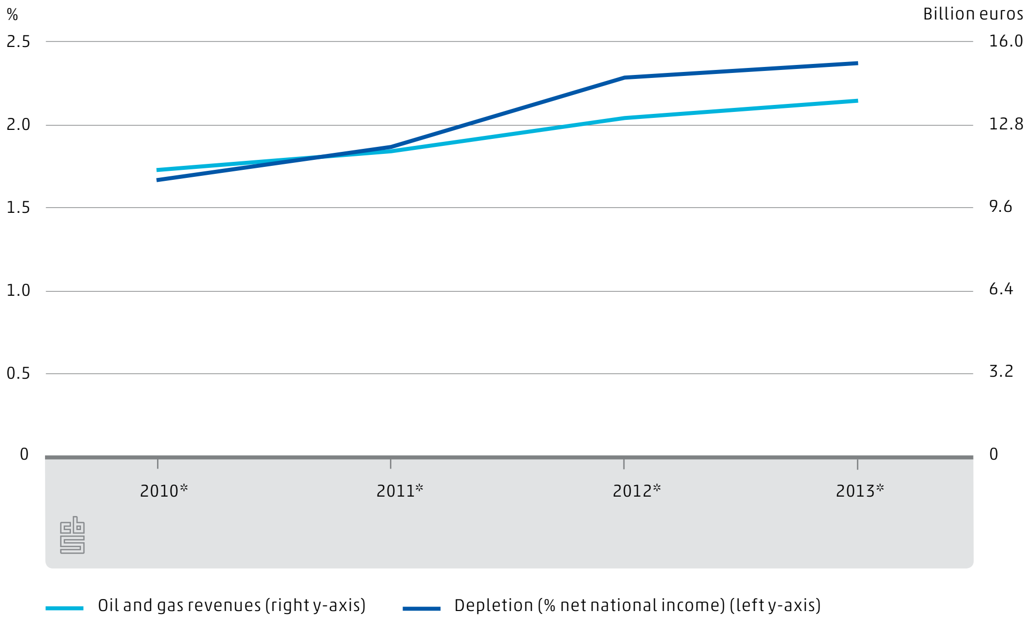


Depletion of oil and gas reserves reduces net national income by 2.1 percent

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 resources as income. The extraction hampers future opportunities for production and income. So the depletion costs should be properly offset against income, just as the depreciation of produced assets is treated via the 'consumption of fixed capital'. This would constitute equal treatment of natural and produced capital used in production.

In the SEEA, balancing items of the current accounts, such as net income and savings, are adjusted for depletion in addition to consumption of fixed capital. As shown in Figure 2.2.4, the depletion of the Dutch oil and natural gas reserves caused a 2.1 percent downward adjustment of net national income in 2013. The adjustment to net national income shows an upward trend in the period 2010–2013, keeping up with the observed increase in revenues from oil and gas extraction.

2.2.4 Oil and gas revenues and depletion



2.3 Water use

Water plays a key role in the Dutch economy and in society as a whole. Water from natural resources finds its way as uptake and transpiration of soil water by natural vegetation and in agriculture. Water also is abstracted and used either as a direct input in production processes such as for cooling, or more indirectly such as for watering crops and animals in agriculture. The water supply industry abstracts large amounts of fresh water, mainly to produce tap water of drinking water quality. It also produces 'industrial water', also called 'other water'[6], that is subsequently used by industries and households. When we use the term 'tap water' in this chapter it refers to 'tap water of drinking water quality'. So industrial water is excluded from this term, unless indicated explicitly. Referring to its source a distinction can be made between flows of surface water and groundwater. Given the importance of water, there are a variety of policies in place to reduce water pollution and protect ground and surface water bodies qualitatively and quantitatively. The water accounts provide information on water abstraction and on water supply and use by different industries and households. Integrating water data with economic and monetary information on water makes it possible to monitor water conservation policies and particular instruments.

The methodology and sources used for compiling the water flow accounts are described in the reports *Dutch water flow accounts* (Graveland, 2006) and in *Water abstraction*

[6] 'Other water', ('industrial water') is water of different quality than tap water of drinking water quality. This may be partially treated water, for instance, pre-treated surface water, or water that has been optimised to the needs of the business market, for instance, distilled and demineralised water (VEWIN, 2013). This water is produced by water companies or other industries and delivered to other companies, particularly the chemical industry (VEWIN, 2012). The delivery of 'other water' by the water companies is separated from the calculations of drinking water presented in this chapter. As such tap water is split into drinking water and 'other water' (See also Baas and Graveland, 2014). If the delivery of 'other water' would be included in the calculations this would add another 6–7 percent to total use of tap water.

and – use at River Basin Level (Baas and Graveland, 2011). The data of the water accounts can be found on Statline, the electronic database of Statistics Netherlands.[7)] The temporal coverage of the figures in this chapter differs, depending on the availability of historical data. Generally 2001–2012 are covered and in some cases 2013 figures are included as well.

Less groundwater and substantially less surface water abstracted by the Dutch economy in 2012

The total abstraction of groundwater by the Dutch economy in 2012 amounted to 940 million m^3, which is a reduction of over 4 percent compared to 2011. Abstraction by agriculture decreased substantially compared to 2011 and 2010. The late spring was wet and required less water for irrigation. Abstraction from surface water amounted to 14.0 billion m^3 in 2012, which is 9 percent less than in 2011 and equal to 2010. This is mainly explained by a sharp decrease among the electricity supply companies which lowered their production, and to lesser extent for agriculture and the refineries. The water supply companies also abstracted 2 percent less surface water.

Groundwater abstraction down since 2005

Fresh groundwater is a scarce resource in the country and should be managed with care. Efforts to deal with this scarcity already started in the sixties, first with a regional and local focus, and later national policies came in. National and local regulations and efficiency gains have resulted in a reduction in groundwater abstraction by the Dutch economy over a longer period of time.

The aim today is to look for further reductions as the easy options for reduction are picked already. Reducing the water intensity of production activities in the country today is an aim where economic prosperity (not necessarily growth in recent years) can be combined and sustained with progress on minimising environmental and resource burden. In the Dutch context, this is particularly relevant for fresh groundwater, as source and extractions have had scarcity issues in recent years. Fresh groundwater has proven to be a scarce resource during parts of the growing season, mainly in spring or summer. These lasting dry circumstances have led to substantially lower groundwater levels with negative effects for several economic activities, for constructions, buildings and for nature. This is even more relevant in certain areas particularly on the sandy soils.

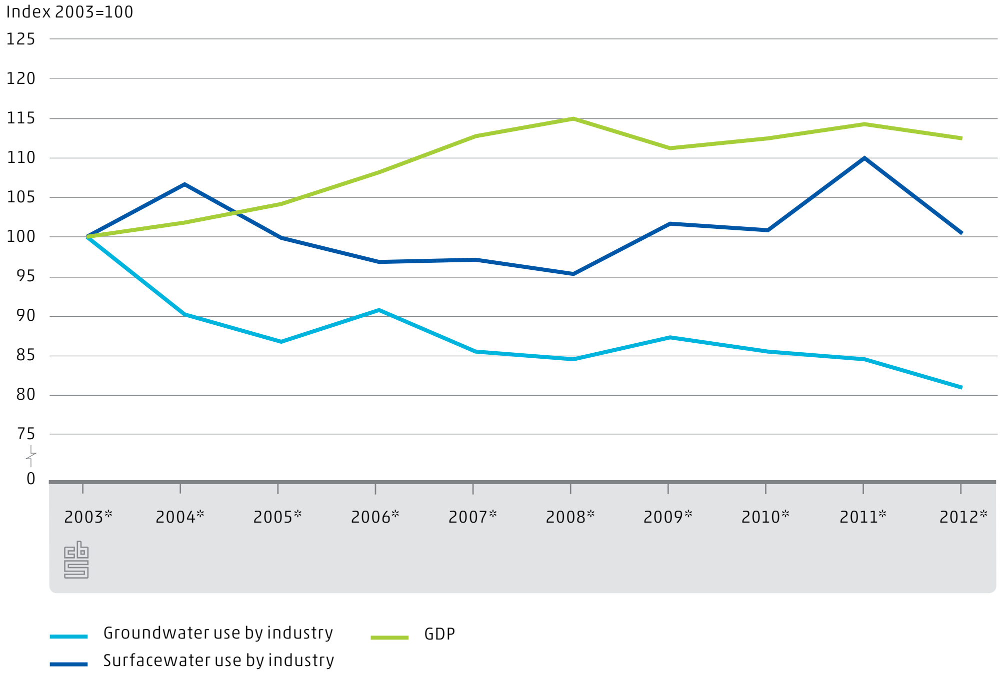
Large quantities of fresh and marine surface water are used for cooling. Surface water is abundant in the delta areas of the large rivers Rhine and Meuse along the North Sea. Surface water is less scarce, although quality concerns limit opportunities for economic abstraction and use under certain circumstance such as peaking discharges by industries or after a drought. Such concerns may originate from the quality aspect of the fresh water bodies and requirements for aquatic life that need to be safeguarded. Long hot dry spells may even result in fish mortality. Abstractions of surface water may then be

[7)] Longer time series are also available in data file: *water use industry and households 1976–2001*, although these are compiled according to previous method. In the current Statline tables, figures are compiled following 2014 methodology.

restricted, limiting further heating of the surface water bodies by the discharges of cooling water.

In figure 2.3.1 we compare the development of Dutch GDP with abstractions of ground and surface water since 2003.[8)] Economic performance measured by GDP has gone up by 15 percent in the 2003–2012 period, an average growth of 1.6 percent, while the abstractions of fresh and sometimes scarce groundwater have been cut by almost 20 percent. Abstractions of surface water have seen a kind of stable development where the 2012 level equals the 2003 level, although there are some fluctuations depending on the weather conditions in a particular year. The main purposes of use here is cooling in power production, so surface water use is largely determined by power production and to a lesser extent by the production in the chemical and basic metal industry. Crops in the Netherlands are predominantly grown under rain-fed conditions, relying on existing fresh water resources as groundwater, soil water and indirectly also surface water. Normally these fresh water sources are replenished in the course of the year. In addition fresh surface and groundwater is abstracted mainly for watering livestock and for irrigating crops such as green maize, and pastures.

2.3.1 Volume change GDP, groundwater and surface water abstraction for production activities



[8)] Current data only allow comparison for time series from 2003 onwards as a consequence of revisions in compilation of ground- and surface water.

Per capita household use of tap water declined after 1990 peak

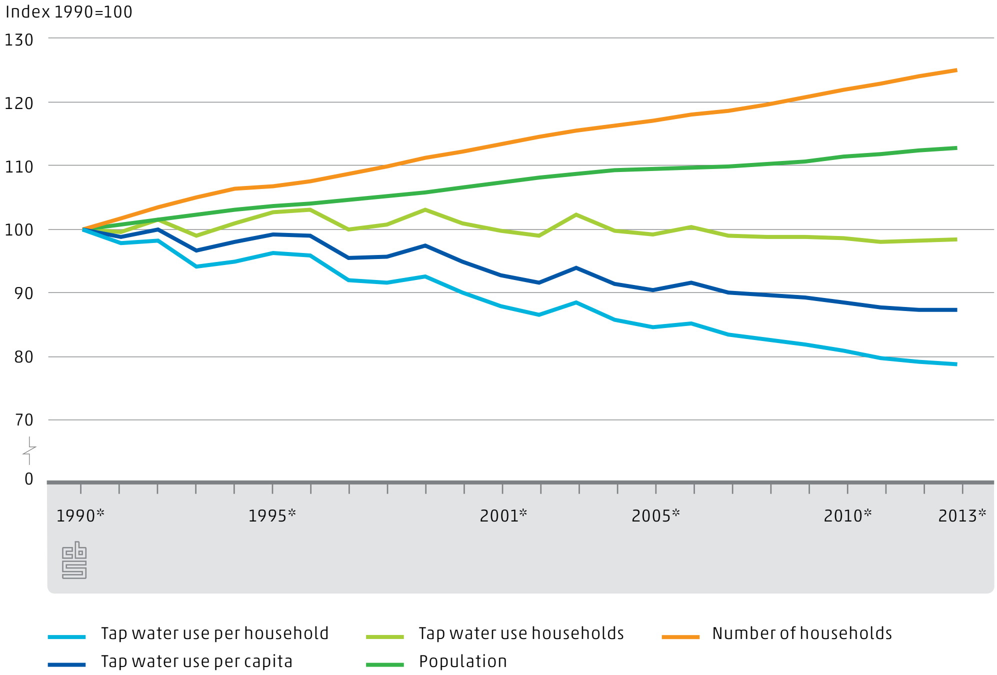
In 2012, 7.1 percent of the total volume of water abstracted from ground and surface water in the country was turned into tap water of drinking water quality supplied by the water supply companies. For groundwater alone this was 80 percent. Moreover, about 0.5 percent of the volume of abstracted water by these companies is destined for industrial water (VEWIN, 2012). Some other companies also supply other water/industrial water, mainly on industrial sites (See also Baas and Graveland, 2014).

Total use of drinking quality tap water in 2013 amounted to 1,076 million m^3. Households account for around 72 percent of overall drinking water use. Since 1990, the total annual amount of tap water used by households has decreased by 2 percent while the Dutch population increased by 13 percent.
In 1990 tap water use by households was 147 litres a day (54 m^3 per person per year). After this peak in 1990, per capita water use was systematically reduced to the 128 litres of 2013. There were some fluctuation over the years depending on the weather conditions. For example 1995, 2003 and 2006 with particularly hot and dry summers show higher uses, with per capita water use exceeding the long term average by 3 percent as people took more showers and plants needed more watering. The drop in the water use after 1990 can be explained by the availability and purchase of more efficient household appliances, water saving toilets and showerheads. The taxes that were implemented from 1995 onwards, namely the tax on groundwater abstraction and the tap water tax itself[9)], added incentives for extra water saving measures. The tax on groundwater abstraction, presumably largely transferred to the end users, was abolished at the start of 2012 though, reducing the incentives for further reductions.

Daily tap water use per household peaked at 361 litres in 1990, and was down to 284 litres in 2013. This is a 21 percent reduction in 23 years that leaves a volume of 104 m^3 per year for an average household. The drop in water use per household from 1990 onwards can be explained by the on-going trend towards smaller households together with the decreasing use of tap water per person as discussed above.

9) In Dutch: Belasting op leidingwater (BOL). The groundwater tax was from 1995 up to 2012.

2.3.2 Changes in tap water use by households, population size and household number



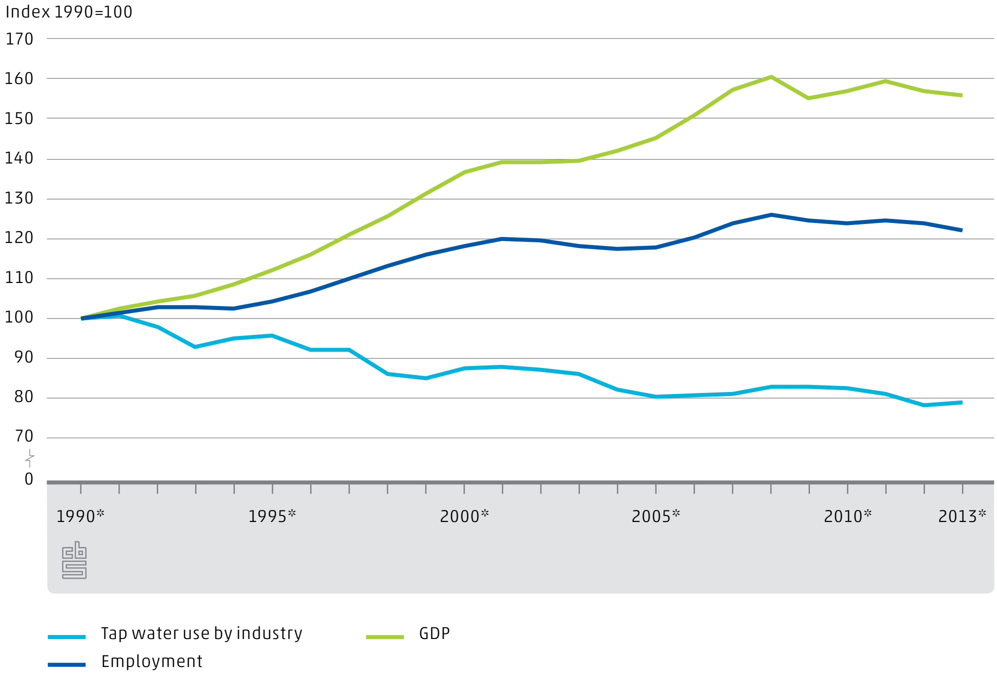
Source: VEWIN, 2014; 2013, 2012, 2010; StatLine 2014.

Tap water use by industries stable since 2005

The use of tap water by businesses has fallen by over 20 percent between 1990 and 2013 as a result of investments in water saving processes in manufacturing and efforts to save tap water. Tap water may also be replaced by groundwater and/or surface water obtained from own abstractions for various reasons. Since 2005 the tap water use by businesses has been relatively stable. After a small drop in 2012 it has gone up again in 2013.

In 2013 the use of tap water by businesses increased by 1.1 percent on 2012, while GDP dropped by 0.7 percent. As a result tap water use intensity has gone up in 2013. The food and beverage manufacturers, the chemical industry, and animal husbandry are extensive users of tap water.
The use of tap water by agriculture shows a slight downward trend and amounts to an average of over 5 percent and in 2012 to less than 4 percent of total tap water used in the Netherlands. Drinking water for cattle and other livestock is a major category of tap water use. Tap water use for drinking purposes has shown a downward trend in recent years, particularly since 2009 and has dropped from 26.9 million m^3 in 2001 to 21.3 million m^3 in 2012.

2.3.3 Volume changes in GDP, employment and tap water used for production activities[1)]



Source: VEWIN, 2014; 2013; 2012; 2010; StatLine 2014.
[1)] GDP and employment time series, combines 2001–2013 based upon ESA 2010 revision and 1990–2000 time series based upon previous ESA guidelines.

Water use intensity further on a downward track

An industry's water use intensity can be defined as its use or abstraction of water in litres divided by its value added[10)] expressed in euros. Since 2003 the size of the economy in terms of value added had grown by 15 percent in 2012[11)], while tap water use was reduced by almost 10 percent. So within nine years the tap water use intensity of the production activities in the Dutch economy has been reduced by 21 percent, implying an average annual reduction of over 2.5 percent. Almost all industries have been able to reduce their tap water use intensities in the 2003–2012 period.

Between 2003 and 2012, an average of 0.55 litres of tap water (drinking water) were used for every euro of value added generated by the Dutch economy (figure 2.3.4). In 2012 this was down to 0.50 litres per euro, a little less than the 0.51 litres in 2011 and significantly less than the 0.63 litres in 2003. Livestock breeding, the manufacture of petroleum products, cokes, and nuclear fuel and other mining and quarrying again showed the highest water use intensity rates, followed by the manufacture of food products, beverages and tobacco, recreational and sporting activities and recycling (excl. waste processing). In 2012, the 16 industries with the highest water use intensity

[10)] Value added is expressed in constant year 2010 prices.
[11)] Comparison is made to 2003 for consistency reasons throughout the chapter. There is no data available at meso level before 2003.

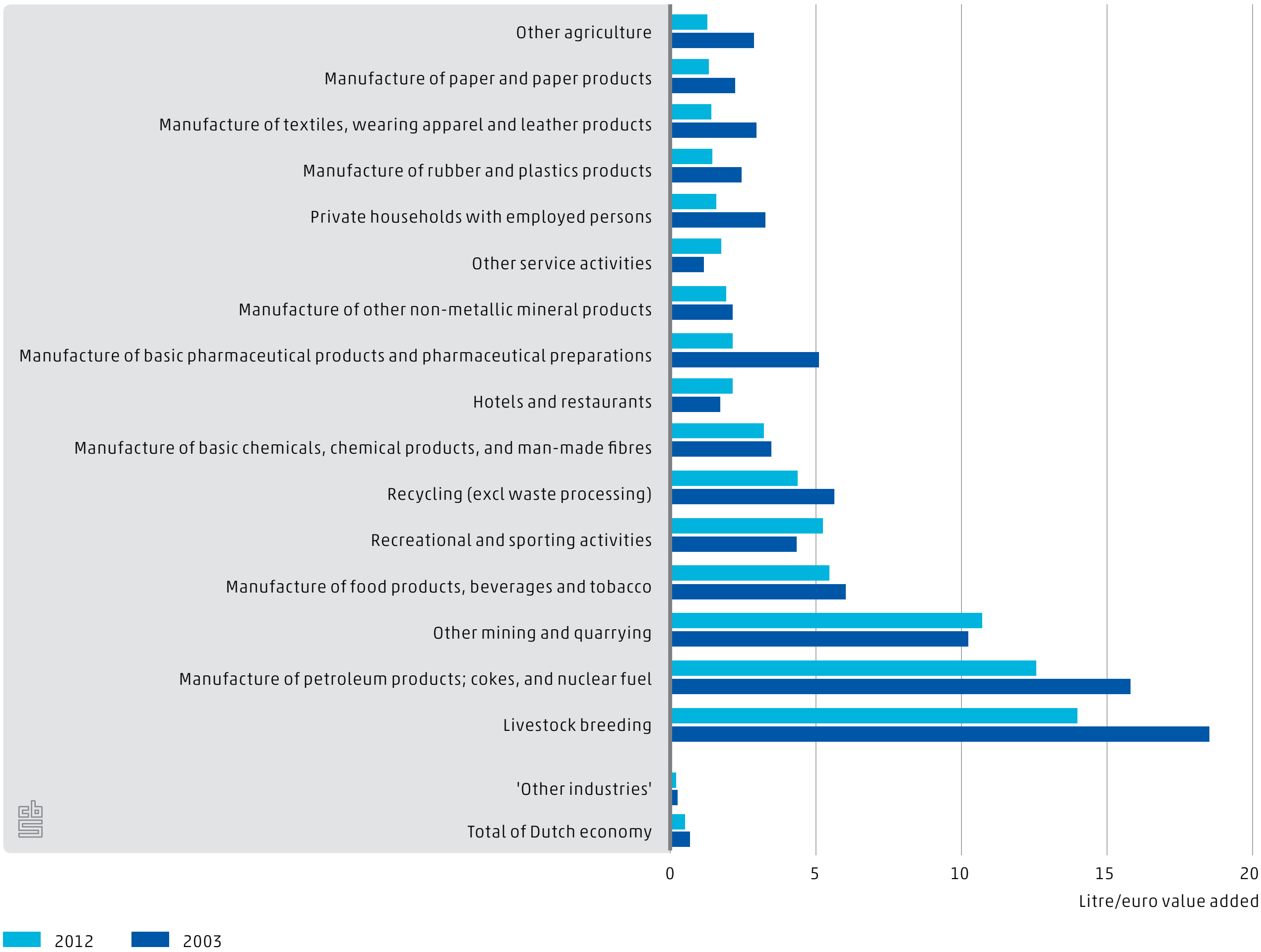
rates (figure 2.3.4), used up to eight (7.8) times more water to earn a euro than average for the Dutch economy.[12)]

One should interpret the order of industries in figure 2.3.4 with caution. This figure shows the tap water use excluding the use of industrial water, so the industries that use up substantial amounts of industrial water have lower intensities compared to the intensities for the complete amounts of tap water (including industrial water). This industrial water use is primarily relevant for few large heavy industries:

4. the chemical industry, manufacture of basic chemicals, chemical products, and man-made fibres;
5. manufacture of basic metals;
6. electricity, gas, steam and air conditioning supply;
7. manufacture of petroleum products, cokes, and nuclear fuel and;
8. few much smaller ones (see also Baas and Graveland; 2014).

This substantially affects the sequence of the drinking water intensity. The manufacture of basic metals for example is no longer even part of the 16 most use intensive industries for tap water in the country.

2.3.4 Industries with the highest tap water (drinking water) use intensities



This figure refers exclusively to tap water of drinking water quality.

[12)] This figure may be slightly underestimated as for several industries that use small amounts of groundwater, the precise abstractions are not known.

2.4 Material flows

Introduction

The global demand for natural resources is gradually increasing, mainly as a result of the growing population and of economic growth. According to the latest OECD prognosis, the world population will increase from the current 7 billion to approximately 9 billion by 2050. Moreover, the OECD expects the scale of the world's economy to increase fourfold during the same period. The economic share of the BRIICS (Brazil, Russia, India, Indonesia, China and South Africa) countries is expected to increase strongly. As the middle classes in the BRIICS countries grow, so will their consumption of material intensive commodities such as improved housing, cars, electrical equipment and food, in particular meat. This in turn leads to even faster resource depletion and higher commodity prices.

The main drivers of global economic growth include the on-going industrialisation and technological advancement, a process that is increasingly dependent on exotic materials. Therefore, the access to natural resources has become a key geopolitical factor for further economic development. The Netherlands and other European countries have relatively little access to natural resources domestically. Part of the Dutch economy depends on natural resources, and is therefore vulnerable to price fluctuations and the availability of such resources. Insight in these dependencies is the first step in securing the supply of the relevant natural resources in the future.

There are several ways to increase our understanding of the Dutch natural resource dependency. One could look at issues like import dependency, resource efficiency (e.g. recycling and waste treatment) and the Dutch place in the production chain (raw, semi-finished, finished). This chapter will focus on Dutch resource efficiency and import dependency by looking at trade, domestic extraction and consumption and the regions of origin of the Dutch imports.

The figures that are presented in this chapter should be interpreted with the following definitions and concepts in mind:

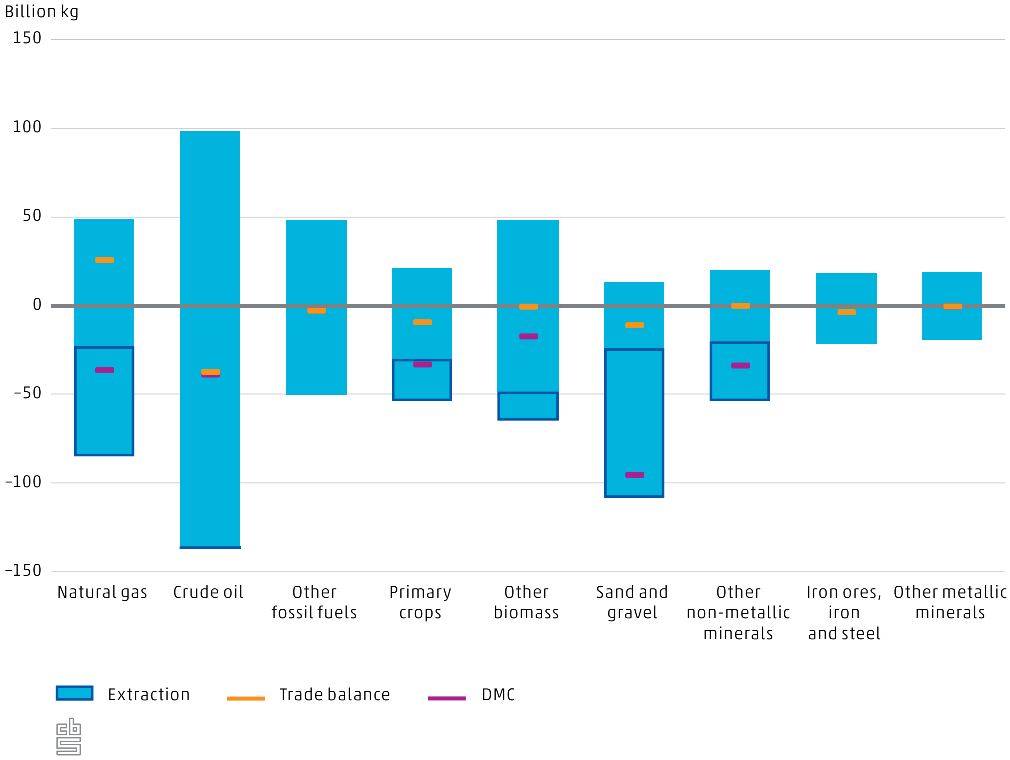
- **Fossil fuels**: Energy sources like coal, crude oil, natural gas or fossil fuel products such as plastics.
- **Biomass**: Plant or animal material, such as crops, timber and derived products such as food products.
- **Metallic minerals**: Iron ore and non-ferrous metals such as copper, zinc or metal products such as cars.
- **Non-metallic minerals**: Inorganic minerals such as chalk, salt, sand or other non-metal mineral products such as glass.

The category to which a product is assigned usually depends on its main ingredients. This is why a car, which does not only contain metal, is categorised as a metal product. Plastic, which requires a lot of crude oil in the production process, is categorised as fossil fuel. However, the system is not rigid, as some products such as toys or furniture that are assigned to the 'other' category, may contain mainly plastic or wood.

Imports, exports and domestic material consumption

The fully filled parts of the bars represent the exports (positive values) and the imports (negative values) and the fully enclosed parts represent the extraction (negative values). The yellow horizontal bars represent the trade balance and the red horizontal bars the domestic material consumption (DMC) of each resource. The DMC equals extraction plus imports minus exports. They can also be considered an estimate of the trade balance when that resource is not domestically extractable/available. The difference between the trade balance and DMC is especially large for 'natural gas' and 'sand and gravel'. This implies that when domestic natural gas is depleted, substantial additional imports of natural gas, or export restrictions, will be required to sustain the current levels of natural gas use. Something similar holds for domestically extracted sand and gravel use, although depletion of domestic sand and gravel stocks is less of an issue.

2.4.1 Import, export and trade balance, 2012

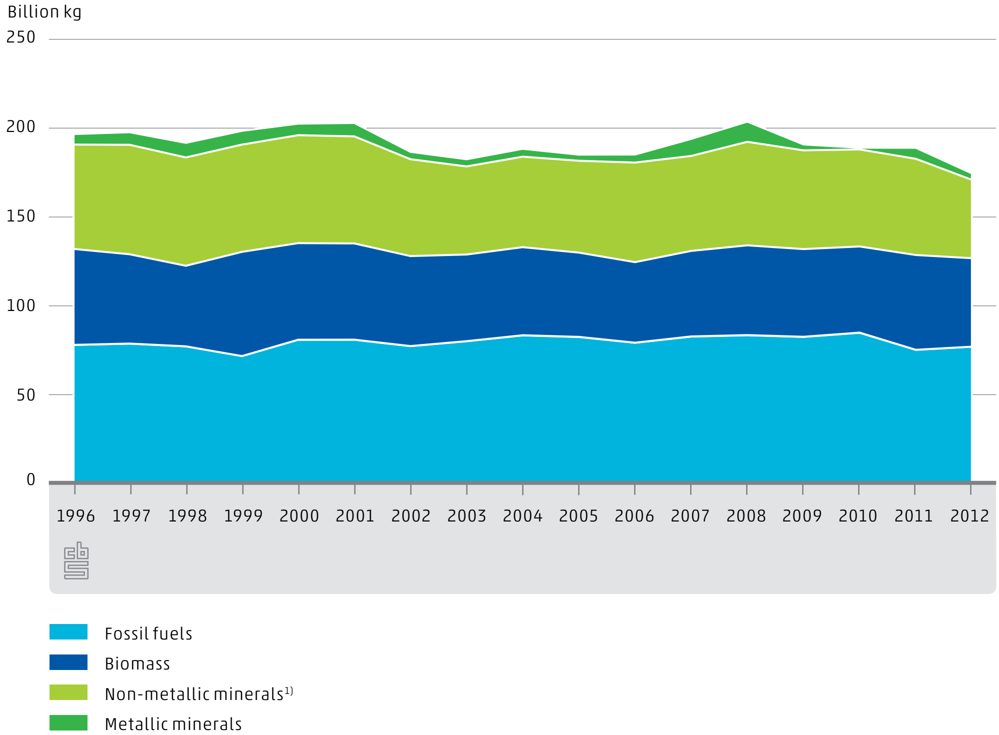


Domestic use of 'primary crops', 'other biomass' and 'other non-metallic minerals' is also significantly supported by domestic extraction. There is no domestic extraction of 'crude oil', 'other fossil fuels' (mainly hard coal), 'iron ores, iron and steel' and 'other metallic minerals' and so for these resources the Netherlands is dependent on other countries. However, the magnitude of the trade balance of these resources is relatively small compared to their total imports and exports, which implies that most of these imports mainly serve as re-exports or as inputs for exports.

On a more aggregate level, total Dutch DMC broken down by fossil fuels, biomass, non-metallic minerals and metallic minerals, shows that domestic material consumption has been decreasing between 1996 and 2012. In fact, total DMC decreased by 11 percent

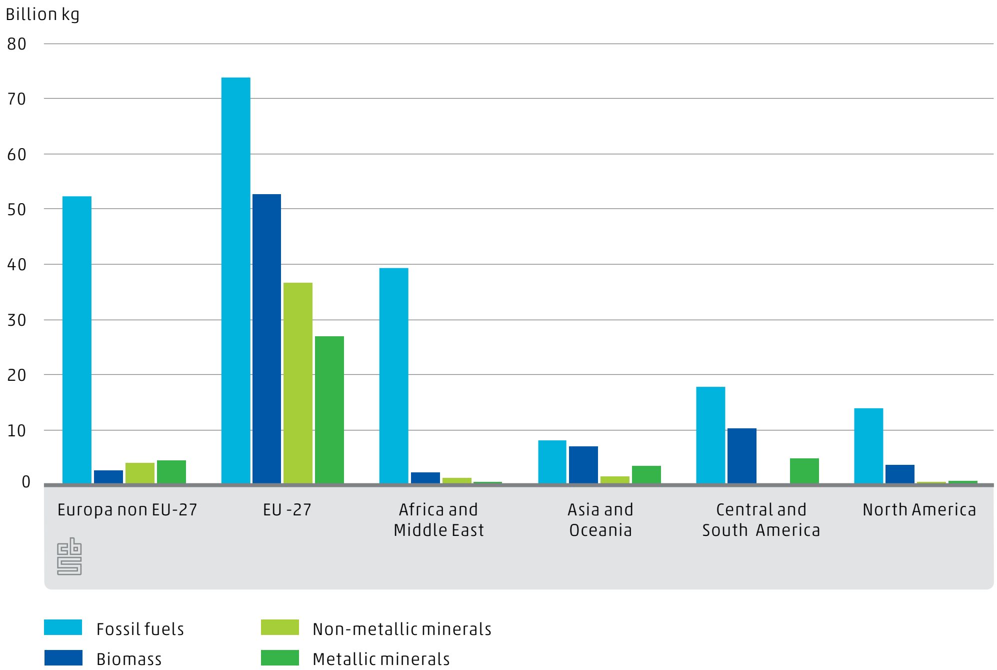
during this period, although a substantial part of this decrease took place in 2012 and so it remains to be seen whether this trend endures. The 11 percent can be broken down as follows: metallic minerals (–1.1 percent), non-metallic minerals (–2.1 percent), biomass (–7.3 percent) and fossil fuels (–0.5 percent).

2.4.2 Domestic material consumption (DMC)



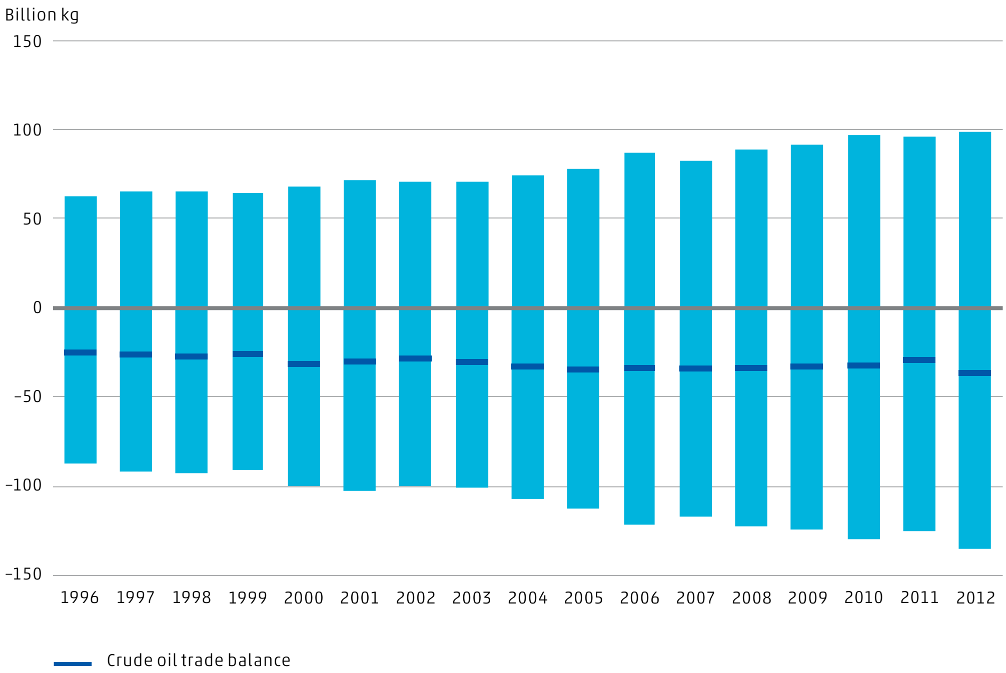
[1] Excluding excavated earthen materials, e.g. sand that was used for the expansion of the harbour of Rotterdam, i.e. 'de tweede Maasvlakte'.

2.4.3 Physical imports from different regions, 2012



In order to zoom in further on foreign dependency and supply security, we separated the trade flows into imports from different regions. The bulk of Dutch imports for most materials comes from within the EU-27, including imports that serve as re-exports. Energy carriers form the exception, as they are imported from inside and outside the EU-27. In fact, 35 percent of energy carrier imports comes from within and 44 percent comes from outside the EU-27 (e.g. Russia) and Africa and the Middle East (e.g. Saudi Arabia). A substantial part of these imports in energy carriers consists of crude oil, so we looked at how the trade in crude oil has developed in 1996–2012.

2.4.4 Physical imports (positive) and exports (negative) of crude oil



Over the period 1996-2012, the volumes of imports (negative values) and exports (positive values) have increased by 55 and 58 percent respectively. This implies that the Netherlands has increasingly been re-exporting crude oil. In the same period, the trade balance, represented in dark blue, decreased from 25 billion kg in 1996 to 37 billion kg in 2012. This is a 46 percent decrease, implying that the Dutch economy has become substantially more crude oil intensive between 1996 and 2012.

3. Residuals

Residuals 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. This chapter first discusses the emissions to water. Next, the emissions of greenhouse gases and other pollutants to air by the Dutch economy are presented. CO_2 emissions are shown for the first and second quarter of 2014. Finally, water quality data are presented, comparing the water quality between 2012 and 2009 building on the experimental water quality accounts.

3.1 Emissions to water

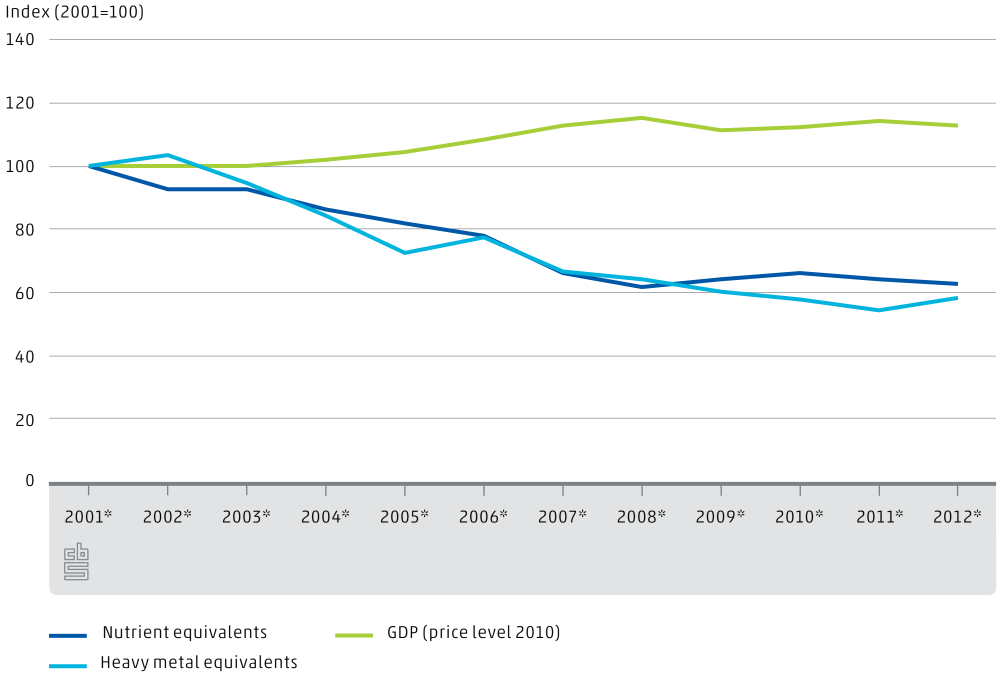
The availability of clean water is essential for humans and many other species on earth. However, nowadays surface waters are continually exposed to discharges of harmful substances by industries and households. These substances can cause severe damage to ecosystems in ditches, rivers and lakes. Therefore,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

The water accounts provide information about the emissions to water by industries and households and are fully consistent with the concepts of the National Accounts. More information can be found in *Emissions to water, methodology* on the website of Statistics Netherlands. Due to its consistency with the National Accounts, it is feasible to compare its physical emission data with economic indicators such as value added. This consistency also suits environmental-economic modelling.

Emissions to water decrease

The relation between economic growth and the emissions to water is an indicator for the environmental performance of an economy. If the emissions decrease with respect to economic growth, this indicates improved environmental efficiency. Run-off and seepage by agriculture are excluded in the analyses in this section, because these two sources are very dependent on the weather and therefore have a great influence on the figures of nutrients in agriculture. For example, in 2012 emissions of nutrients in agriculture were 9.3 billion nutrient equivalents. Without run-off and seepage, the discharge was almost 841 thousand nutrient equivalents.

3.1.1 Emissions to water and GDP

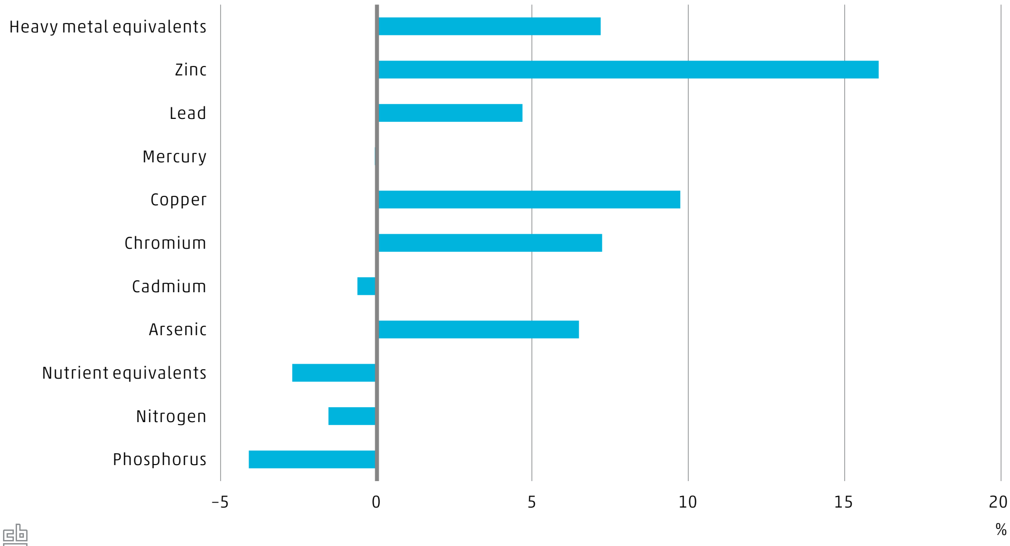


In terms of GDP, the Dutch economy grew 13 percent between 2001 and 2012, while in that same period the emissions of heavy metals were reduced by 46 percent and nutrient emissions by 35 percent. With regard to 2012, nutrient emissions continued to decrease but emissions of heavy metals went up for the first time since 2001.

When we zoom in on the emissions of different metals in recent years, we see that the increase in zinc emissions was the largest contributor to the total increase of heavy metals between 2011 and 2012, followed by copper. Mercury emissions did not contribute to the total increase that occurred. Cadmium was the only metal with lower discharges. The increase of heavy metals emissions in 2012 was primarily caused by the manufacturing of metal products and chemical products. Also the amount of heavy metals in the effluents of Urban Waste Water Treatment Plants (UWWTP's) increased, especially effluents of zinc and copper. 2011 was a dry year with less than average precipitation whereas 2012 was wetter than average. This is the main reason for the increase of the loads of copper (+55 percent) and zinc (+60 percent) from atmospheric deposition on paved surface areas draining into the sewer system and subsequently to UWWTP's.

In contrast with heavy metals, the discharge of nutrients decreased in 2012 as well as the discharge of the underlying substances nitrogen and phosphorus. There was less discharge in the manufacturing of food products and of chemical products. Increased emissions of nitrogen and phosphorus were reported in other industries, but the net result is an overall decrease.

3.1.2 Emissions to water net approach, 2011-2012

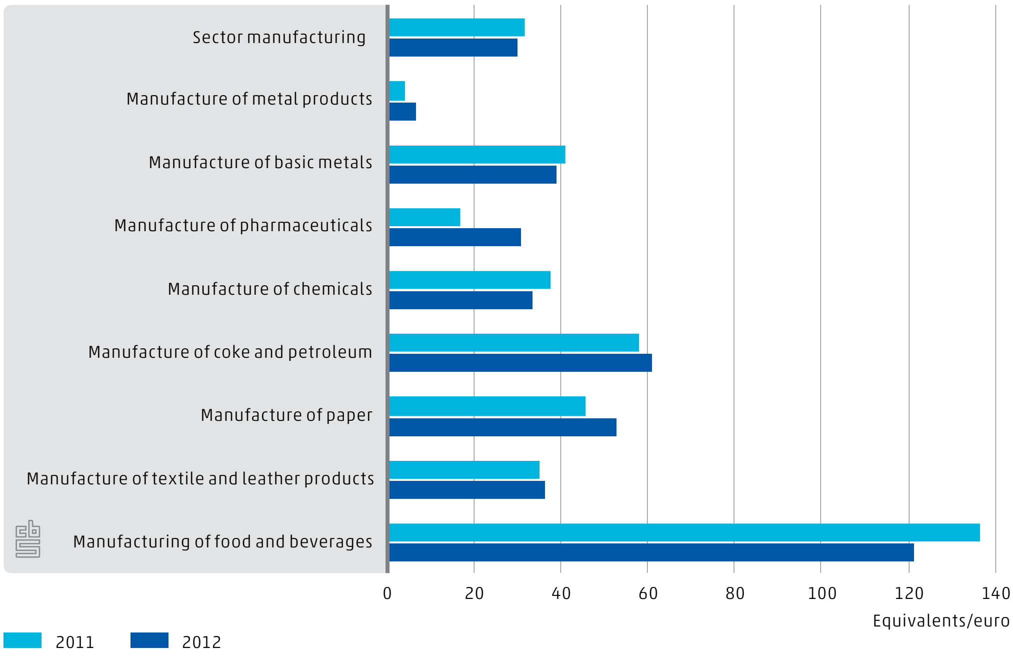


Emission intensities of nutrients in manufacturing

The emission intensity is a measure for the environmental efficiency of production processes. It is equal to the total emission divided by value added. In 2011, the emission intensity of manufacturing as a whole was equal to almost 32 equivalents per euro. In 2012 this decreased slightly to 30 equivalents per euro. Within manufacturing there are significant differences. The biggest polluter, measured as total emission divided by value added, is manufacturing of food products, with an intensity of more than 136 equivalents per euro in 2011. Here the processing of agricultural products is responsible for the high nutrient emissions. Another big polluter is the sector manufacturing of coke and petroleum (refineries). In 2011 the emission intensity of this sector was 58 equivalents per euro. In 2012 this increased to 60 equivalents per euro.

In 2011 manufacturing of food products had a share of more than 80 percent in the total emissions of phosphorus for total manufacturing. In 2012 it came to almost 76 percent. Its share in the total emissions of nitrogen was 58 percent in 2011 and almost 55 percent in 2012. Due to strict standards, the total discharge of nutrients for manufacturing was lower in 2012 than in 2011.

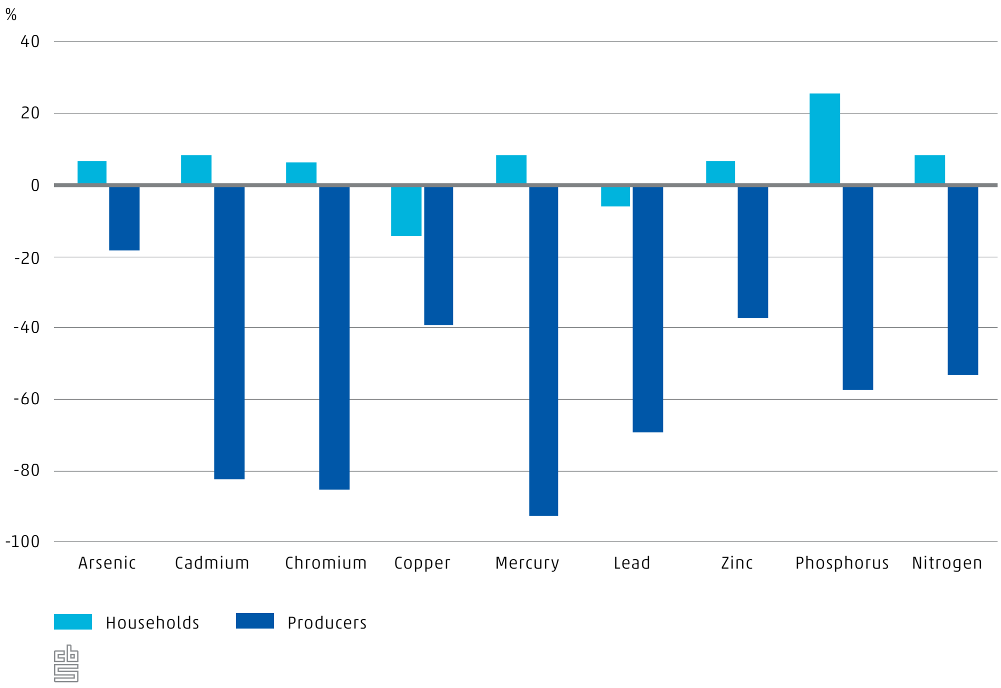
3.1.3 Emission intensity of nutrients sector manufacturing



Households emitted more in 2012 than in 1995

Compared to 1995, the discharge of emissions by households had increased for almost all substances in 2012. The main cause is the growing population. Copper and lead are the exceptions. The decrease of discharge of copper and lead by households is mainly caused by using less copper coatings in recreational shipping and by using less load in bullets for hunting.

3.1.4 Changes in emissions to water 1995-2012 by households and producers



In the period 1995–2012 the discharge of emissions by producers decreased for all substances, for some substances by more than 80 percent even. This is due to the strong measures producers have taken to reduce emissions, as a result of policy measures and European Directives. Also a few major polluters in the chemical industry have been closed, which caused a sharp drop in the emissions of nutrients and heavy metals.

3.2 Greenhouse gas emissions

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. Accelerating emissions of carbon dioxide, methane, and other greenhouse gases since the beginning of the 20th century have substantially increased the concentration of greenhouse gases in the atmosphere. As a result the average global temperature rose by 0.85°C over the period 1880–2012 and global precipitation patterns changed. Combustion of fossil fuels, deforestation, but also specific industrial processes and extended agricultural activities are the main drivers of the increased emission of greenhouse gases. Enhanced concentrations of greenhouse gases in the atmosphere, CO_2 in particular, will increase global temperatures by radiative forcing. Likewise, climate change has a direct impact on all kinds of economic processes. This may be positive or negative, though the expectation is that the overall impact will be primarily negative. A good conception of the economic driving forces of climate change is key for the design of effective mitigation policies.

The *air emission accounts* can be used to analyse the environmental pressures and responsibilities in terms of greenhouse gas emissions in relation to production and consumption patterns. Because of their compatibility with the National Accounts, greenhouse gas data can be linked directly to the economic drivers of global warming. Statistics Netherlands annually publishes the air emission accounts, which include all emissions caused by the residents of a country, regardless of where the emissions take place.

Greenhouse gas emissions according to different frameworks

There are several frameworks for estimating the greenhouse gas emissions for a country, yielding different results. Well-known are the:

1. emissions reported to the UNFCCC (United National Framework Convention on Climate Change) in particular under the Kyoto Protocol. 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;
2. but also environmental statistics (greenhouse gas emissions within the Dutch territory, the so-called actual emissions);
3. as well as the air emission accounts (emissions by residents).

These frameworks all 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. A bridge table provides insight in how the different conceptions quantitatively relate to each other (see Table 1.4.1).

3.2.1 Bridge table for greenhouse gases

	2001	2005	2010	2011	2012	2013*
	Mton CO_2 equivalents					
1. Stationary sources[1]	184	180	183	169	168	168
2. Mobile sources on Dutch territory	40	41	41	42	41	41
3. Mobile sources according to IPCC	38	39	38	39	37	36
4. Short cyclic CO_2	8	11	14	14	14	13
5. Total, IPCC (excl. LULUCF)[2] = 1+3-4	213	208	208	194	191	192
6. Land Use, Land-Use Change and Forestry (LULUCF)	3	3	3	3	3	3
7. Total, IPCC (incl. LULUCF) = 5+6 (Kyoto-protocol)	215	211	211	197	195	195
8. Actual emissions in the Netherlands = 1+2	224	221	224	211	209	210
9. Residents abroad	26	26	25	25	26	26
10. Non-residents in the Netherlands	6	7	7	7	7	7
11. Total emissions by residents = 8+9-10	243	241	243	229	228	228

[1] sources include short-cyclic CO_2.
[2] Include Land Use, Land Use Change and Forestry. This concerns the effect of land use and forestry on greenhouse gas emissions and sequestration of CO_2 into biomass.

The total greenhouse gas emissions for the Netherlands according to the IPCC guidelines equalled 192 Mton CO_2 equivalents in 2013[1]. This is 10 percent below the emission level of 2001. The CO_2 emissions. However, diminished by 9 Mton, a 5 percent decrease during this period. The substantial reductions of the other greenhouse gases, as a result from a variety of emission reduction efforts, by far surpassed the small decrease in CO_2 emissions. These have led to a 32 percent cut in emissions of all other greenhouse gases (CH_4, N_2O, F-gases) in period 2001–2013[2]. This increased the share of CO_2 in total greenhouse gas emissions from 83 percent in 2001 to 87 percent in 2013. The emissions of greenhouse gases generated by the Dutch economy equalled 228 Mton in 2013 which is 6 percent less than the 2001 emissions. The differences between these conceptualisations are primarily due to the different treatment of the emissions caused by international transport, which is only partly included in the Kyoto figures. More information can be found in the background document *Greenhouse gas emissions according to different frameworks* at the website of Statistics Netherlands.

[1] Excluding LULUCF (Land Use, Land Use Change and Forestry), both emissions and uptake. Data are calculated based upon 1996 Guidelines.
[2] As part of ESA-2010 revision, Dutch National Accounts are revised. So far time series for 2001–2013 are compiled. As a result for this publication most data are compiled for 2001 onwards. Longer time series are foreseen for next year.

Greenhouse gas emissions in 2013

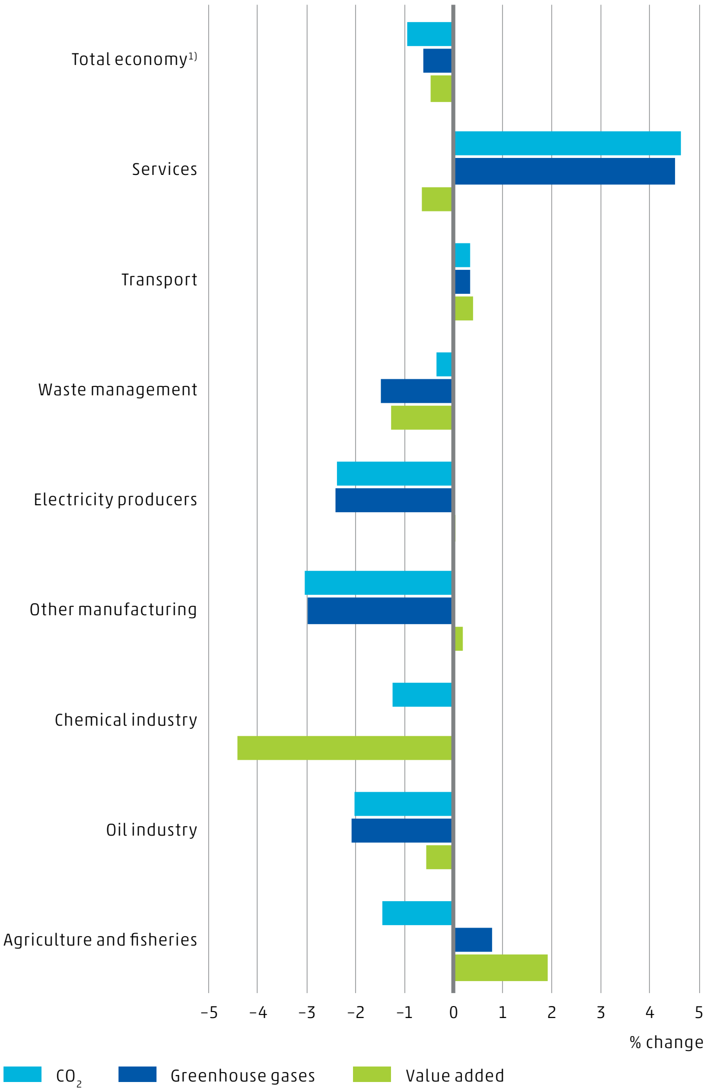
The total level of greenhouse gas emissions in the Netherlands in 2013 was comparable to 2012 and 2011. The total emissions by economic activities, which includes emissions by households, equalled 228.4 Mton CO_2 equivalents. Carbon dioxide (CO_2) emissions were nearly equal to 2012. Methane (CH_4) emissions increased by 1 percent and nitrous oxide (N_2O) by 3 percent. The economy contracted by 0.7 percent in 2013 after an even stronger contraction in 2012. The fact that the economic downturn was not accompanied by a decrease in emissions is mainly due to the cold weather in the beginning of 2013. March has been the coldest month since 1987 and saw records in the gas sales for space heating.

The emissions from all industries have been falling since 2010. The 2013 emissions were 1 percent lower, like in 2012, while the decline in 2011 was 5 percent. The emission reductions in 2013 were similar to those in 2012. However, they were less than the decrease in production and value added. Among the manufacturing industries, the chemical industry was the largest emitter in 2013 and contributed nearly 40 percent to the total greenhouse gas emissions of the total production by manufacturing industry. In 2013 its value added fell by 3 percent and its CO_2 emissions decreased by 2 percent. For some other non-manufacturing industries with extensive emissions, as the electricity companies and refineries, greenhouse gas emissions fell by 2 percent or more. The electricity producers in particular showed a drop in greenhouse gas emissions. A further increase of the already positive import balance, and the shrinking demand for electricity, had their impact on further lowering of the domestic electricity production as from 2012. CO_2 emissions from horticulture (glasshouses) remained virtually the same in 2013, while both production and value added increased by about 1 percent in horticulture.

An important measure for environmental pressure caused by economic activities is the emission intensity, which can be calculated by dividing the greenhouse gas emissions by value added. In 2013 the emission intensity remained the same despite of the declining long term trend. For several of the large emitters such as the mining industry, food and beverages industry, and the basic metal industry and also electricity producers, the emission intensity improved. In contrast the emission intensity increased for manufacturers of chemicals. Services in general also showed increasing intensities mainly due to extra greenhouse gas emissions from energy used for space heating.

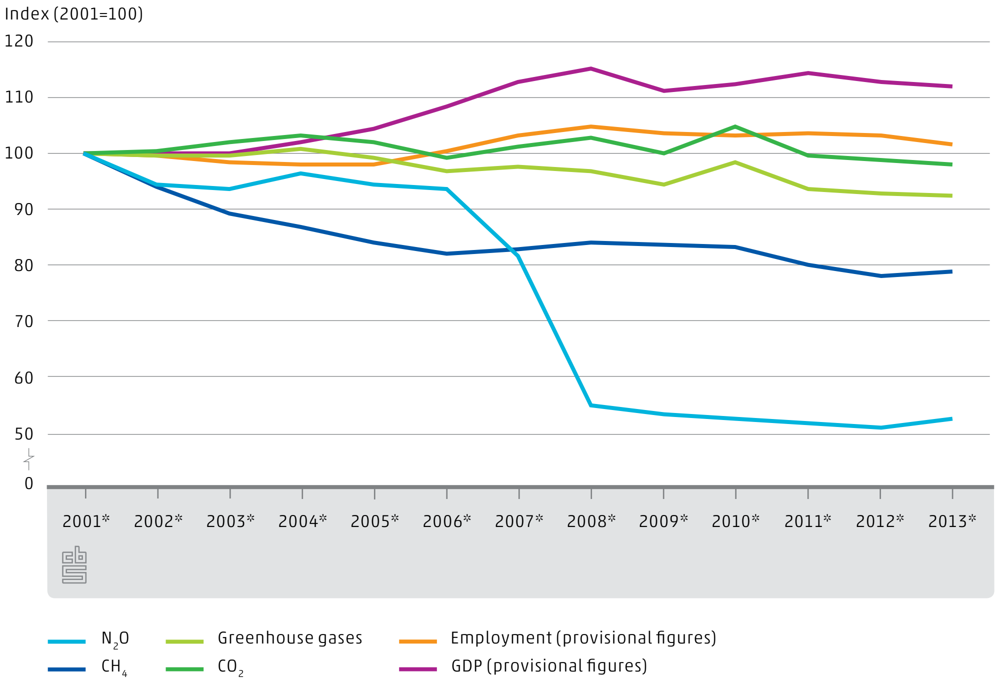
In the period 2001–2013, economic growth far exceeded greenhouse gas emissions. While the economy grew by 12 percent and employment by 2 percent in twelve years, the emissions of greenhouse gases by industries fell by 8 percent and CO_2 emissions by 2 percent. The strongest reduction in absolute terms came from the electricity producers, refineries and building material manufacture, mainly as a direct result from reduced production volumes, partly from adjusted production processes. So we observe absolute decoupling in the Netherlands with respect to the 2001 emission levels for greenhouse gases and for CO_2 separately. The latter mainly observed in recent years. Absolute decoupling here means lower emissions than in 2001 despite economic growth.

3.2.2 Changes in value added, greenhouse gas and CO_2 emissions, 2012-2013*



[1] Excluding emissions from households.

3.2.3 Volume changes in GDP, employment and greenhouse gas emissions by industries



Households directly contribute to the emission of greenhouse gases by consuming energy products for heating, cooking and generating warm water, and by using motor fuels for driving. Dutch households were responsible for 42.0 Mton of greenhouse gas emissions in 2013, which represent 18 percent of the total emissions by economic activities. In 2013 direct greenhouse gas emissions from households rose by 3 percent with respect to 2012, while consumer expenditure decreased by 1.6 percent. The population grew only by 0.3 percent in 2013 compared to 2012 and the number of households only by 0.7 percent, both far less than the growth in emissions. The main reason for increased emissions was the additional use of natural gas for space heating due to the extra cold weather in the beginning of 2013.

3.3 CO_2 per quarter

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

environmental performance of different industries. The CO_2 emissions are calculated according to the definitions of the environmental accounts. Besides these year-on-year changes there are also weather adjusted changes. For households, agriculture and some other services the assumption is that the natural gas consumption has not changed compared to the same quarter of the previous year.

Quarter 1 of 2014

CO_2 emissions down by 10 percent in the first quarter of 2014

CO_2 emissions by the Dutch economy were 10.1 percent lower in the first quarter of 2014 than in the same quarter of 2013. Adjusted for the differences in the weather, CO_2 emissions fell by just 0.4 percent. The Dutch economy contracted by 0.5 percent year-on-year in the first quarter of 2014 (flash estimate[3)]).

Mild winter leads to lower CO_2 emissions

Last winter was relatively warm, so far less natural gas was burned to heat indoor spaces than the year before. The CO_2 emissions by households were therefore cut by over 20 percent. Likewise CO_2 emissions in services fell sharply because of the mild winter.

Lower CO_2 emissions by energy companies

CO_2 emissions by ‘energy, water supply and waste management’ was lower than a year before. The energy companies produced less electricity and consumed less natural gas. However, they did use more coal, although the increase in coal was lower than the decrease in natural gas consumption.

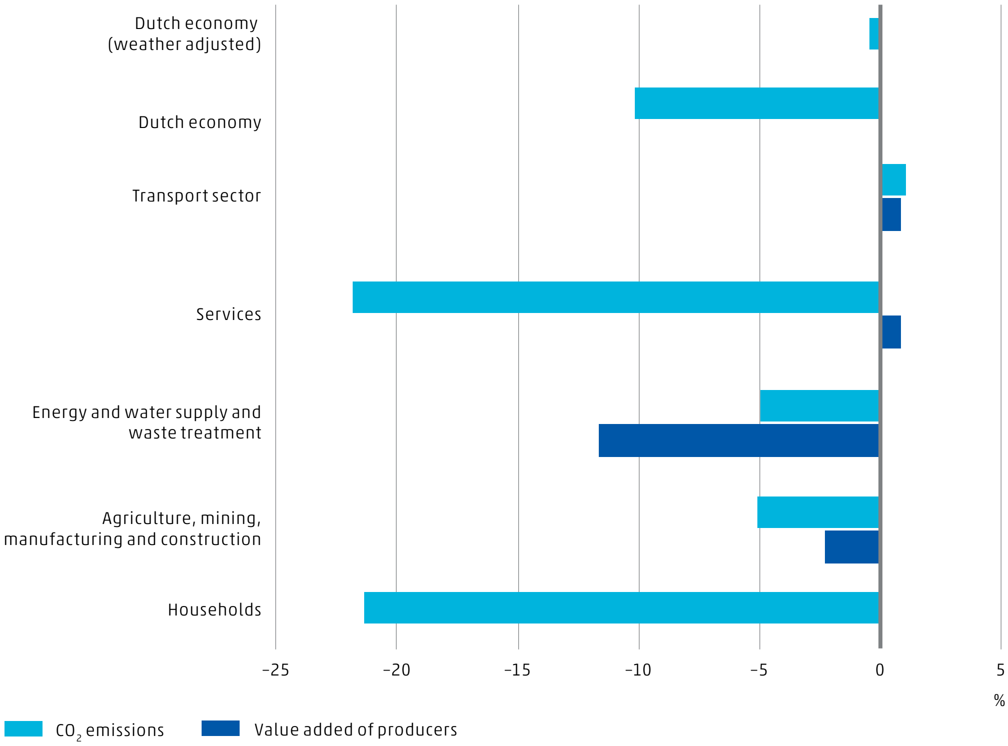
‘Agriculture, mining, manufacturing and construction’ saw a decrease in its totality. This mainly came about by the lower emissions in agriculture caused by the mild weather. Heavy industries did have higher CO_2 emissions though. This is because production in manufacturing increased relative to the first quarter of 2013.

Rise in CO_2 emissions of the transport sector

CO_2 emissions by the transport sector rose slightly due to the growing production of aviation and sea transport. Emissions by road transport of goods has remained stable.

3) Figures have been adjusted. The year-on-year volume change is equal to zero according to the second estimate. For more information see: http://www.cbs.nl/nl-NL/menu/themas/dossiers/conjunctuur/publicaties/conjunctuurbericht/inhoud/kwartaal/archief/2014/2014-804-pb.htm.

3.3.1 Changes in CO_2 emissions and economic development, first quarter of 2014



Quarter 2 of 2014

Mild weather leads to lower CO_2 emissions

CO_2 emissions by the Dutch economy were 0.9 percent lower in the second quarter of 2014 than in the same quarter of 2013[4]. Adjusted for the differences in the weather, CO_2 emissions increased by 3.7 percent however. The Dutch economy grew by 0.9 percent year-on-year in the second quarter of 2014 (flash estimate).

Higher CO_2 emissions by energy companies due to the increased use of coal

CO_2 emissions by 'energy, water supply and waste management' was higher than in 2013. The energy companies produced more electricity and consumed more coal. They also used less natural gas, but this did not compensate for the increased CO_2 emissions due to the extra use of coal. Firing coal not only leads to relatively higher emissions, it also has a lower efficiency than natural gas. The value added of the energy companies fell. While electricity production rose, the production of energy distributors and networks fell due to the mild weather.

[4] The figures have been adjusted. The year-on- year volume change is 1.1 according to the second estimate. For more information see: http://www.cbs.nl/nl-NL/menu/themas/dossiers/conjunctuur/publicaties/conjunctuurbericht/inhoud/kwartaal/2014-tweederaming-economische-groei-2013-mededeling.htm.

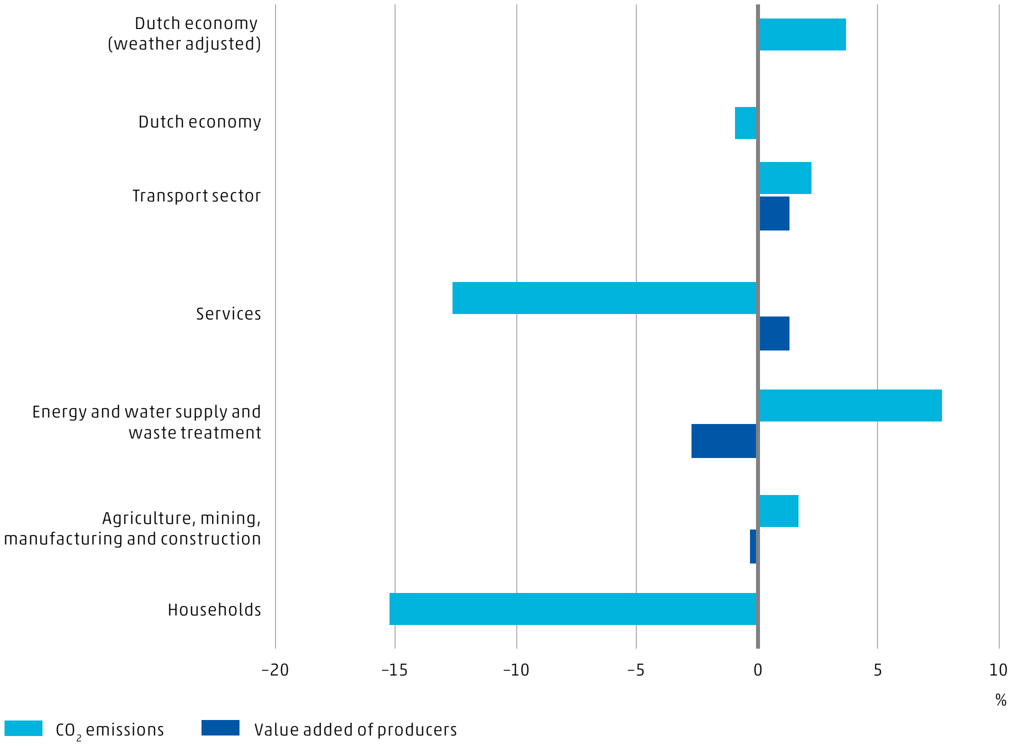
Industrial growth lead to higher emissions

Emissions rose in 'agriculture, mining and extraction, manufacturing and construction'. Manufacturing in particular increased its CO_2 emissions due to rising production. However the value added of 'agriculture, mining and extraction, manufacturing and construction' fell. This is because the value added of mining and extraction as well as construction were significantly lower than in the same quarter of 2013. Agriculture grew, but had lower CO_2 emissions due to the mild weather.

Rise in CO_2 emissions of the transport sector

CO_2 emissions by the transport sector rose again this quarter, according to the GDP flash estimate, mainly because of the growing production of sea transport and road transport of goods. The number of flights in aviation also rose slightly.

3.3.2 Changes in CO_2 emissions and economic development, second quarter of 2014



Households and the services sector used less fuel due to the warm weather

Far less natural gas was burned to heat indoor spaces in the Netherlands in the second quarter of 2014 than in the corresponding quarter of 2013, because it was relatively warm like in the first quarter. Therefore CO_2 emissions by households and services were much lower. So the mild weather led to a reduction of CO_2 emissions in the second quarter.

3.4 Other air emissions

Production and consumption activities cause the emission of a variety of substances to the air. Due to their physical and chemical characteristics some substances, such as greenhouse gases, have effects on a global scale. The air emissions discussed in this section, such as nitrogen oxides or particulate matter, have a more local or regional impact. Their impact may be on human health and/or on the quality of the environment. Air emissions of several substances can be aggregated by weighting them by their respective impacts, so as to form indicators to measure their contribution to a variety of key environmental themes. The themes discussed here are acidification, smog formation, particulate matter emissions, and ozone layer depletion.[5] Some polluting substances contribute to several themes. NO_x for example contributes to both acidification and smog formation (TOFP), while CH_4 contributes to both smog and the greenhouse effect.[6]

Emissions of acidifying pollutants continue their downtrend

Acidification is caused by the emissions and resulting deposition of nitrogen oxides (NO_x), sulphur dioxide (SO_2) and ammonia (NH_3), affecting the living environment. The combined emissions of these acidifying substances, expressed as acid equivalents, increased by 1 percent in 2013, after a 2 percent decrease in 2012. Acidifying emissions have been cut by 33 percent since 2001. The NO_x emissions were responsible for 53 percent of the emissions of acidifying pollutants, ammonia for one third and sulphur dioxide emissions only for 11 percent in 2013.

Acidifying soils and ground and surface water have a negative impact on the biodiversity of natural areas such as forests and heaths, but also in agricultural areas. Because acidification also affects ground and surface water, it forms a threat to both drinking water and industrial process water. Agriculture and transport in particular are responsible for the acidifying emissions. This is mainly due to the ammonia emissions from livestock farming, manure application, and to emissions of nitrogen oxides and sulphur dioxide by transport over water, but also from air travel and transportation by households. The quantities of emissions from these sectors and activities are much higher than those from refineries and the chemical industry.

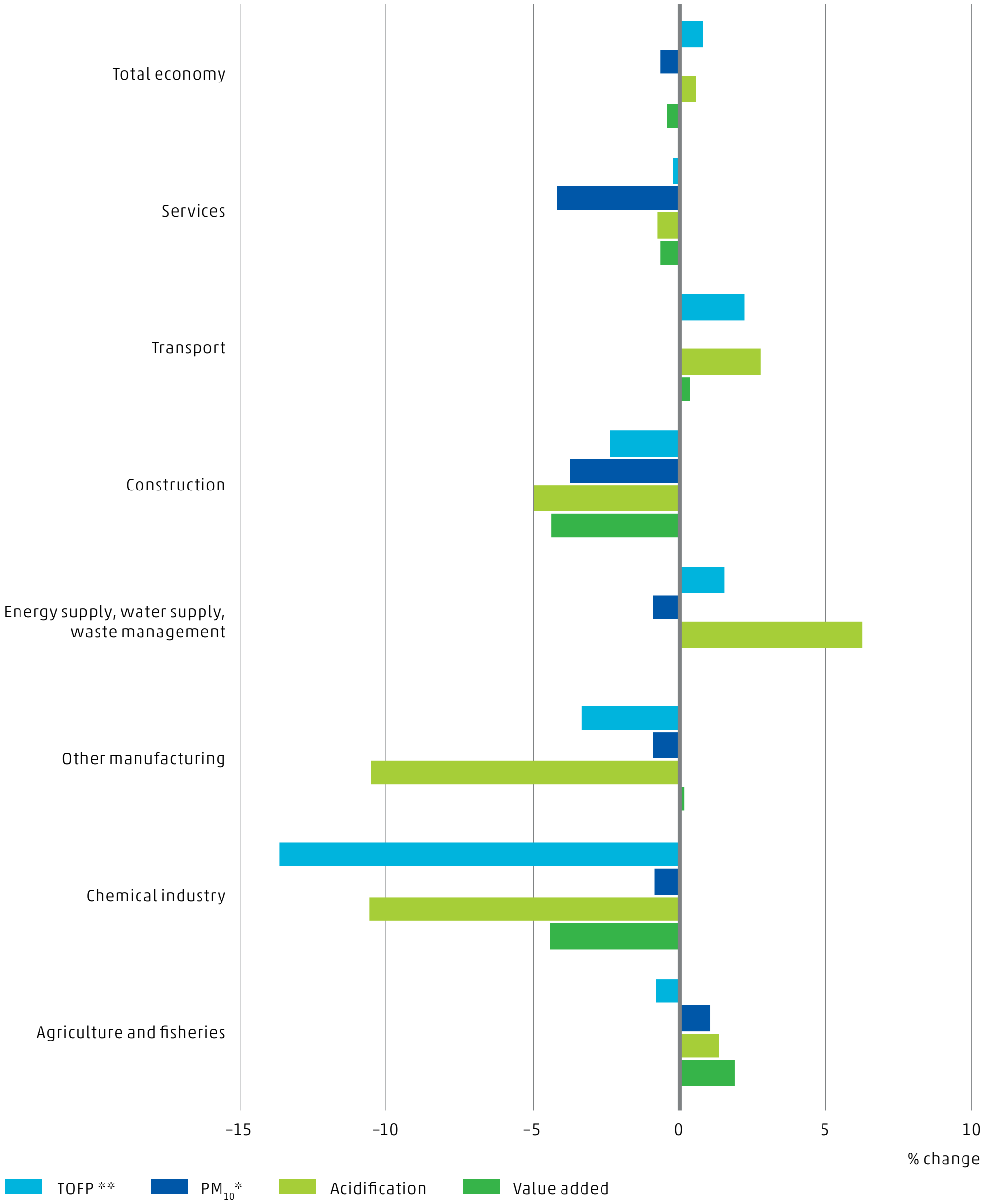
In 2013 the emissions of nitrogen oxides (NO_x) related to the Dutch economy as a whole practically equalled the 2012 emissions. In contrast, the emissions originating from transportation, particularly road transport, declined steadily with minus 6 percent, while production was down by only 1.5 percent. The strong growth in the number of vehicles with cleaner engines helped to cut emissions in road transport. These cleaner engines are enforced by robust European legislation with gradually tightened emission

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

[6] TOFP, Tropospheric Ozone Formation Potential is an indicator for the formation of tropospheric ozone (local air pollution).

standards for all kinds of road vehicles, in particular those with diesel engines. The NO_x emissions resulting from maritime and inland water transport remained stable, while air transport extended its emissions by over 10 percent. Electricity companies increased their NO_x emissions by 3 percent, despite the fact that nearly 4 percent less electricity was generated in 2013 and 2 percent less by the large power plants. The emissions did not decrease correspondingly because of a change in fuel mix using more coal at the expense of natural gas in specific plants. The downward trend seems to have stalled. NO_x emissions by electricity companies have been reduced by close to 30 percent since 2001, while production increased, as a result of extensive emission reduction measures at plant level.

3.4.1 Changes in value added, emissions of acidifying substances, particulate matter (PM_{10}) and smog, 2012-2013



* PM_{10}, 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 troposheric ozone.

Although there was only a limited decrease in 2013 of 2 percent compared to 2012, households too have been able to steadily decrease their NO_x emissions to almost half of their 2001 emission level. This is largely the result of the continuously improved performance of car engines, due to the step by step tightening of exhaust gas standards set by the European Union. Other factors that contributed to lowering the emissions are the improved energy efficiency in space heating, i.e. from the use of improved boilers, good quality insulation in a larger share of new houses, improved energy performance of existing homes and related emissions.

The sulphur dioxide emissions (SO_2) fell by 2 percent in 2013. Sulphur dioxide emissions are mainly caused by water transport (46 percent) and, although significantly less, by the oil industry (15 percent), power production (13 percent), aviation (8 percent) and the basic metal industry (6 percent). Advancing technology induced by the implementation of environmental policies resulted in a reduction of emissions for several sectors. For shipping, especially maritime shipping, SO_2 emissions seem to have stabilized after the sharp decline since 2006. For 2013 a 1 percent increase was observed following the substantial 6 percent increment in 2012.

The oil industry and the electricity plants have been able to structurally reduce sulphur emissions since 2001 notwithstanding strong growth. The annually recurring reductions are mainly achieved through technical measures, such as the application of desulphurisation of flue gases, and in some cases by using more natural gas and adjustment of the fuel mix at the expense of fuels with higher sulphur content. This downtrend came to a halt for both industries in 2012, but continued again in 2013 for the oil industry. The increase in emissions from electricity companies since 2012 is mostly explained by the changed fuel mix,primarily the increased use of coal at the expense of natural gas, as we mentioned earlier.

The ammonia emissions (NH_3), primarily stemming from livestock and from the application of manure on arable land, were up by 2 percent in 2013. This mainly came from a larger number of dairy cows in the cow sheds. NH_3 emissions have been reduced by over 20 percent since 2001.

PM_{10} emissions continued to decrease in 2013

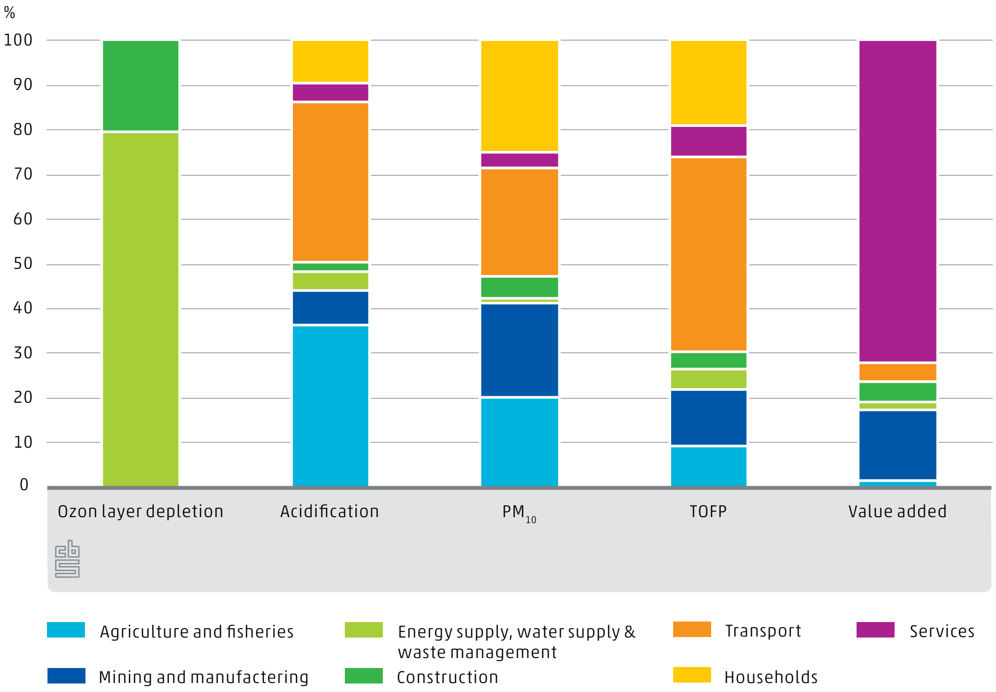
Air pollution of fine particulates can be harmful to the respiratory system. The transport sector, animal husbandry, households and to lesser extent some other industries and construction are the main contributors. In 2013 the total emissions of particulate matter (PM_{10}) decreased by 1 percent compared to 2012. Since 2001 a total reduction of 35 percent across all economic activities has been achieved. It turned out to be much harder to make reductions in agriculture and transport, resulting in the highest shares in total emissions for those industries.

Emissions of ozone precursors (CH_4, CO, NMVOC, NO_X) are weighted by their Tropospheric Ozone Formation Potentials (TOFP), or smog formation in short. In 2013 these emissions increased by 1 percent. Since 2001 these emissions have fallen by 28 percent across all activities.

Figure 3.4.2 provides a breakdown of the environmental themes and value added in 2013 by economic sectors and households. It demonstrates that whereas services (excluding transport) are responsible for over 70 percent of value added, their contribution to environmental themes is 7 percent at most.

Ozone layer depletion is mostly caused by Chlorofluorocarbon (CFCs)[7)] that reduces the amount of ozone in the stratosphere and causing higher levels of UV rays to reach the earth. This has damaging effects for humans and nature. Ozone layer depletion is primarily driven by waste management and construction, while acidification is dominated by agriculture and transport. PM_{10} emissions originate from a mixture of sectors where households, transport, mining and manufacturing and agriculture all contribute substantially. Smog formation (TOFP) is mainly determined by transportation emissions stemming primarily from the transport sectors, but also from transportation activity across all industries and households.

3.4.2 Contributions to value added and environmental themes in 2013



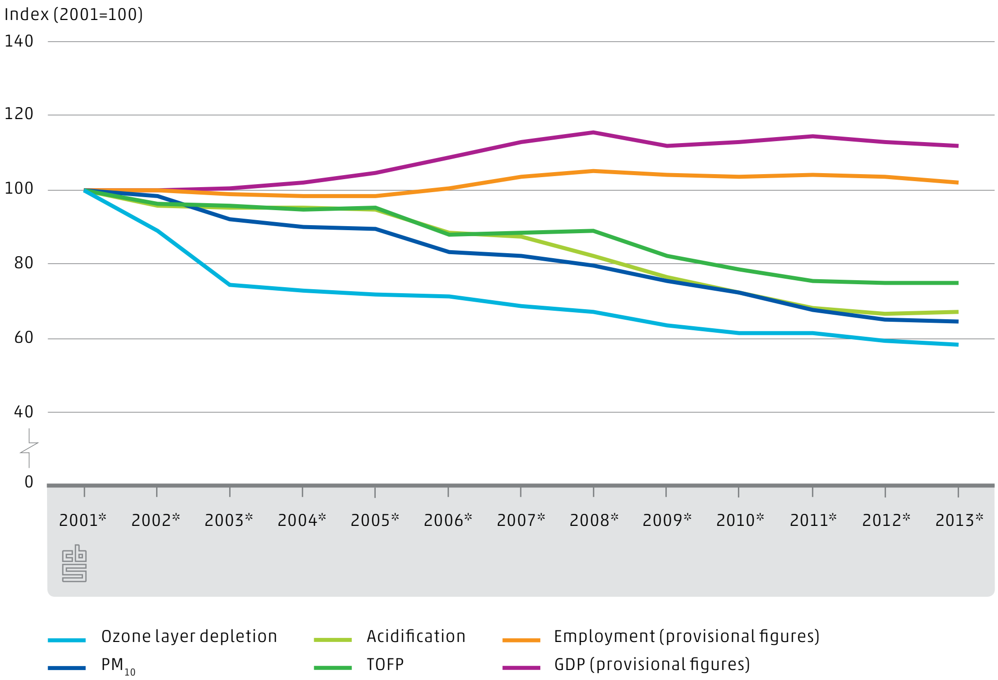
Other air emissions continue to decouple from economic growth in 2013

Between 2001 and 2013 the Dutch economy grew at an average rate of close to 1 percent annually. Employment grew by 2 percent in the 2001–2013 period as a whole. At the same time the emission of all substances to air were cut by 33 percent or more, with the exception of Tropospheric Ozone Formation Potential (TOFP) with a 25 percent decline and of course of the CO_2 emissions hardly experiencing a drop. The drop in all local air pollutants described in this section implies that absolute decoupling has taken place

7) Some other ozone depleting substances are halons and methyl chloroform.

in the Netherlands since 2001. Gases contributing to ozone layer depletion were no exception. These emissions still decrease, although the major reductions were achieved prior to 2001. Emission levels for particulate matter and the substances contributing to acidification and to smog formation to some extent also generally show the same pattern of decline since 2001. Net energy use, as one of the main denominators of emissions of several of these substances, roughly matches the 2001 level of use. It shows that emission factors have structurally improved, with a variety of explanations such as technological advancement in engine technologies.

3.4.3 Volume changes in GDP, employment and several environmental themes



3.5 Water quality accounts time series

Reporting on the water quality of Dutch surface waters for the Water Framework Directive is required once every three years. In this section we construct a time series, comparing the water quality between 2012 and 2009 building on the experimental water quality accounts that were developed at Statistics Netherlands (2011). Another novelty is that we have estimated average depth profiles for the different types of water bodies (and some individual lakes) which allows us to compile a water stock account for water quality.

Data and method

The 2012 data, obtained from the Dutch 'Information House Water', were similar to the 2009 data, containing water quality measurements and assessments for all water bodies recognized for the Water Framework Directive (WFD).[8)]

In order to compile stock accounts disaggregated by water quality, information about surface area per water body had to be complemented by information about average water depth for the water types distinguished within the water framework directive (Elbersen, 2003). The methodology is described in *Environmental Accounts in the Netherlands 2010* (Statistics Netherlands 2011, Chapter 11). It is restricted to an analysis of fresh water rivers and lakes, excluding transitional and coastal waters.

In order to estimate water depth for Dutch lakes and rivers, we have estimated average depths for each water type distinguished in the WFD.
- For lakes, one criteria used in classifying water bodies, is whether they are more or less than 3 meters in average depth. We gave all lakes <3 meters an average depth of 2.5 meters. For the types M20 and M21 (types average depth >3 meters), all lakes with a surface area larger than 2 km^2 have been researched individually using information from internet or water maps. The remainder was assigned an average depth of 4 meters.
- For rivers, no average depth is used in classifying them into different WFD types. Here we have used the average width to estimate an average depth as follows: rivers with average width between 0 and 3 meters were assumed to be 1 meter deep; rivers with average width between 3 and 8 meters were assumed to be 2 meters deep; rivers with average width between 8 and 25 meters were assumed to be 3 meters deep; rivers with average width >25 meters were assumed to be 4 meters deep.

According to the WFD directive each water body is given two main assessments: a chemical status based on more than 30 different substances, and an ecological status which is predominantly based on the biological quality. The biological quality itself is based on 4 quality elements: fish, phytoplankton, water plants and macro fauna.

Assessments are made according to the 'one out, all out' principle, which implies that the lowest score of the indicators within the scope of the final indicator determines the overall outcome. However, this methodology is not always instructive for monitoring changes over time in the quality of water bodies (PBL 2014). Therefore, we will focus here on an analysis of changes in the biological quality of water bodies.

Results

As shown in figure 3.5.1 – which is inspired by the presentation in PBL 2014 – the percentage of surface water bodies classified as having good fish and water fauna increased between 2009 and 2012. However, phytoplankton (algae) decreased. Overall, the effect is that the biology summary indicator improves.

8) 2012 data covered 721 water bodies, whereas the 2009 data covered 3 additional water bodies. The 2012 data unfortunately did not provide a detailed breakdown of the chemical status.

3.5.1 Water quality of surface water bodies, 2009 and 2012

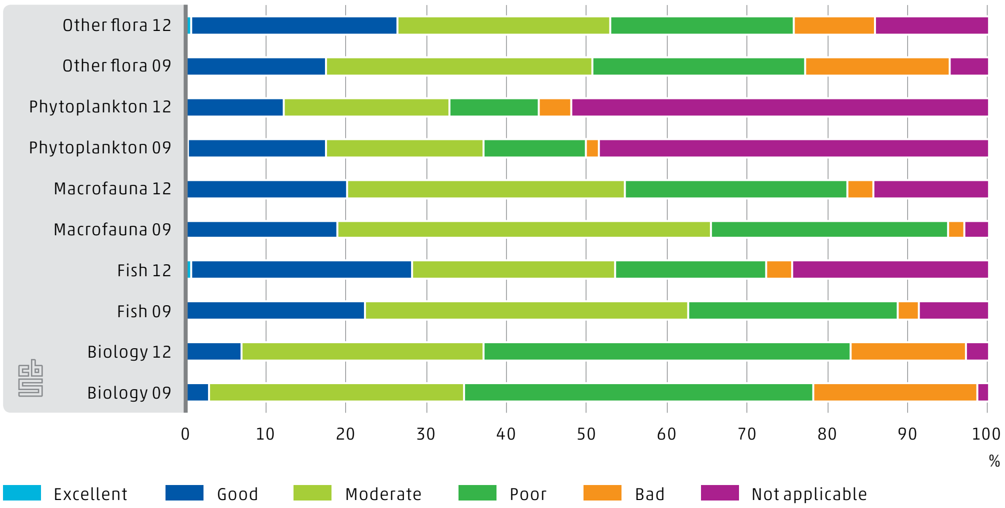


Table 3.5.2 shows that the number of water bodies with good water biological quality increased from 22 in 2009 to 50 in 2012 (from 3 percent to 7 percent of the water bodies). There were even 3 water bodies that changed from bad towards good (and one the other way round). The number of bad status water bodies decreased from 144 to 103.

3.5.2 Change matrix biological status (number of water bodies), 2009 to 2012

	Good	Moderate	Poor	Bad	Total-2009
Good	8	12	1	1	22
Moderate	18	124	76	9	227
Poor	21	65	176	44	306
Bad	3	16	76	49	144
Total-2012	50	217	329	103	699

Table 3.5.3 shows the experimental results of the water quality stock account for 2009 expressed as volumes. We see that approximately 85 percent of fresh surface water is stored in lakes (M types), with the majority in M21 (which consists of two water bodies, the IJsselmeer and the Markermeer) with an average biological water quality. Only 0.5 percent of the surface water volume is considered of good biological quality.

Table 3.5.4 has a smaller scope than table 3.5.3 as it includes only water bodies that were biologically assessed in 2009 as well as 2012. Table 3.5.4 is the same change matrix as Table 3.5.2 but now expressed in terms of volume. It demonstrates that, in volume terms, large changes have occurred in water bodies that have changed from moderate to poor quality (24 percent), which is predominantly due to a change in the status of the Markermeer.

3.5.3 Water quality stock account (m³), 2009

WFD type	Description	Good	Moderate	Poor	Bad	Total
		%				
M1a	Freshwater ditches (well buffered)	.	0.0	0.0	0.0	0.1
M1b	Non-freshwater ditches (well buffered)	.	0.0	.	.	0.0
M2	Ditches (weak buffered)	.	0.0	0.0	.	0.0
M3	M3 Buffer zone (regional) canals	0.0	0.4	0.4	0.1	0.9
M6a	Large shallow canals without shipping	.	0.1	0.1	0.0	0.2
M6b	Large shallows canals with shipping	.	0.4	0.2	0.1	0.7
M7a	Large deep canals without shipping	.	.	.	0.0	0.0
M7b	Large deep canals with shipping	.	0.9	0.5	0.8	2.1
M8	Buffer zone (low) fen/marsh/bog ditches 18 3	.	.	0.1	0.0	0.1
M10	Weak buffer zones (high moorland) ditches	.	0.1	0.4	0.3	0.8
M12	(Low) fen waterways and canals	.	.	0.0	.	0.0
M14	Small very shallow weakly ponds (buffer zone)	0.4	2.9	3.3	0.2	6.8
M20	Very shallow ponds(buffer zone)	0.0	1.3	2.5	0.9	4.7
M21	Moderately large deep lakes (buffer zone)		68.4	.	.	68.4
M23	Large deep lakes (buffer zone)	0.0	0.0	0.0	0.0	0.1
M27	Large shallow lime-rich ponds	0.0	0.3	1.2	0.6	2.2
R4	Permanent slow flowing upper course on sand	.	0.0	0.0	0.0	0.0
R5	Slow flowing middle/lower course on sand	0.0	0.2	0.1	0.0	0.3
R6	Slow flowing small river on sand/clay	0.0	0.2	0.3	0.0	0.5
R7	Slow flowing river/side channel on sand/clay	.	1.2	4.0	.	5.2
R8	Fresh tidal water (river) on sand/clay	.	3.7	3.1	.	6.7
R12	Slow flowing middle/lower course on peat	0.0	0.0	0.0	.	0.0
R13	Rapid flowing upper course on sand	.	0.0	0.0	.	0.0
R14	Rapid flowing middle/lower course on sand	.	0.0	.	0.0	0.0
R15	Rapid flowing river (siliceous soil)	0.0	.	.	.	0.0
R16	Rapid flowing river/ side channel (siliceous or sandy soil) 1 9	.	.	0.3	.	0.3
R17	Rapid flowing upper course on lime rich soil	0.0	0.0	.	0.0	0.0
R18	Rapid flowing middle/lower course on lime rich soil	0.0	0.0	.	0.0	0.0
Total		0.5	79.9	16.5	3.0	100.0

3.5.4 Change matrix biological status (volume of water bodies), 2009 to 2012

	Good	Moderate	Poor	Bad	Total-2009
	%				
Good	0.1	0.5	0.0	0.0	0.5
Moderate	0.7	54.2	24.3	0.8	80.0
Poor	0.7	3.6	8.1	4.0	16.5
Bad	0.0	0.1	1.6	1.3	3.0
Total-2012	1.5	58.3	34.0	6.1	100.0

Discussion

The information presented in the water quality stock account could be useful for informing policies regarding the availability of water resources by type and by quality. Disaggregation by volume is arguably more informative than by the mere amount of water bodies in a certain category. That said, the volume estimates are sensitive to the assumptions used and could be further improved by using more detailed maps (e.g. nautical maps), but fitness for purpose should be kept in mind, given that the bulk of the volume comes from a small number of lakes. Likewise, we have assumed here that

surface areas did not change during the 2009 and 2012 assessment. Furthermore, depth will vary tremendously over the season, especially for rivers, and it is questionable whether a volume measure is most revealing. For example, the SEEA Water proposed to use Standard River Units as unit of aggregation, which takes into accounts the debit of rivers.

4. Economic opportunities and policy instruments

Governments can choose between several policy instruments such as taxes, subsidies and regulation to steer development in a preferred direction. In this chapter environmental taxes and environmental subsidies are discussed. Monitoring the extent and effects of these 'green' instruments is of great interest to policy makers. Environmental measures may also create new opportunities for economic activities that may generate new jobs and stimulate economic growth. This chapter also provides a quantitative overview of the environmental goods and services sector (EGSS) for value added, production and employment in the period 2001–2012.

4.1 Environmental taxes and fees

Production and consumption activities result in pressure on the environment due to the use of natural resources, waste generation and the emission of pollutants. The government has several options for discouraging environmentally damaging consumptive or productive activities. Imposing environmental taxes and fees is one of them.

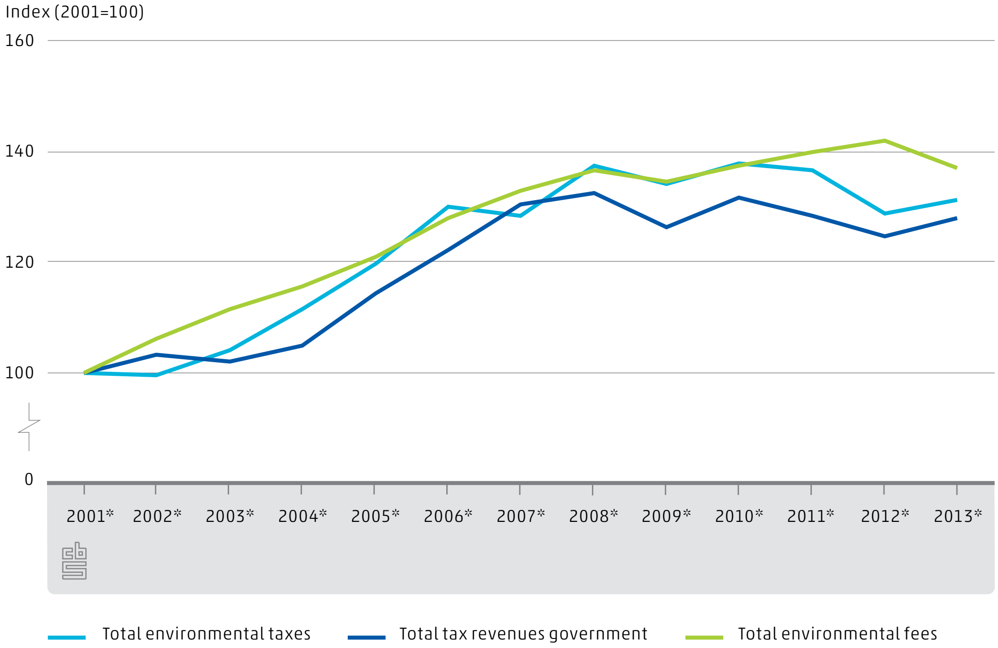
The main difference between a tax and a fee is the use of revenues. Tax revenues flow into the general budget, while the revenues of fees are earmarked mostly for providing environmental services. Environmental taxes and fees relate to activities or products that have a negative effect on the environment. According to SEEA and the Eurostat 2001 and 2013 statistical guidelines, an environmental tax is 'A tax of which the tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment'. Examples of environmental taxes are the tax on gas and electricity use and the motor vehicle tax. Examples of environmental fees are sewerage charges and fees on the after-care of refuse dumps.

This section reports on the revenues from the various environmental taxes and fees and shows who are actually paying them. An analysis of mobility taxes and a comparison between mobility taxes and environment taxes are also included.

Environmental tax revenues slightly higher, environmental fee revenues slightly lower

In 2013 environmental tax revenues came to almost 19 billion euros, up 1.7 percent on 2012. Environmental tax revenues decreased by almost 6 percent in 2012, due to the abolition of the groundwater and waste tax, and a dip of more than 24 percent in car and motor cycle tax. The increase in 2013 was caused by the introduction of an additional increment on the tax on gas and electricity to afford renewable energy subsidies (in Dutch: *opslag duurzame energie*). Furthermore, companies were no longer exempt from fuel tax, especially tax on the use of coal by electricity companies. This increase was offset by a further decrease of the tax on cars and motor vehicles and the abolition of the packaging tax. Therefore, the overall increase of tax revenues was limited.

4.1.1 Developments in revenues of environmental taxes and environmental fees



The share of environmental taxes in the total tax revenues of the government had fluctuated around 14 percent for years and then declined slightly towards 13.5 percent in the last two years. Total environmental tax revenues increased by 37 percent in the period 2001–2008. Subsequently they remained more or less stable until 2012, and then, by 2013, environmental tax revenues increased again but at a lower level than before the economic crisis.

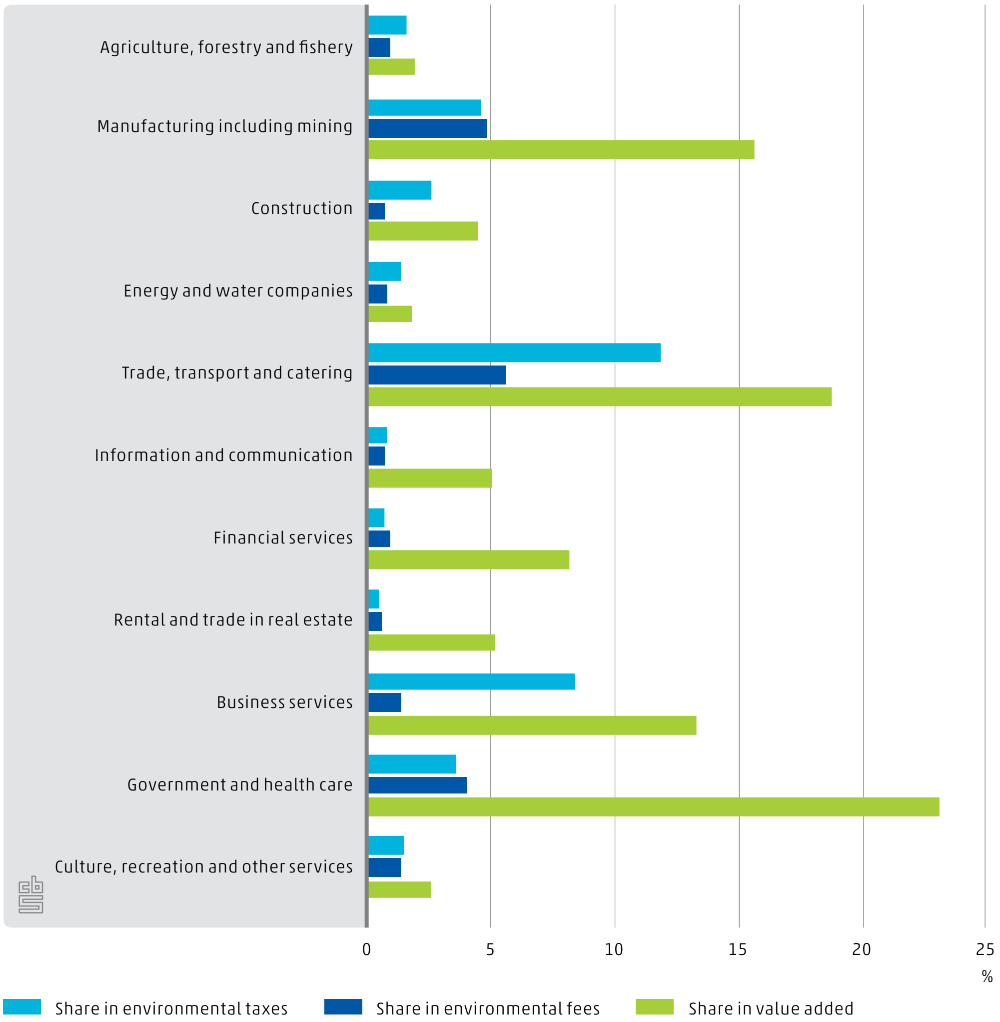
Total revenues of environmental fees have increased by almost 40 percent since 2001. This is caused by a massive increase in the revenues from sewerage charges. In 2001 the revenues amounted to 665 million euros, whereas in 2013 they had risen to nearly 1.5 billion euros, a 110 percent increase.

Households pay the most

In 2013, households paid more than 62 percent of the total environmental tax revenues. Their contribution to environmental fees was even higher, 78 percent. The remainder is paid by companies.

Companies in business services and in trade, transportation and catering contributed most to the revenues from environmental taxes, 8.4 percent and 12 percent respectively. These sectors also generate a lot of value added. Companies in the sectors rentals and trade in real estate, information and communication, and financial services paid less than 1 percent.

4.1.2 Contributions of companies to environmental taxes and environmental fees, 2013*

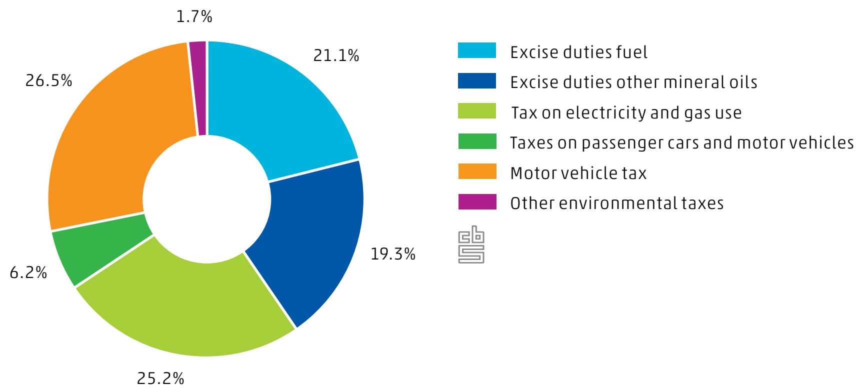


The outliers in paid environmental fees are companies in the sectors trade, transport and catering, government and health care. They contribute 5.6 and 4 percent respectively to revenues from environmental fees. In contrast to the environmental taxes, companies in the sector business services make a very small contribution to environmental fees. It is striking that manufacturing, an important sector for the economy and one of the biggest polluters, did not contribute much to environmental taxes and fees.

Motor vehicle tax largest contributor

In 2013, the largest part of total environmental tax revenues came from the motor vehicle taxes, over 26 percent, followed by the tax on gas and electricity use. The share of the latter was substantially higher in 2013 than in 2012, due to the introduction of the additional increment mentioned before.

4.1.3 Share of different environmental taxes, 2013*



Tax on car ownership and car use diverges

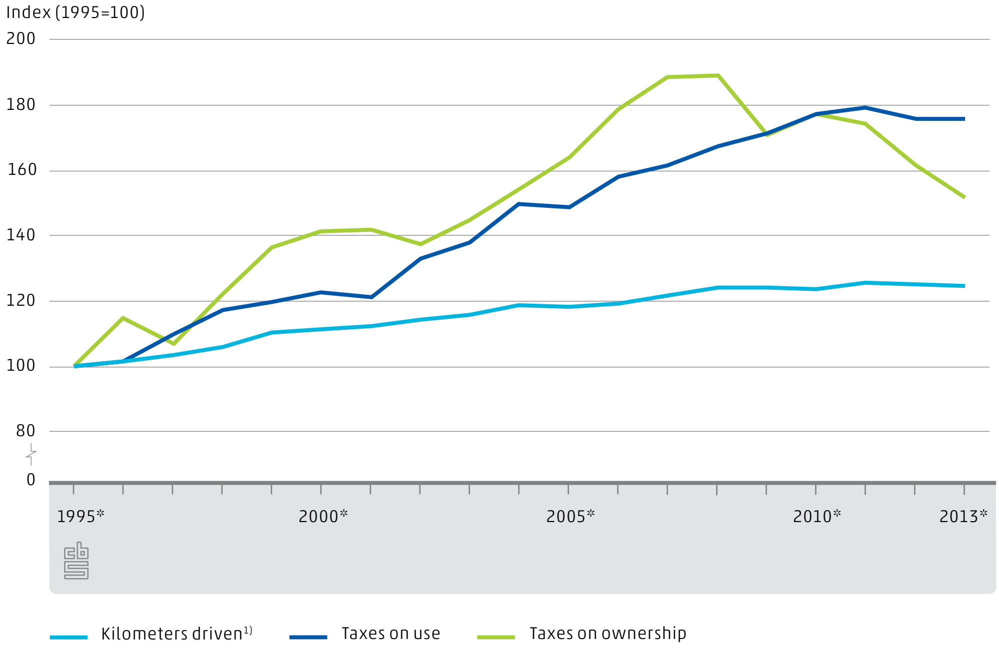
Taxes on mobility (excise duties, tax on passenger cars and motor vehicles and the motor vehicle tax) have increased considerably since 1995. In 1995, mobility tax yielded 8.3 billion euros. In 2013 this had risen to 13.7 billion euros, which constitutes an increase of over 64 percent. However, the peak was in 2008, when mobility tax yielded nearly 15 billion euros. In 2013, 73 percent of the environmental taxes consisted of mobility tax.

The tax paid when purchasing a car or motor vehicle (in Dutch: *BPM*) and the motor vehicle tax are taxes on the ownership of cars. The use of cars is being taxed through excise duties on fuels. Until 2008 their ratios remained more or less the same. Then car ownership taxes taxes fell sharply, BPM in particular. BPM on environmentally friendly cars was abolished and otherwise reduced and sales of new cars declined.
In contrast, the revenues from excise duties increased from more than 72 billion euros in 2008 to nearly 76 billion euros in 2013, with a peak of more than 77 billion euros in 2011. The decrease in revenues from excise duties since 2012 was partly caused by a decrease in the number of kilometers driven. Another explanation is the fact that people in the border regions buy more fuel in Belgium and Germany, as excise duties there are lower than in the Netherlands.

Environmentally based taxes increase rapidly

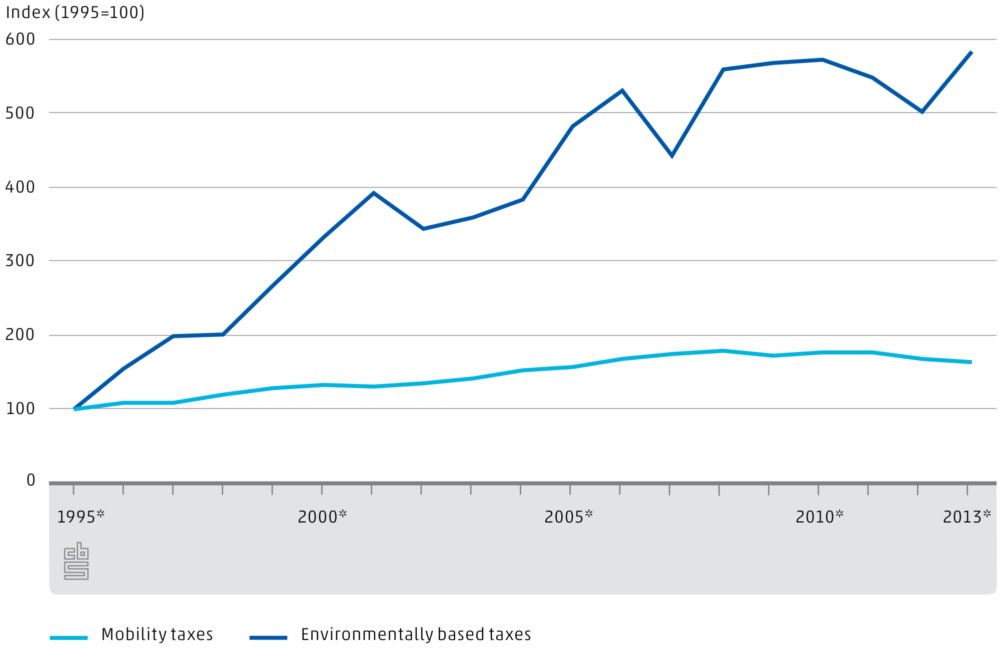
Taxes on mobility are one pillar of the total of environmental taxes. The other pillar consists of taxes under the environmentally based tax act of 1995. The latter includes taxes on tap and groundwater, the tax on gas and electricity use, fuel tax, waste tax, the tax on flying and the packaging tax. In 2013, 73 percent of total revenues of environmental taxes came from the mobility taxes. The environmentally based taxes had a 27 percent share. Despite this fairly low percentage, their revenues increased enormously in the period 1995–2013, namely over 482 percent. In 1995 these taxes together yielded 858 million euros, in 2013 their total revenues had increased to almost 5 billion euros. This is mainly due to several price increases in the electricity rates. The tax on average electricity consumption (MWh 0.8–10) increased from 13.39 euro per KWh in 1996 to 118.50 euro per KWh in 2013.

4.1.4 Taxes on car ownership and car use



[1] Figures are final.

4.1.5 Environmentally based and mobility taxes



4.2 Economic developments in the environmental goods and services sector

In order to reduce the pressures on the environment that lead to resource depletion and deterioration, environmental measures are becoming more and more stringent. Dutch policymakers are interested in the economic impact of these measures. In general, environmental policy has economic pros and cons. First, there is the effect of the additional financial burden for companies, because they may have to make additional investments to comply with environmental regulations. Second, there are the new (job) opportunities that result from these regulations.

A good starting point in evaluating the opportunities is by monitoring the companies and institutions that 'produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration' (Eurostat, 2009). All these companies and institutions belong to the environmental goods and services sector (EGSS). EGSS statistics measure the size of the 'green economy' in the Netherlands. The green economy contributes to total employment, total production, exports and to the Dutch gross domestic product. According to the definition used in the Eurostat handbook on the EGSS (Eurostat, 2009) the sector consists of a heterogeneous set of producers of environmental goods and services. This definition was also adopted by SEEA (UN et al., 2012). Various activities come under the definition of the EGSS.

This section presents a quantitative overview of the EGSS for gross value added, production and employment in the period 2001–2012. Employment is measured in fulltime equivalents, while production and gross value added are measured in euros and in current prices. Measurement in current prices means that price inflation is included in the figures. Production and gross value added are valued at basic prices so subsidies and taxes on products (e.g. subsidies on electricity produced from renewable resources) are included. The basic price is the amount receivable by the producer from the purchaser for a unit of a product minus any tax on the product plus any subsidy on the product.

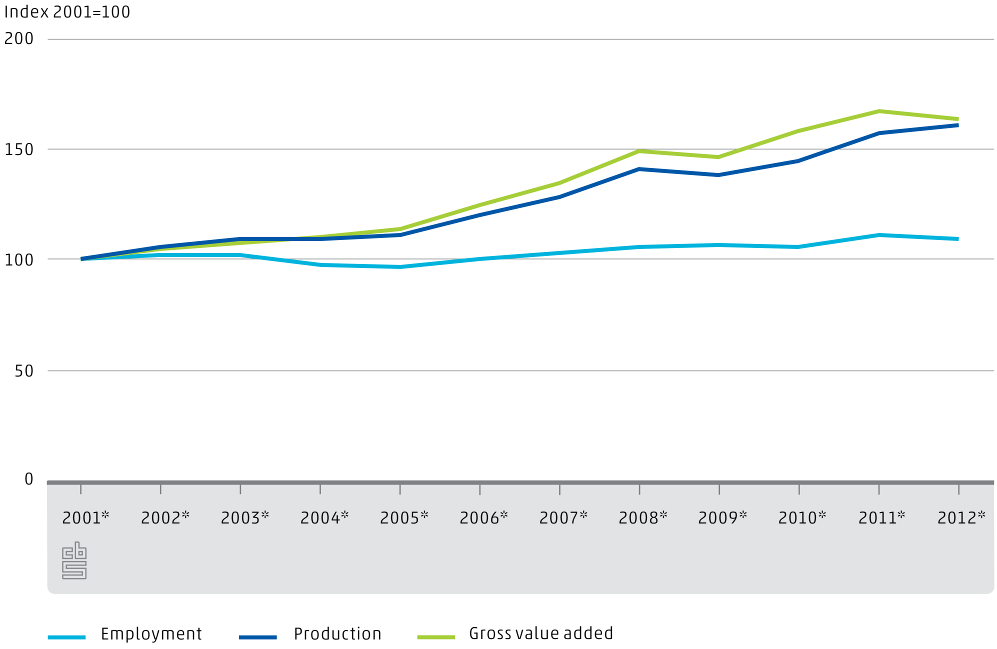
The time series on the EGSS (2001–2011) have been revised. Many of the economic activities within the EGGS are quantified on the basis of economic figures from the National Accounts and the labour accounts. Both accounts were revised in 2014 in order comply with the new accounting principles of the updated European System of National and Regional Accounts (ESA 2010). Also, new methodologies or data sources have been implemented for several activities. Especially insulation activities in the construction industry (existing residential and non-residential buildings) have figures that are noticeably different because of the implementation of new methodologies and data sources.

The time series for the National Accounts and labour accounts (2001–2013) have a provisional/preliminary status, this also applies to the EGSS results presented in this section and online (StatLine).

The figures are compiled according to the guidelines of the handbook on the EGSS (Eurostat, 2009). Data collection is based on three methodological studies carried out at Statistics Netherlands (commissioned by Eurostat). An overview of these studies is presented in a methodological paper on the EGSS available at the website of Statistics Netherlands (Statistics Netherlands, 2012a). The next section presents the results for the EGSS in the 2001–2012 period.

Employment and gross value added decreased in 2012

4.2.1 Employment, production and gross value added in the EGSS

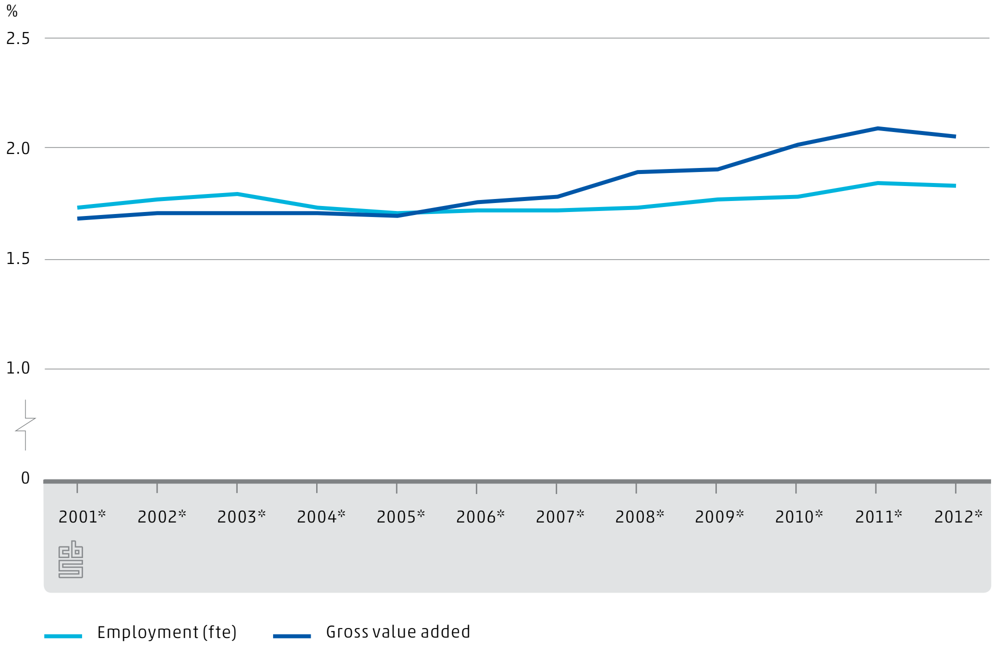


Gross value added and production in current prices both grew in 2001–2012 (Figure 4.2.1), although there were several years of decline. In 2009, when the Dutch economy saw the effects of the global financial crises, gross value added and output decreased for EGSS. Likewise in the most recent year (2012), value declined while production showed a small growth.

Developments in employment in the EGSS were much more stable, total growth was just 10 percent in the 2001–2012 time frame. So the average annual growth was less than 1 percent. Employment fell in 2004, 2005 and later in 2010 and 2012. Employment in the EGSS outperformed employment in the Dutch economy, which saw only a 3 percent growth rate between 2001 and 2012. The share of EGSS in the national employment figure is presented in Figure 4.2.2. Its share is small, but grew from 1.7 percent in 2001 to 1.8 percent in 2012.

Gross value added (basic prices) in the EGSS activities to the gross domestic product (GDP, market prices) in the Dutch economy has increased continuously from 1.7 percent in 2001 to 2.1 percent in 2011. In 2012 it fell a bit as gross value added decreased slightly faster than gross value added in the total economy.

4.2.2 EGSS gross value added and employment as a share in GDP/national employment



Many activities contribute to gross value added and employment in the EGSS

In order to analyse the current status and development of the EGSS, it is interesting to break down the sector's growth into the different activities that take place in it. The next two figures show the growth in gross value added and employment per activity over 2011–2012.

Figure 4.2.3 shows that the gross value added generated in 'Organic agriculture' was 11.3 percent higher than in the previous year. In 2012 the acreage increased by 2 percent and the number of businesses in organic agriculture rose by 3 percent (CBS, PBL, Wageningen UR (2014)). The share of organic farms in the total number of farms has almost doubled between 2001 and 2012. The 'organic share' in the agricultural surface area grew from 1.6 percent in 2001 to 2.7 percent in 2012. While the acreage used in organic agriculture grew by 56 percent between 2001 and 2012, the total acreage for agricultural use decreased by a little over 5 percent. Most gross value added was generated in organic livestock farming. Organic arable farming generated the least gross value added.

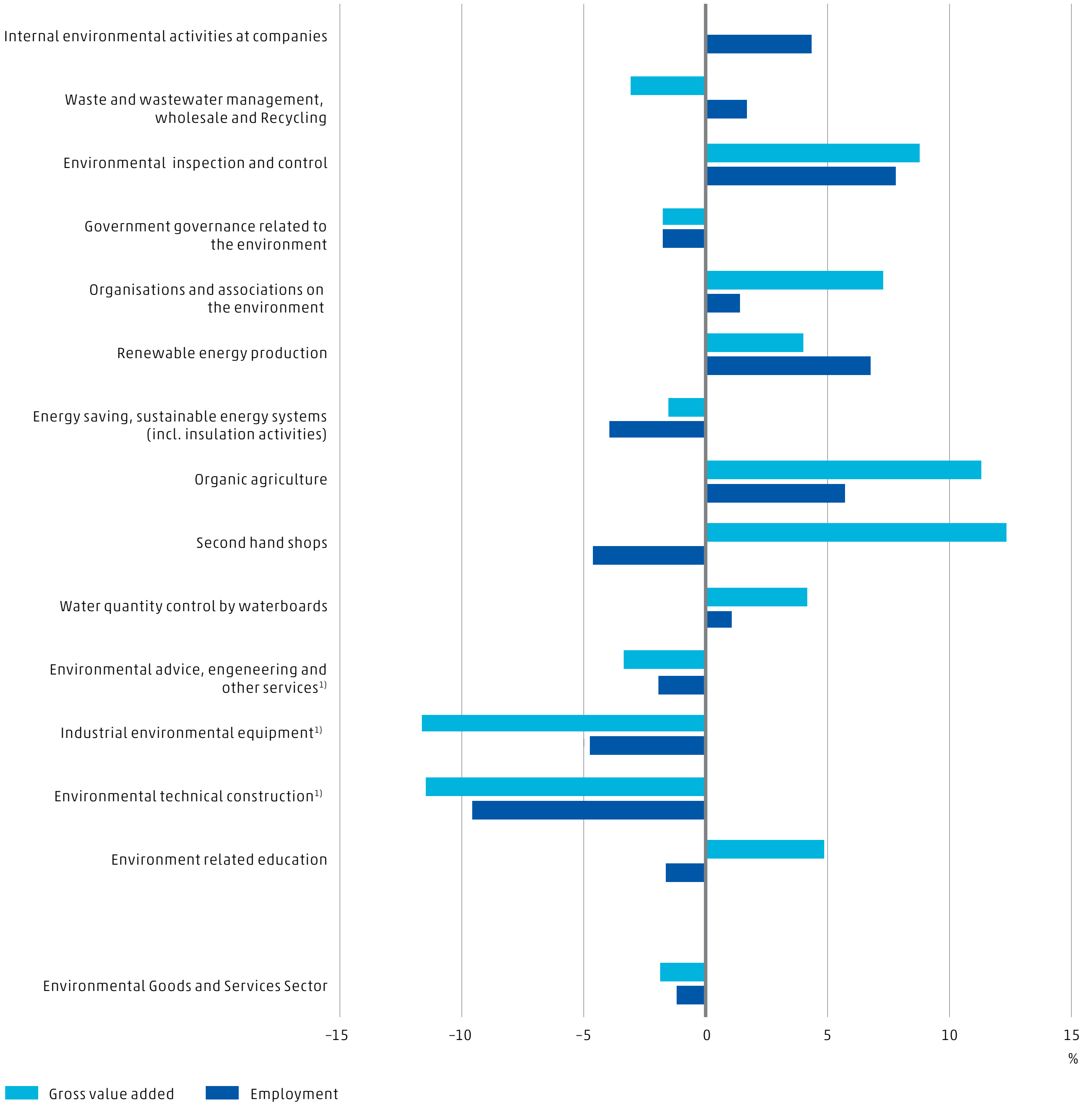
The gross value added of 'Renewable energy production[1]' grew because of the increased production of heat, electricity and biogas from biomass. Gross value added from wind energy declined slightly as there was less electricity production in 2012 than in 2011, on top of which electricity prices fell.

[1] This activity also includes solar energy produced by households.

Gross value added declined by more than 10 percent for both 'Industrial environmental equipment' and 'Environmental technical construction'. Figure 4.2.3 shows that employment also declined rapidly in the relevant construction activities. This is especially true for construction activities related to waste processing plants.

In Waste and wastewater management and in Wholesale and Recycling the gross value added decreased in 2012, partly because prices for ferrous and non-ferrous scrap metals fell. The employment in wholesale activities remained stable.

4.2.3 Change in gross value added and employment for different activities within the EGSS, 2011-2012



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

Figure 4.2.4 presents the economic key figures for the individual activities for 2001 and 2012. Only 3 out of 14 activities saw falling employment numbers, i.e. internal activities at companies, government governance activities and education activities related to the environment. Production in 'Internal environmental activities at companies' also shows a decrease. Gross value added of this activity is zero by definition as the services produced are fully used as intermediate consumption in the production process. The 'Energy saving, sustainable energy systems (incl. insulation activities)' contributed most, nearly 4 thousand FTE's, to the overall growth of employment within EGSS (11.5 thousand FTE's). The 'production of renewable energy' and 'Environment related inspection and control' showed the strongest growth, both employed over three times more FTE's in 2012 than in 2001.

4.2.4 Production, gross value added and employment in the Environmental Goods and Services Sector

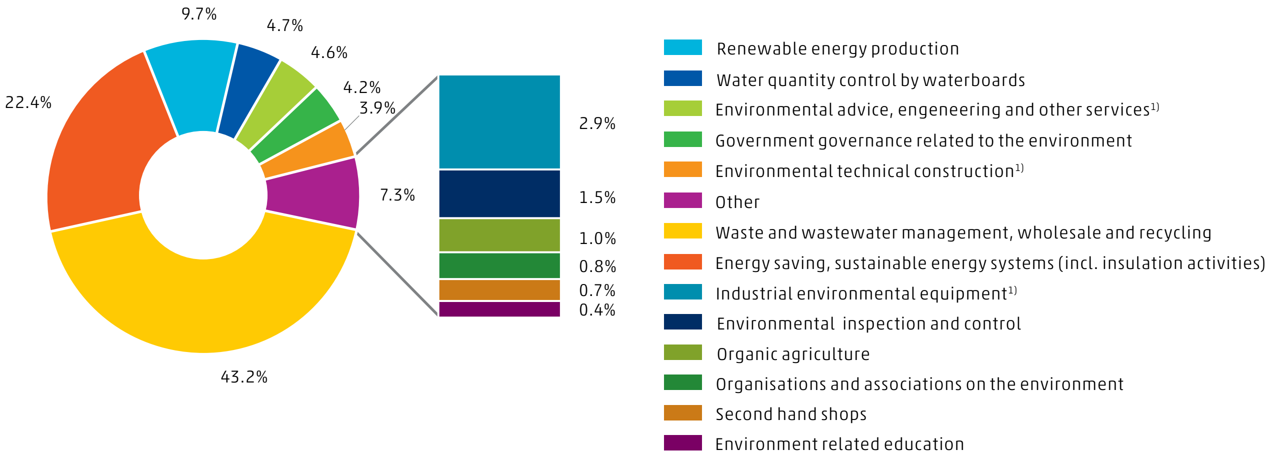
	Production		Value added		Employment	
	2001*	2012*	2001*	2012*	2001*	2012*
	billion euros				FTE (x 1,000)	
Activity						
1. Waste and wastewater management, Wholesale and Recycling	8.3	13.2	3.5	5.7	38.6	41.7
2. Environmental related inspection and control	0.1	0.3	0.0	0.2	0.8	2.5
3. Government governance related to the environment	1.2	1.4	0.5	0.6	10.5	8.7
4. Organisations and associations on the environment	0.1	0.2	0.1	0.1	1.6	1.6
5. Internal environmental activities at companies	1.5	1.3	0.0	0.0	5.0	3.3
6. Renewable energy production	0.2	3.0	0.1	1.3	0.8	3.0
7. Energy saving, sustainable energy systems	5.8	8.7	2.2	3.0	36.2	40.0
7.1. Insulation activities in construction industry	1.8	2.1	0.9	0.9	20.8	17.8
7.2. Other Energy saving and sustainable energy systems	4.0	6.6	1.3	2.0	15.3	22.2
8. Organic agriculture	0.3	0.5	0.1	0.1	1.7	3.0
10. Second hand shops	0.1	0.2	0.0	0.1	1.1	1.8
11. Water quantity control by waterboards	0.6	1.1	0.4	0.6	3.3	3.9
12. Environmental advice, engeneering and other services[1]	0.8	1.1	0.4	0.6	7.0	8.3
13. Industrial environmental equipment[1]	1.2	1.4	0.3	0.4	4.7	5.1
14. Environmental technical construction[1]	1.4	1.8	0.4	0.5	6.6	6.7
15. Environment related education	0.1	0.1	0.0	0.1	0.6	0.4
Total Environmental Goods and Services Sector	21.5	34.5	8.1	13.2	118.5	130.0

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

One 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 earlier in the value chain. Apart from renewable energy, the sustainable energy sector also includes companies and institutions that focus on energy saving activities. The sustainable energy sector consists of two activities: 'Renewable Energy production' (exploitation of renewable energy production facilities) and 'Energy saving, sustainable energy systems (incl. insulation activities)'. The latter includes, for example, the construction of (offshore) wind farms, the manufacturing of solar panels and the manufacturing as well as the installation of insulation materials for buildings.

The sustainable energy sector[2] in 2012 was responsible for 32 percent of the total (gross) value added in the EGSS. The three more traditional environmental activities combined, i.e. waste and wastewater management, recycling and the wholesale of waste and scrap, hold the largest share in gross value added (43%) of the distinct activities in figure 4.2.5.

4.2.5 Distribution of gross value added in the EGSS over different activities, 2012*



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

[2] In October 2014 ECN (Energy Research Centre of the Netherlands), PBL (Environmental Planning Agency of the Netherlands, RvO) and Statistics Netherlands published the 'Nationale Energie Verkenning' (National Energy Intelligence report), available in Dutch. This report provides more details on the sustainable energy sector.

5.

Green growth in the Netherlands

Green growth is a theme that is receiving much attention, both internationally and nationally. This chapter provides an update for the monitoring of green growth in the Netherlands. The OECD measurement framework for green growth and its underlying themes are presented which is the basis for monitoring green growth in the Netherlands.

5.1 Introduction

The performance of an economy is usually measured in terms of changes in its gross domestic product (GDP). Economic growth, i.e. the increase of GDP, offers benefits such as welfare, but it also has negative side effects. So there are various reasons to look at the nexus of the environment and economy. Non-renewable resources such as fossil fuels and some metals are becoming scarce, and renewable stocks, such as fish and forests, are vulnerable to over-exploitation. In turn, these developments can hamper future growth. In addition, there is substantial scientific evidence that the quality of our environment is degrading to a critical level. For instance, global boundaries such as the concentration of greenhouse gases in the atmosphere, water extraction and biodiversity losses have exceeded their tipping points (Rockström et al. (2009), IPCC (2013)). There is international consensus that more action is required (e.g. OECD (2008) UNEP (2009), UN (2012a)).

As a result of these concerns, the notion of 'greening the economy' is receiving more attention from policy and decision makers. It was one of the central themes on the United Nations Conference on Sustainable Development (Rio+20) in June 2012. Also in the Netherlands green growth is high on the political agenda. The government is committed to realizing economic growth that does not deplete nature's resources (EZ (2013)). As part of the Green growth policy, the Green Deal Programme aims to involve the private sector in the green transition. The Netherlands will also pursue greener production outputs by switching to a bio-based economy. The national energy agreement, which was negotiated in the summer of 2013 between the social partners, environmental organizations and the government and includes agreements on energy, clean technology and climate policy, is key to contributing to 'green growth' in the Netherlands (SER (2013)).

In this chapter an overview is presented of the status of green growth in the Netherlands based on a dashboard of 36 indicators which follow the OECD measurement framework for green growth. It provides an update for the two Green growth publications that have been published in 2011 and 2013. For more information see also the *Sustainability monitor of the Netherlands* (CBS (to be published on 25 November 2014)).

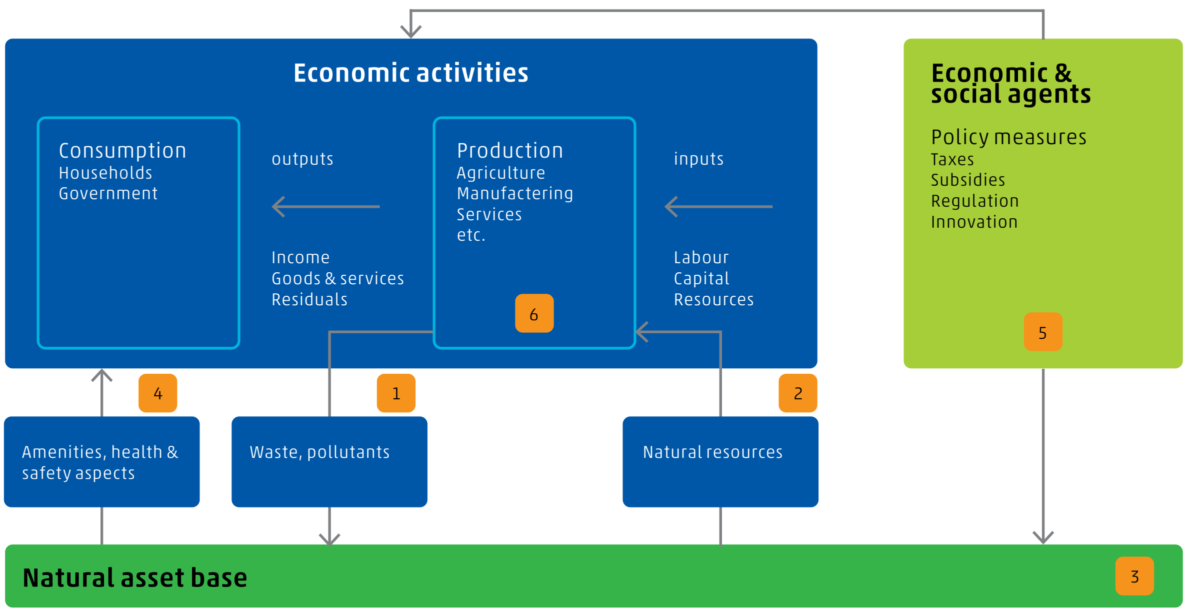
The OECD measurement framework for green growth

The concept of 'greening the economy' is still relatively new. Two important recent initiatives focus on the economic and ecological aspects of sustainability, namely the green growth strategy of the OECD and the green economy of UNEP (United Nations Environment programme). Although both initiatives broadly encompass the same topics, there are some conceptual differences.

According to the definition formulated by the OECD (OECD (2011a)), green growth is about '*fostering economic growth and development while ensuring that the quality and quantity of natural assets can continue to provide the environmental services on which our well-being relies. It is also about fostering investment, competition and innovation which will underpin sustained growth and give rise to new economic opportunities*'. UNEP defines a green economy as one that results in '*improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*' (UNEP (2011)). Statistics Netherlands has chosen to apply the OECD framework to measure green growth as this currently provides the most elaborate measurement framework.[1)]

Indicators for green growth focus on the economic-environmental nexus, that is the extent to which economic activity is being 'greened'. The conceptual framework for measuring green growth developed by the OECD is therefore based on the setup of the production sphere of a macroeconomic model, whereby inputs are transformed into outputs (OECD (2011b)). Accordingly, the indicators describe a) the natural asset base (natural capital) that provides crucial inputs into production, b) the 'greening' of production processes, in terms of improving the environmental efficiency, and c) the outputs, which refers to the broad notion of well-being that also captures aspects not reported by conceptual macro-economic measures (i.e. certain environmentally related services, environmentally related health problems, and amenities). In addition, the production function approach should be supplemented by indicators on government policies and economic opportunities.

5.1.1 OECD measurement framework for green growth



[1)] Recently, the OECD, UNEP, the World Bank and GGGI have taken a first step in harmonisation efforts to develop an internationally agreed framework to measure green growth/green economy (Green Growth Knowledge Platform (2013)). The first outcome paper proposes an indicator framework that is very similar to the OECD conceptual framework and uses the same classification.

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

9. Environmental and resource productivity of the economy

Economic production and growth depend on the environment for inputs of natural resources such as energy, water and basic materials, but also use it as a sink for outputs in the form of waste and emissions. Therefore, *environmental and resource efficiency* and its evolution over time are central measures of green growth. Environmental efficiency is defined as creating more goods and services while using fewer resources and creating less waste. Environmental efficiency can be monitored by the environmental or resource intensity which is defined as the pressure caused by an economic activity (for example CO_2 emissions) divided by the economic value added of that activity (for example GDP) or the environmental and resource productivity (which is the reciprocal of environmental/resource intensity). Efficiency increases may coincide with displacement effects, for example if domestic production is replaced by imports. In view of globalising supply chains as well as the non-local nature of the problems at stake – global warming, worldwide biodiversity losses – it is essential to also include 'footprint' type indicators here that estimates worldwide environmental pressure as a result of national consumption requirements.

10. The natural asset base

In addition to monitoring the relationship between environmental burden and economic growth, it is equally important to ensure that the burden does not exceed nature's carrying capacity, so as to prevent irreversible quality losses of natural assets. It is in the interest of an economy's long-term stability to ensure it retains a healthy balance with its natural resource base. The *natural asset base* (natural capital) is monitored by assessing the stocks of renewable assets, like timber, water, biodiversity, and non-renewable assets such as fossil energy reserves, preferably in terms of quantity and quality.

11. The environmental quality of life

As well as being a provider of resources and an absorber of pollution, the environment also provides ecosystem services such as recreation. Also, a less polluted local environment leads to a healthier population. There is therefore a direct link between the *environment and quality of life*, which is captured in the third set of indicators.

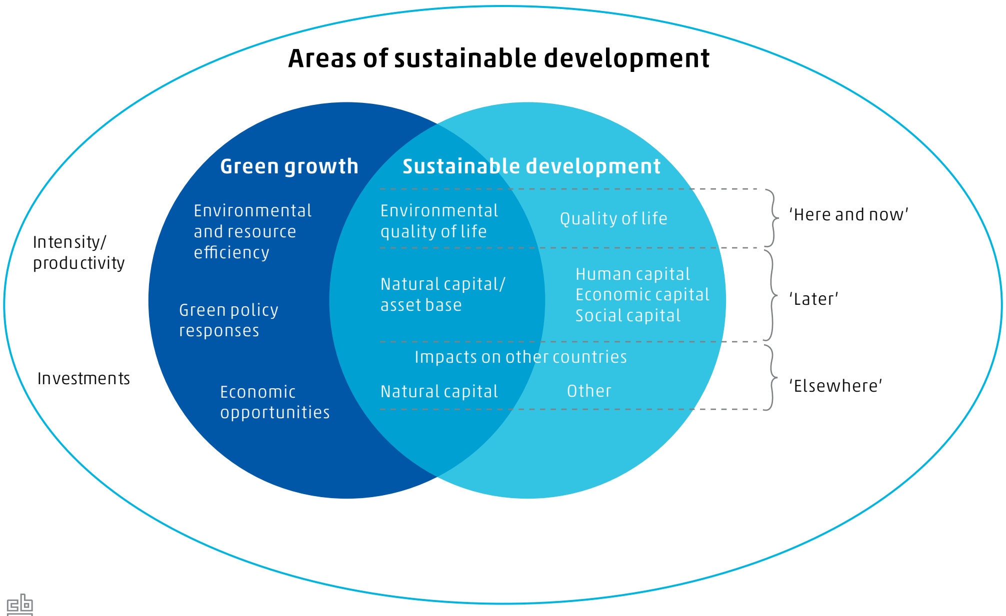
12. Policy responses and economic opportunities

This category combines two type of indicators, namely on policies that stimulate green growth and on economic opportunities. Governments can choose between several policy instruments such as taxes, subsidies and regulation to steer development in a preferred direction. Monitoring the extent and effects of these 'green' instruments is of great interest to policy makers. These measures will also create new opportunities for economic activities that may generate new jobs and stimulate economic growth.

Green growth and sustainable development

Sustainable development and green growth/green economy are sometimes thought to be the same. Although they have similar goals in preserving sufficient natural resources and protecting the environment for future generations, there are some clear differences. The cores of sustainable development and green growth partially overlap on the green aspects such as environment, quality of life, natural capital and impacts on global natural capital (see figure below). Yet each measurement framework also focuses on specific issues that are not addressed by the other. General human well-being, human and social capital form the core of sustainable development while green growth focuses on environmental and resource productivity, green policy responses and economic opportunities. Green growth can be seen as the path towards sustainable development. In an overarching view, green growth and the core measurement of sustainable development are conceptually not conflicting and can be regarded as part of the broader domain of sustainability, as is illustrated in the figure below.

Green growth and sustainable development



Scoring of the indicators

Data for the Dutch green growth indicators originate from several different sources. Many indicators are derived from the Dutch environmental accounts. Other indicators come from a variety of statistics, including environmental statistics, energy statistics, and innovation and technology statistics. A few indicators are obtained from sources outside Statistics Netherlands.

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

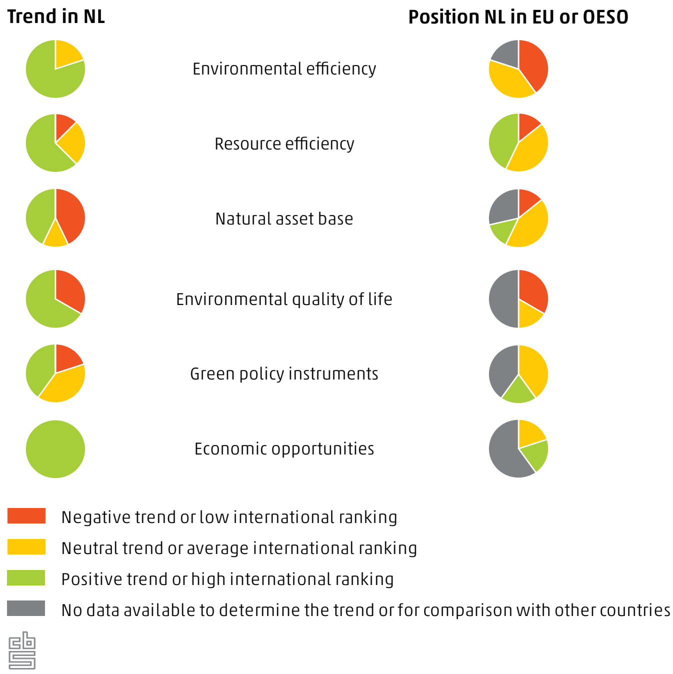
The scores for environmental and resource efficiency indicators are based on the relationship between environmental pressure and economic growth. When economic growth exceeds the increase of the environmental indicator in a given period, it is called decoupling. Decoupling can be absolute or relative.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

It is important to emphasise that these scores do not convey the 'speed' of greening economic growth. For example, the share of renewables in energy production is growing. But this 'positive' score does not express how fast the transition towards renewable energy production is taking place. In addition, the scores of the indicators do not convey whether these developments are sufficient to prevent irreversible damage to the environment. So, the steady decrease of nutrient and heavy metal emissions to the environment may not be able to prevent damage to ecosystems and loss of biodiversity. Finally, the scores also do not convey if policy targets are met. Scores and, if available, policy targets are described in more detail in the respective indicator descriptions.

5.2 Green growth according to the OECD measurement framework

Overall, the Dutch economy has generally become ‘greener’ since 2001. However, this development has taken place gradually and is not yet observed for all aspects of green growth. This becomes clear when looking at the different themes of the green growth framework shown in the figure below.

5.2.1 Overview green growth in the Netherlands



The Dutch economy exerts less direct pressure on the environment than in 2001. All *environmental efficiency* indicators for emissions and waste show absolute decoupling with economic growth. For example, the emissions of greenhouse gases and the emissions to water of heavy metals have decreased since 2001 while GDP increased. Energy saving, higher imports of electricity and the financial and economic crisis are important reasons for the decline of production-based greenhouse gas emissions. It is striking however, that while the environmental efficiency within the Netherlands has improved significantly, the international position of the Netherlands is still average compared to other EU and OECD countries. Nutrient surpluses in agriculture are still the highest in Europe. Greenhouse gas emissions from consumption activities (the carbon footprint) have remained stable, which contrasts with the direct emissions from production activities. The carbon footprint of the Netherlands is very high compared to other EU countries. This is due to the high level of consumption in the Netherlands and also because a large part of the electricity used in the Netherlands is generated from fossil fuels.

All indicators for *resource use* efficiency show that fewer resources are required to generate an equal amount of value added. For biomass, minerals and metals the absolute level that is needed for economic production are decreasing (absolute decoupling). The raw material footprint has increased between 2008 and 2012. Although we use fewer materials directly in our economy, we indirectly consume more raw materials abroad. The energy use for production activities is more or less on the same level as in 2001. Internationally, the Netherlands scores average for resource efficiency. The percentage of renewable energy production increases, but is still very low compared to other countries.

Although environmental and resource efficiency are improving, it does not mean that the economic growth inflicts no damage to the environment in the Netherlands. The group of indicators for *the natural asset base* shows a rather negative picture. This is mainly caused by a deteriorating biodiversity (farmland bird index), a high rate of conversion into built up land and decreasing energy reserves. The number of endangered species (in Dutch: *Rode Lijst indicator*) has stabilised since 2005 and thus shows an improvement for the first time. The stocks of timber and the quality of fish stocks are improving. However, fish stocks in the North Sea are still close to threat levels. Internationally, the Netherlands scores average on this theme. The Netherlands scores above average with respect to the standing stock of timber, and below average with respect to land conversion into build up land.

Indicators for the *environmental quality of life* show a rather mixed picture. This theme measures the direct impact of air, water and soil emissions on the quality of life and perception. The urban exposure to particulates (PM_{10}) is improving, but very few water bodies comply with the ecological quality standards defined by the European Water Framework Directive. The biological water quality has improved between 2009 and 2012, whereas the chemical quality has further deteriorated. Although the environmental quality of life and natural assets score rather negatively, indicators for perception (environmental concern and willingness to pay for the environment) show a sharp decline over the past decade. In 2012, 40 percent of the respondents believed that the environment was strongly polluted and only 24 percent were willing to pay extra taxes to protect the environment.

Indicators for *green policy instruments* also show a varied picture. The share of environmental taxes in total tax revenues has been constant for several years and has recently shown a decline. Also, the share of environmental subsidies in total government expenditures has been constant since 2005. Environmental expenditure as a share of GDP has decreased in recent years, indicating that less financial resources have been committed for the protection of the environment. Although the trend of greening policy instruments stabilized or declined in the recent years, the Netherlands scores very high on these indicators when compared internationally. For instance, it possesses one of the highest share of green taxes and has a very high implicit tax rate for energy.

All indicators show that the *economic opportunities* that arise from greening the economy increase. For instance, the share, but also the absolute number of green patent applications has grown significantly since 2001. Also internationally, the Netherlands has a high share of green patent applications. Furthermore, the share of the environmental goods and service sector (EGSS) is increasing steadily with respect to employment and value added in the Dutch economy. For example, the employment in the sustainable

energy sector (part of the EGSS) has grown by 23 percent since 2001, while employment in the Netherlands increased by only 2 percent. The share of environmental investments is higher than in 2001, although it has decreased since 2007.

5.2.2 Scores of green growth indicators according to the OECD framework

Theme	Indicator	Trend since 2001	Position of the Netherlands in Europe/OECD
Environmental efficiency	Production-based greenhouse gas emissions	green	yellow
	Carbon footprint	yellow	red
	Emissions to water, heavy metals	green	grey
	Nutrient surpluses	green	red
	Waste generation	green	yellow
Resource efficiency	Net domestic energy use	yellow	yellow
	Renewable energy share in total energy use	green	red
	Groundwater abstraction	green	green
	Water footprint	grey	grey
	Domestic metal consumption	green	yellow
	Domestic mineral consumption	green	yellow
	Domestic biomass consumption	green	green
	Raw material footprint	red	grey
	Waste recycling	yellow	green
Natural asset base	Stocks of standing timber	green	green
	Stocks of fish	green	grey
	Energy reserves	red	yellow
	Farmland birds	red	yellow
	Red list indicator	yellow	yellow
	Biodiversity footprint	green	grey
	Land conversion into built-up land	red	red
Environmental quality of life	Urban exposure to particulates	green	yellow
	Chemical quality of surface waters	red	red
	Biological quality of surface waters	green	red
	Nitrate in groundwater	green	grey
	Level of concern	green	grey
	Willingness to pay	red	grey
Green policy instruments	Environmental taxes as share of total tax revenue	red	green
	Implicit tax rate for energy	green	yellow
	Environmental subsidies and transfers	yellow	grey
	Mitigation expenditure by government	green	grey
	Environmental protection expenditure as percentage of GDP	yellow	yellow
Economic opportunities	Green patents	green	green
	Environmental investments as share of total investments	green	yellow
	Contribution renewable energy sector to total employment	green	grey
	Contribution EGSS to total employment	green	grey
	Contribution EGSS to total value added	green	grey

6.

Do the new SNA 2008 concepts undermine Environmental Input Output Analysis?

The new SNA 2008 (UN, 2009) guidelines have led to changes in the recording of global manufacturing in National Accounts worldwide. The SNA 1993 stipulated that exports and imports of goods should be recorded at the time ownership passes from a resident to a non-resident unit, but allowed for several exceptions to the ownership principle in case of merchanting, goods sent abroad for processing, and goods shipped to a foreign affiliate (UN, 1993). With the SNA 2008 these exceptions have been dropped in favour of the application of pure ownership criteria. This chapter explains the theoretical consequences of the new SNA 2008 guidelines for IO analysis.[1)]
The effect of the new SNA 2008 guidelines on footprint indicators is quantified by reversing the conceptual changes for global manufacturing in the Dutch 2010 after revision IO table and compares the outcomes.

6.1 Introduction

The System of National Accounts (SNA) is the internationally agreed standard set of recommendations on how to compile measures of economic activity (UN et al. 2009). In 2008 new SNA guidelines were adopted by de United Nations Statistical Commission. These new SNA guidelines (SNA 2008) have led to changes in the recording of global manufacturing. The SNA 1993 stipulated that exports and imports of goods should be recorded at the time in which ownership passes from a resident to a non-resident unit. However it noted four possible exceptions to the ownership principle: goods subject of a financial lease; goods shipped to a foreign affiliate; merchanting, and goods sent abroad for processing.[2)] With the SNA 2008 these exceptions have been dropped in favour of the application of pure ownership criteria.

The SNA 2008 recommendations are largely motivated by the empirical realities of a globalising world in which it becomes increasingly difficult to monitor production processes, especially when supply chains are lengthening and the businesses involved are increasingly interconnected across multiple countries. As a result, the SNA 2008 has made the explicit choice to follow more closely those business accounting practices where ownership concepts play a key role. In this way economic statistics are more compatible with economic reality and data collection is easier, which in the end leads to a better quality of economic statistics. The downside, however, is that a wedge has been driven between monetary and physical descriptions of the economy.

The SNA 2008 recommendations have major implications for the National Accounts, in particular for the recording of imports and exports, but also the recording of production and intermediate use, with the result that the input-output tables will also change. The recommendations also have a major impact on the environmental accounts (UN, 2014), especially concerning hybrid environmental indicators like emission-intensities and consumption-based indicators which are based on input-output analysis.

1) This chapter has been submitted, as a conference paper, to the 22nd International Input–Output Conference, 14–18 July 2014, Lisbon (Maarten van Rossum, Roel Delahaye, Bram Edens, Sjoerd Schenau, Rutger Hoekstra and Daan Zult).
2) The rationale for the first two exceptions was that although legal ownership did not change, economic ownership was effectively changed with the transferral of responsibilities and risks. Merchanting was recorded net in order to measure the value of the service the merchant provides. Processing was recorded net or gross depending on the extent to which the identity of the goods sent abroad was changed (with 3-digit CPC as criteria).

The objective of this paper is to investigate to what extent the new SNA 2008 concepts undermine the ability to conduct Environmental Input Output analysis. The main novelty lies in the fact that we will quantify the effect of the new SNA 2008 guidelines on footprint indicators. This is accomplished by reversing the conceptual changes for global manufacturing in the Dutch 2010-after-revision-IO table. Subsequently, we compare outcomes for footprint analysis using both tables.

The outline of this paper is as follows. In section 6.2 we will briefly describe the SNA 2008 recommendations related to processing, deliveries between affiliates, merchanting and production abroad. In Section 6.3 we will discuss the implications of the SNA 2008 recommendations for various aspects of the environmental accounting system, in particular environmentally extended input-output analysis. In Section 6.4 we discuss in detail how we have reversed the conceptual changes in order to construct a reversed 2010-after-revision IO table. In Section 6.5 we present our results, followed by discussion and conclusions in Section 6.6.

6.2 The SNA 2008 recommendations

Goods sent abroad for processing (GSP)

The SNA 1993 stipulated that in case of goods sent abroad for processing (or goods sent to a foreign affiliate) a change of ownership had to be imputed even in case no change in legal ownership occurred. According to the revised SNA 2008 ownership transfer (or a product transaction) is leading without exceptions in determining how to record commodity import and export flows. This implies that goods sent abroad for processing are no longer automatically recorded as imports and exports in the National Accounts. However, they are – at least for now – still recorded in international trade statistics where as a general rule the cross border registration principle is followed. To clarify the issue upfront, let us consider the following realistic example for the Netherlands (Van der Holst and de Haan, 2010):
An oil refinery plant (the processor) – resident in the Dutch economic territory – converts 75 million euros worth of crude oil into 100 million euros worth of petrol. The crude oil is owned by a foreign parent company and shipped in from abroad. The foreign parent sells the petrol abroad. The oil refinery plant receives processing fees from the parent company to compensate for operational costs.

The differences between the 1993 and the SNA 2008 recording of this economic activity are illustrated in table 6.2.1. The SNA 1993 demands the imputation of a transfer of ownership. In this way the output of petrol and intermediate consumption of crude oil is explicitly covered in the production account of the oil refinery plant. The new national accounting guidelines do no longer allow this imputation, and as a result imports of crude oil and exports of petrol are no longer recorded. Instead exports consist only of industrial services delivered to the owner of all products (crude oil and petrol).

6.2.1 Global manufacturing: inward industrial processing

	mln euro
According to SNA 1993	
Output of petrol	100
Intermediate use of crude oil	75
Value added	25
Imports of crude oil	75
Exports of petrol	100
According to SNA 2008	
Output of industrial services	25
Value added	25
Export of industrial services	25

In theory, these new accounting conventions do not lead to a difference in value added or to different trade balance totals.[3] *However, these new accounting conventions do lead to changes in the amount of production. In our example, production has been downwardly adjusted due to the new recording conventions.*
The mirror situation in which the domestic economy sends goods abroad for processing (outward industrial processing) is treated similarly. In this case, the domestic economy exports crude oil (intermediate use) and imports petrol (production) according to SNA 2008 concepts. A processing fee is imported.

Merchanting

Merchanting occurs when a resident buys goods from a non-resident, and sells these goods to another non-resident without these goods ever entering the economic territory of the resident. *A Dutch merchant buys 100 euros worth of timber in Ghana from a Ghanese company and subsequently sells these for 120 euros to a Chinese company.* The SNA 1993 would record only the margins of the merchanter in our case 20 euros as exports of services. In case of a strict application of the ownership principle, one should record imports of timber and exports of timber, where the margin would be a valuation layer balancing supply and demand. This would, however, result in major changes to total import and export values. Therefore, it was decided in the SNA 2008 to record the imports of timber as negative exports. In the example we would have remaining positive exports of timber of 20 euros.

During the revision process of the Dutch National Accounts it was decided not to distribute the merchanting margins to underlying products within the balancing routines. The merchanting margins are considered as a separate product in the Dutch National Accounts. At the same time, an estimate has been made for the value of imports and exports of goods that are subject to merchanting. The margin is no longer recorded as service exports but as exports of goods. There is therefore no effect on GDP, but the main implication is on the respective trade balances of goods and services. The values of

[3] As argued in De Haan and van der Holst different ways of measuring (not based on imputed product flow values) of these activities may nevertheless lead to changes in outcomes.

these imports and exports need to be deducted from the SNA 2008 table, and the margin reinserted as service exports.

Production abroad (PA)

Production abroad occurs when a resident company has economic ownership of all the inputs and outputs of a production process, while the actual production takes place abroad. It differs only slightly from processing (and could also be considered a special case of processing), the main difference being that with production abroad both the inputs and outputs are usually bought and sold abroad (Van der Ende and Verbiest, 2011).

Although the actual production process takes place abroad, according to the SNA 2008 accounting framework all the output is recorded in the domestic National Accounts. Likewise, all inputs are recorded as imports, even though they probably will not be recorded in international trade statistics. In general, production and intermediate consumption will increase as well as imports and exports.

Deliveries between affiliated enterprises

In the case of deliveries between affiliated enterprises (parent company and daughters) the SNA 1993 by definition assumed a transfer of ownership in the case of border crossing. Using the new guidelines, this is no longer the case. Using the SNA 2008 the first assessment is whether or not the resident group company is the economic owner of the goods (the degree of control over contracts, prices and quantities). When the resident group company is not the economic owner of the goods, it provides a service. In the opposite case, if the resident group company remains the owner of the goods, it is importing a service. It is assumed that the value of the service is broadly equal to the balance of the flow of the goods (GDP effect zero). Goods shipped to foreign affiliates result in similar adjustments as goods send for processing.

6.3 Implications of SNA 2008 recommendations for environmental accounting (SEEA 2012)

The implications of the SNA 2008 are not confined to the National Accounts only. From its inception, the SEEA (System of Environmental-Economic Accounting; UN et al. 2014) supplements the monetary transactions recorded in the SNA with descriptions of physical flows. For example, Economy Wide Material Flow Accounts describe the use of various types of materials (metals, energy, biomass) by the economy. With the new SNA guidelines, the monetary description of economic activity focusses primarily on changes in ownership and its subsequent financial settlement, at the expense of a focus on the actual production process (Van der Ende and Verbiest 2011).

Indeed, as the refinery example showed, a wedge is driven between the physical and monetary description of the economy (UN, 2011): from an economic perspective the refinery can indeed be portrayed as a service producer, but from a physical perspective it transforms crude oil into petrol, which is no longer reflected in the National Accounts. This issue was debated during the SEEA revision (Van Rossum et al. 2011) and was finally concluded (UN et al. 2014, para 1.36/1.43) as follows:

'Because it uses the same accounting conventions, the SEEA Central Framework is, in general, consistent with the SNA. However ..., there are some differences: ... in situations of goods send to other countries for processing or repair, or in cases of merchanting, the SEEA Central Framework recommends recording the actual physical flows of goods...'.

The choice for a physical description has severe implications for environmental accounting practices. It implies for instance that hybrid indicators like energy-productivity will differ dramatically depending on the use of the SNA 1993 or the SNA 2008. Some of these issues may be avoided by using hybrid energy indicators on value added.
The ramifications for environmental IO analysis, which is the main focus of this chapter, are highly problematic. First and foremost, because the National Accounts are no longer aligned with international trade in goods and services, which exclusively follow a cross-border principle, trade linking practices are undermined. Second, it also implies that industries become less homogeneous in case processing occurs, which causes difficulties for the estimation of environmental extensions (Miller and Blair, 2009).

There seem to be three possible options to assure consistency of results of IO analysis:
- Adjust SNA 2008 IO tables by reversing the conceptual changes for global manufacturing.
- Separately identify production abroad and regular manufacturers in the IO table. For such industries the IO table would therefore obtain an extra row and column; each with their own emission coefficients.
- Aligning production boundaries for pressures (e.g. CO_2) and the economy in the case of production abroad.

The first option has the advantage that it is consistent with the SEEA approach (describing physical reality). Moreover, by reverting the conceptual changes for global manufacturing, the import and export data would be much closer to the values reported in international trade statistics.
The second option has as its main advantage that it is consistent with the SNA. Its main drawback, however, would be that it requires splitting industries as well as making specific estimates of emissions caused by processors (resident/non-resident) and non-processors. In this chapter we explore the feasibility of following the first approach as it is in line with the SEEA CF recommendations.

6.4 Methodology

In order to quantify the empirical impact of the new SNA 2008 guidelines on global manufacturing and discuss its magnitude, we want to compare the outcomes of using the SNA 2008 IO table, with an IO table in which conceptual changes for global manufacturing have been reversed. We have chosen the year 2010 as this was the year used for the SNA 2008 revision in the Netherlands.

Reversing global manufacturing in the IO table

Earlier on in 2014 Statistics Netherlands finished the SNA revision for the revision year 2010 (Statistics Netherlands 2014). As a result, the IO table based on the SNA 2008 concepts was compiled. Subsequently, this table was adjusted in order to reverse the new measures introduced by the SNA 2008 concepts related to global manufacturing. The adjusted IO table records goods sent for processing, deliveries between affiliates, merchanting and production abroad according to SNA 1993 concepts. All other SNA 2008 conceptual changes (i.e. those not related to these specific issues) remain part of the adjusted table.

Adjustments of the SNA 2008 IO table are based on data gathered by the international trade division of the National Accounts department. This division converts gross international trade flows of products (taken from the international trade statistics) into net service flows (processing fees) in case of processing. In case of production abroad, trade of goods are added to the international trade statistics data. In order to compile the adjusted IO table all changes made because of production abroad and goods sent for processing had to be 'reversed'. This means gross trade of goods was added and the trade of services (as the net value of the imported and exported goods) was subtracted. If possible the adjustments were made without changing GDP. Finally, gross flows of merchanting – that is the purchase of goods by residents from non-residents where the resale of the same goods is to other non-residents without the goods ever having been present in the compiling economy – were removed from the SNA 2008 IO table. As a result the main changes in the IO tables relate to the import rows and export columns.

6.4.1 Descriptive statistics: differences between the two IO tables (SNA 2008 vs. adjusted table), 2010

	%
Exports	–3.4
Imports	–3.3

In Table 6.4.1 the extent of all the conceptual changes related to global manufacturing are shown (based on input-output tables 2010). In total, imports and exports are adjusted by 3.4 and 3.3 percent respectively[4)]. The adjustments are very much concentrated in manufacturing. The differences presented in table 6.4.1 represent the sum of all corrections related to processing, merchanting and production abroad.

6.5 Results

For the year 2010 we have tested if and to what extent the new SNA 2008 guidelines have a substantial impact on the results of IO analysis. For this purpose, we have chosen a 'simple' analysis where domestic CO_2 emissions are attributed to final demand categories. The IO model used is explained in greater detail in Edens et al. (2011). It seems that at meso level (industry and product level) the impact is quite significant.

4) In the case of merchanting, gross flows are recorded in the Dutch input/output tables.

However, at the macro level the impact seems less substantial, mainly because the plusses and minuses at the meso level cancel out at the macro level. Altogether a shift of 1.15% from final demand towards exports occurs. These results can be explained by three factors:

13. The Leontief inverse has changed due to less homogenous industries

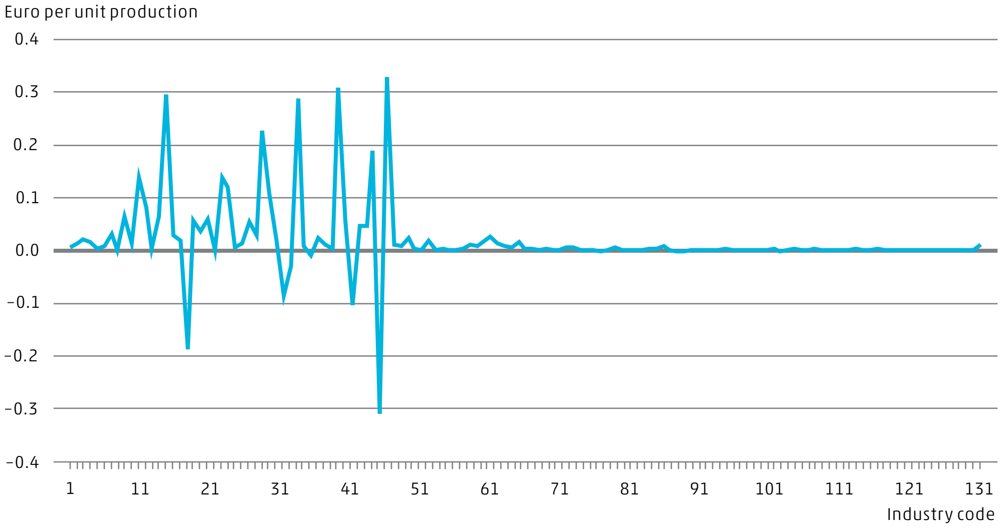
The different structure of the input-output table also affects the Leontief inverse and its corresponding multipliers. Not a single multiplier is unaffected when one replaces SNA 2008 IO-tables by the reversed table. The multipliers that are most affected are the multipliers of the industries that are most affected by the new SNA concepts, as depicted in Figure 6.5.1.

6.5.1 Descriptive statistics: Emissions embodied in final demand categories, difference 2008 SNA vs. adjusted table

	Exports	Consumption government	Consumption households	Stock changes	Investment
	mln kg				
Agriculture	–1	0	22	1	3
Mining & Manufacturing	–1,131	2	280	–18	82
Energy companies and environmental services	2	0	4	0	2
Construction	17	0	3	0	222
Trade	13	0	8	0	1
Transport	95	1	154	0	14
Commercial and non-commercial services	13	85	106	0	18
Macro	–992	88	577	–17	343

In general the manufacturing industries such as the oil industry, the chemical industry and tobacco industry are most affected. According to the SNA 2008 concepts these industries produce relatively more services and less goods.

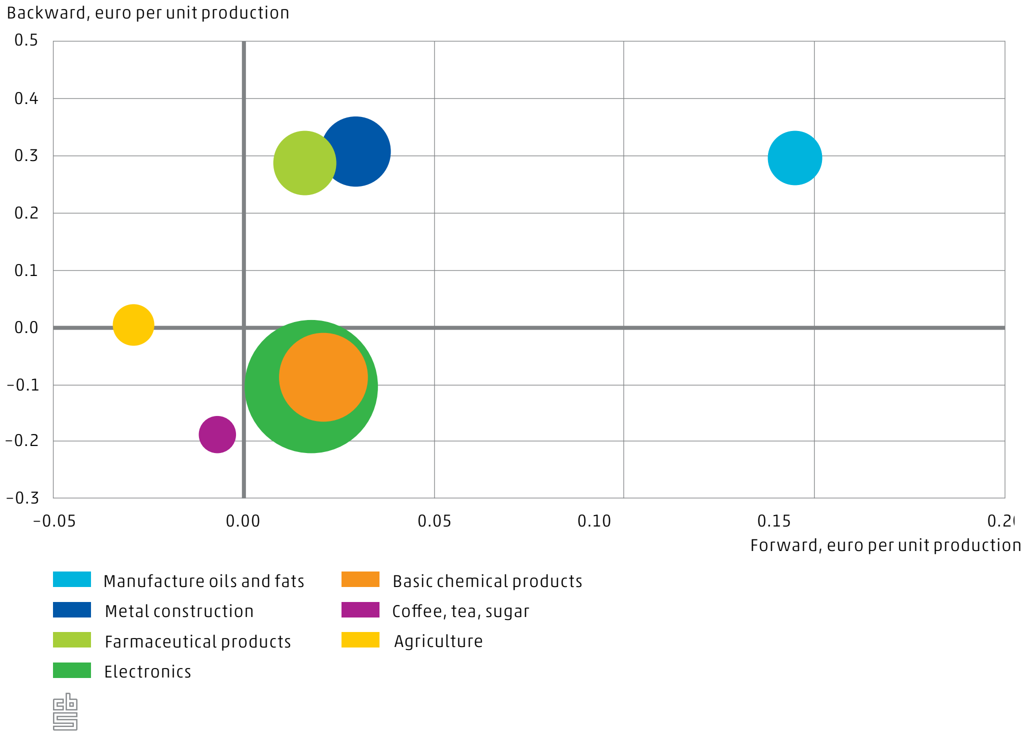
6.5.2 Difference in output multiplier (backward linkage) per industry[1)]



1) SNA 2008-adjusted table; from left to right: agriculture, industry, services (133 industries).

It is important to distinguish between backward linkages (the column totals of the Leontief inverse) and forward linkages (the row totals). Backward linkages indicate the effect an increase of output of industry *i* has on the required inputs from other activities, and therefore provide a measure of induced economic activity; forward linkages express the sensitivity of industry *i* to changes in outputs from other industries (Guo and Planting, 2000).

6.5.3 Differences in backward and forward output multiplier for a few selected industries, SNA 2008 vs. adjusted table, 2010



Electronics production (ISIC[5]) 26) and basic chemical products (ISIC 20) show large decreases in backward linkages and smaller increases in forward linkages. In the electronics production sector this is caused primarily by corrections for production abroad, which have led to significant downward adjustments for production and intermediate consumption during reversal.
Examples of activities that experience increases in forward and backward linkages are the manufacture of oils and fats (part of ISIC 10) and metal production (part of ISIC 25) and pharmaceutical products (ISIC 21). In case of oil and fats production, this is caused by corrections made for processing, which increases total output by this sector when reversing. The relative linkages with the domestic economy therefore decrease.

14. Recording of products (services versus goods) is not the same for final demand categories

Emissions embodied in final demand are allocated to different final demand categories (by means of their corresponding share in total final demand per industry). Final demand is recorded differently per category using the rules of SNA 2008. Products destined

5) ISIC stands for the International Standard Industrial Classification of All Economic Activities.

for 'exports' are valued less than products destined for 'consumption of households'. This results in less embodied emissions in 'exports' and more emissions embodied in 'consumption of households' and the other final demand categories.

15. Emission intensities have changed
Emission intensities are defined as emissions divided by production in IO analysis. Because production changes due to the new regulations, emission intensities change as well and become less homogenous. More globalisation probably will lead to less homogenous industries over time.
These three factors combined explain the different outcomes of using SNA 2008 IO tables instead of SNA 1993 IO-tables.

6.5.4 Structural Decomposition Analysis of changes in embodied emissions due to reversing

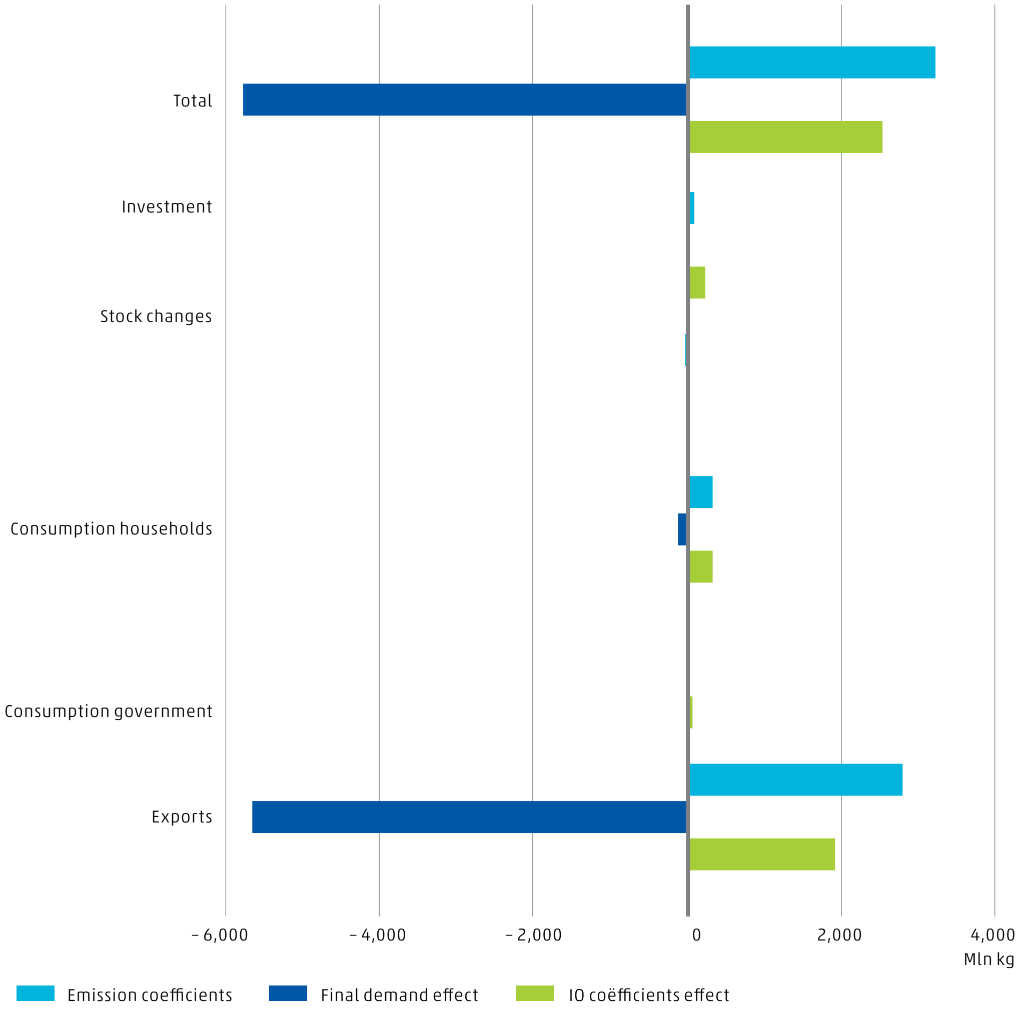


Figure 6.5.4 provides a SDA of the changes due to reversal of the three effects described above for each final demand category. The sum of the effects equals for each demand category the data presented in Table 6.5.1. As could be expected, the largest changes occur in the export column, as this column was modified most during reversal.

Overall, the final demand effect has a negative effect of almost 5.8 Mton CO_2, which is due to the overall decrease in the value of exports. This effect is offset by a positive emissions coefficients effect of 3.2 Mton and a positive change in structure effect of 2.5 Mton. The former is explained as reversing leads to lower exports and hence lower total output and hence higher emission coefficients by industries affected by reversal. The latter effect is likewise explained by changes in output.

Outcomes emission trade balance using SNA 2008 as well as reversed IO tables

For the year 2010 we have also tested if and to what extent the new SNA 2008 guidelines have a substantial impact on the outcome of the emission trade balance of the Netherlands. Embodied emissions in imports of the Netherlands differ substantially using SNA 2008 IO tables or reversed tables (–8.4 percent). This also has consequences for the emission-trade balance (+12.4 percent). Again, the largest impact can be seen for mining, energy companies and manufacturing.

6.5.5 Descriptive statistics: Emissions embodied in trade balance (SNA 2008 vs. reversed table)

	Exports	Imports	Trade balance
	mln kg		
Agriculture	–1	–244	242
Mining and manufacturing	–1,131	–3,921	2,789
Energy companies and environmental services	2	–989	991
Construction	17	2	15
Trade	13	44	–31
Transport	95	–26	122
Commercial and non-commercial services	13	67	–54
Macro	–992	–5,066	4,074

6.6 Discussion and conclusions

The main conclusion is that, for the moment, the new SNA 2008 concepts undermine Environmental Input Output Analysis to some extent. At the meso level (industry and product level) the impact is substantial. Particularly the way in which transactions of emission-intensive manufacturing industries are recorded seems to affect the results. The effects are noticeable at the macro level but limited. This situation may change however in the (near) future, because when globalisation continues its current course it is quite likely to increase the predominance of the phenomena discussed here.

The SNA 2008 guidelines on global production affect the results of environmental IO analysis. The assumption that activities in industries are homogenous is an important assumption in carrying input-output analysis (Miller and Blair, 2009). This assumption is under further pressure because industries become less homogeneous due to the new guidelines.

A response from the IO community is needed to deal with these challenges. The reversal option investigated here proved not too difficult to implement and may be of interest to other researchers. The alternative would be to split up industries to differentiate between processors and non-processors. We believe that this option is more difficult to implement, due to the fact that it would require emissions data to be available at the enterprise level. Moreover, this option would also substantially increase the size of IO tables, and pose additional challenges when trade linking. The results obtained here were due to usage of a simple IO model (domestic technology assumption), in future research we intend to analyse the changes also in an MRIO setting.

7.

Piloting ecosystem accounting

Ecosystem accounts are a novel development within environmental accounting. In this chapter we report on the results of a pilot study commissioned by the Dutch Ministry of Economic Affairs. Its main objective was to investigate the possibility of developing natural capital accounts (more specifically ecosystem accounts) for the Netherlands. The research contributes to a further testing of the SEEA Experimental Ecosystem Accounting guidelines (UN. et al., 2013) that have recently been developed.

7.1 Introduction

Ecosystem accounts are a new development within environmental accounting. The main idea is to provide a description of nature in terms of ecosystems that provide society with ecosystem services. Examples of ecosystem services are provisioning services in the form of water supply or crop production, regulating services such as carbon sequestration or flood protection and cultural services such as nature tourism. Ecosystem accounting is an exciting new development made possible by advances in new observation techniques such as remote sensing and new analysis techniques such as the use of GIS data.

In this chapter we report on the results of a pilot study commissioned by the Dutch Ministry of Economic Affairs. Its main objective was to investigate the possibility of developing natural capital accounts (more specifically ecosystem accounts) for the Netherlands. The research contributes to a further testing of the SEEA Experimental Ecosystem Accounting guidelines (UN. et al., 2013) that have recently been developed. Although there currently is much interest in developing ecosystem accounts (e.g. the World Bank-led Wealth Accounting and the Valuation of Ecosystem Services (WAVES) partnership, or within the EU the Mapping and Assessment of Ecosystems and their Services (MAES) program) experience with applying ecosystem accounts is so far limited to a few countries.

The main approach towards establishing ecosystem accounts has been to develop a land use account as a first step (similar to ABS 2012). This is being accomplished by interlinking several often spatially explicit data sets, most importantly: a set containing cadastral information; the Dutch business register, and data sets with information about crop production and land use. The desired outcome is a spatially explicit data set specifying the economic use category for each land parcel, ideally by ISIC.[1] Such a dataset not only has intrinsic value, it can also be used to derive estimates on the supply of ecosystem services by ISIC, as we will show later.

We have restricted the scope of this pilot study to two municipalities: Roerdalen in the province of Limburg and Rotterdam in South-Holland. Roerdalen was chosen because of the combination of agriculture activities and forested areas. Rotterdam was chosen because of its concentration of industrial activities.

[1] ISIC stands for the International Standard Industrial Classification of All Economic Activities.

7.2 Methodology

Data sources

A number of geographical and administrative data sources have been combined to describe the land surface, using ISIC terminology as much as possible. In this pilot we used the following data sources:

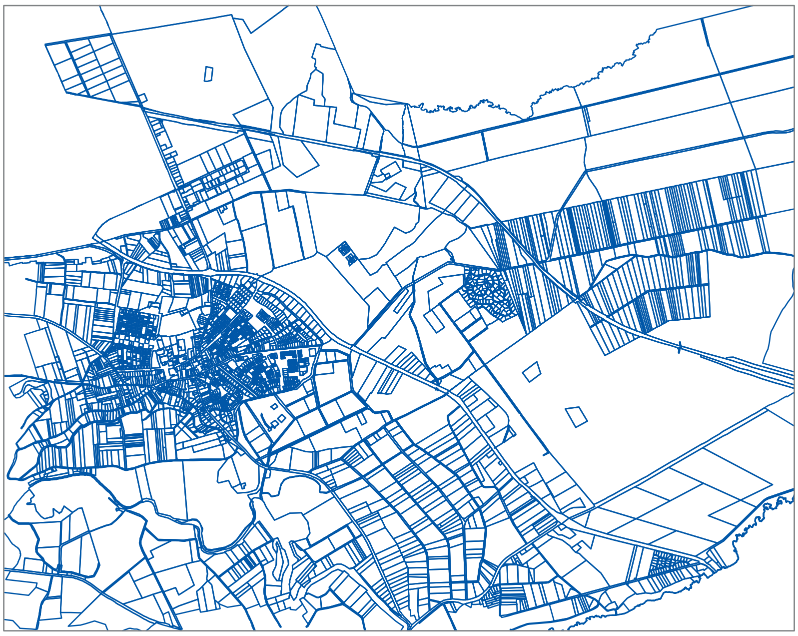
7.2.1 Data sources used

Name (in Dutch)	Translation	Year
Digitale Kadastrale Kaart	Digital Cadastral Map of NL	1 Jan. 2013
Geautomatiseerde Kadastrale Registratie	Automated Cadastral registration	1 Jan. 2013
BRP Gewaspercelen	Agricultural crops grown	2012 final
Regiobase CBS 2012 definitief	Address based Business Register 2012 final	31 Dec. 2012
Basisadministratie Adressen en Gebouwen (BAG)	Base register of Addresses and Buildings	1 Jan. 2013
Basisregistartie Topografie (BRT)	Basic Topographical Registry	2011–2012
Bestand Bodemgebruik (BBG) CBS	Land use map (Statistics Netherlands)	2010

Method

The starting point is a map with land parcels that was purchased from the Dutch Cadastre (see 7.2.1). First, we link the regional Dutch business register (called Regiobase) via the address to cadastre parcels (7.2.2). Next, we also identify cadastre parcels as an inhabited area using the BAG functional codes. The BAG addresses are connected to a point based map. The cadastre parcel connected to the BAG address point is usually the parcel on which the building which holds the address is located. This approach connects administrative registers to an area (Figure 7.2.3 and 7.2.4.).

7.2.2 Cadastral map Roerdalen (excerpt of 4.5 x 3.5 kilometres)



Source: Cadastre

7.2.3 Cadastral parcels linked to business register

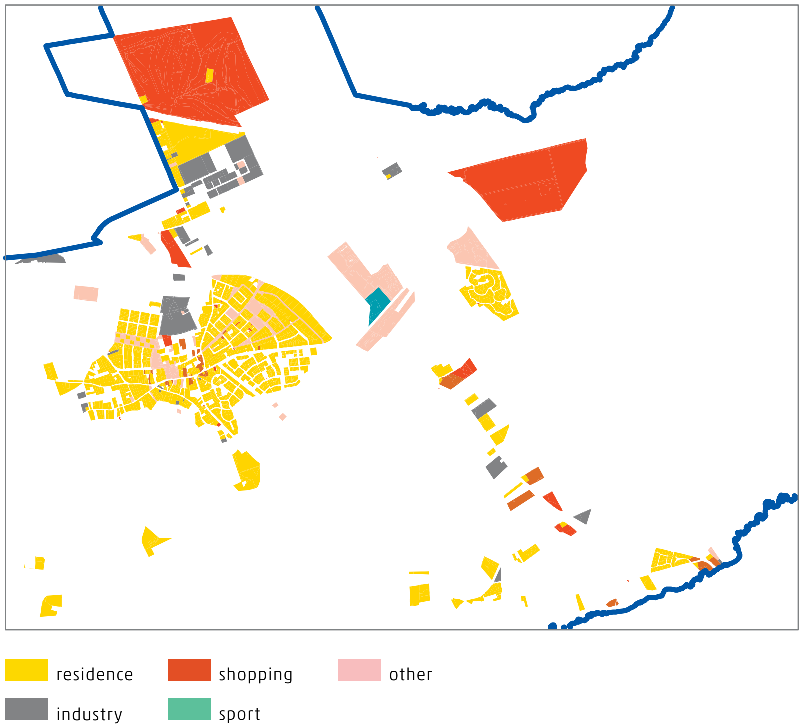
- 02 - Forestry and logging
- 03 - Fishing and aquaculture
- 05-09 Petroleum an gas extraction and mining of coal, lignite and metal ores
- 10-12 Manufacture of food, beverages and tobacco
- 13-15 Manufacture of textile, wearing apparel and leather
- 16 - Manufacture of wood and of products of wood and cork
- 17 - Manufacture of paper and paper products
- 18 - Printing and reproduction of recorded media
- 19 - Manufacture of coke and refined petroleum products
- 20 - Manufacture of chemicals and chemical products
- 22 - Manufacture of rubber and plastics products
- 23 - Manufacture of other non-metallic mineral products
- 24 - Manufacture of basic metals
- 25 - Manufacture of fabricated metal products, except machinery and equipment
- 26 - Manufacture of computer, electronic and optical products
- 27 - Manufacture of electrical equipment
- 28 - Manufacture of machinery and equipment n.e.c.
- 29 - Manufacture of motor vehicles, trailers and semi-trailers
- 30 - Manufacture of other transport equipment
- 31-32 Manufacture of furniture and other manufacturing
- 33 - Repair and installation of machinery and equipment
- 35 - Electricity, gas, steam and air conditioning supply
- 36 - Water collection, treatment and supply
- 37-39 Sewerage and waste management
- 41 - Construction of buildings
- 42 - Civil engineering
- 43 - Specialized construction activities
- 45 - Wholesale and retail trade and repair of motor vehicles and motorcycles
- 46 - Wholesale trade, except of motor vehicles and motorcycles
- 47 - Retail trade, except of motor vehicles and motorcycles
- 49 - Land transport and transport via pipelines
- 50 - Water transport
- 51 - Air transport
- 52 - Warehousing and support activities for transportation
- 53 - Postal and courier activities
- 55-56 Accomodation and food and beverage service activities
- 58 - Publishing activities
- 59-60 Motion picture, radio and broadcasting activities
- 61 - Telecommunications
- 62-63 IT and information service activities
- 64 - Financial service activities, except insurance and pension funding
- 65 - Insurance, reinsurance and pension funding, except compulsory social security
- 68 - Real estate activities
- 69-70 Legal, accounting and management consultancy activities
- 71 - Architectural and engineering activities; technical testing and analysis
- 72 - Scientific research and development
- 73 - Advertising and market research
- 74-75 Veterinary and other professional activities
- 77 - Rental and leasing activities
- 78 - Employment activities
- 79 - Travel agency, tour operator, reservation service and related activities
- 80-82 Security, services to buildings and office support activities
- 84 - Public administration and defence; compulsory social security
- 85 - Education
- 86 - Human health activities
- 87-88 Residential care and social work activities
- 90-92 Creative arts, libraries and gambling activities
- 93 - Sports activities and amusement and recreation activities
- 95 - Repair of computers and personal and household goods
- 96 - Other personal service activities
- 99 - Activities of extraterritorial organizations and bodies

Source: Analysis based on cadastral map and address based business register.

Outside the paved area designated by the address, the unpaved area is delineated by other geographical sources. In the process of actual delineation of non-paved areas, we used several maps other than the cadastre parcels.

The agricultural crop growth map (Min EZ, Dienst Regelingen) delineates the actual crop grown (Fig. 7.2.5). The crop growth items are grouped into Dutch ISIC codes (Figure 7.2.5, codes 111–210).

7.2.4 Map BAG functions

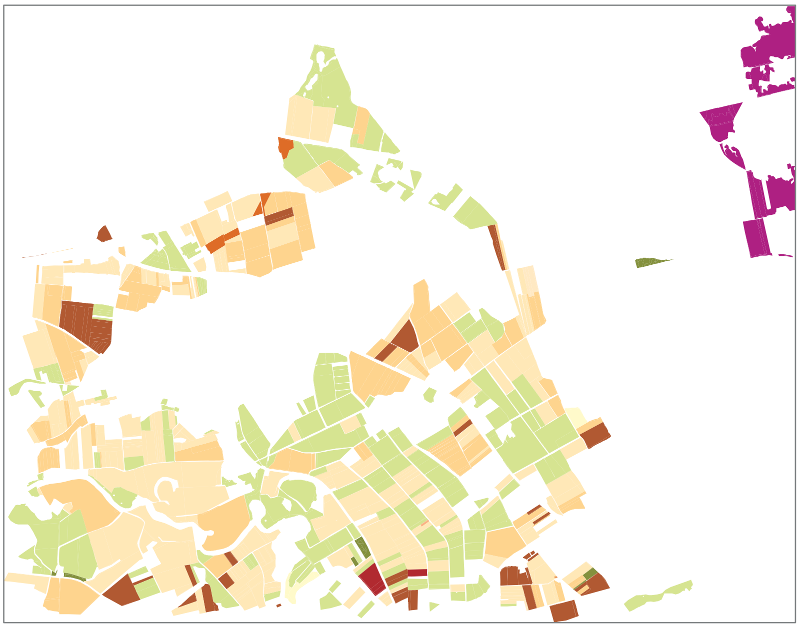


Source: Analysis based on cadastral map and address based business register.

Other sources describing the surface of the Netherlands continuously are the topographical map, also from the cadastre, and the land use map of Statistics Netherlands. Items of the topographical map cannot be transferred directly into ISIC codes. But this map is useful to delineate unpaved nature areas, other crop- and grassland, the paved area of the roads, water bodies and waterways with a width of 6 meters and more (Figure 7.2.6).

The land use map of Statistics Netherlands is a continuous map of the Dutch surface, and groups together topographical areas into functional areas. The land use map may be used to assign areas which are functional to inhabited and industrial areas, but they are not covered by an address.

7.2.5 Map crop growth parcels



- fauna border farmland
- grassland for livestock
- fauna border grassland
- heath
- other nature area
- fallow
- fallow nature
- cereals and leguminous crops
- vegetables, melons, roots and tubers
- fiber crops
- other non-perennial crops
- pome and stone fruits
- plant propagation
- forestry

Source: BRP crop growth parcels

The areas described by various datasets partially overlap. This is why a dominance strategy is required which provides the sequence in which data sources are used to allocate land to economic use categories. The following dominance rules were applied to the areas:

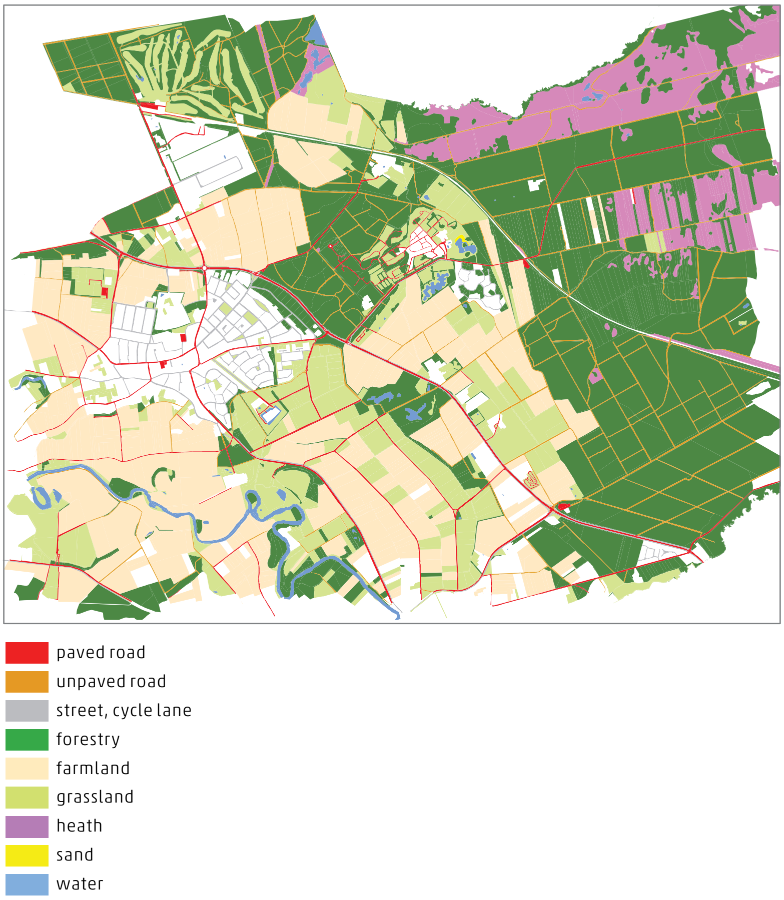
1. Water bodies (BR Topography);
2. Cadastre parcels and business register 4-digit ISIC codes;
3. Cadastre parcels and BAG function 'dwelling';
4. BRP crop growth area;
5. Nature areas, paved road and unpaved agricultural area from BR Topography;
6. Functional areas within residential and industrial land use areas.

Statistics Netherlands encountered a number of difficulties during the integration of data sets:

- More than one business use per parcel may appear. This may lead to different ISIC codes 4-digit, but not to different codes 1-digit. So this is a problem only when a high level of detail is required.

- More than one address may be connected to a single cadastre parcel. Also mixed use by industries and dwellings appears on a cadastre parcel. In such a case, the business use is assigned to the parcel.
- Invalid addresses in the business register lead to unaddressed records. Not all addresses could be connected to BAG addresses, so not all businesses could be assigned to cadastre parcels. These areas may be allocated to industrial areas by the land use map, but will have no 4-digit ISIC code.
- More than one cadastral parcel per address. A cadastral parcel is assigned a 4-digit code based on its address location. Larger cadastral parcels are split up by the cadastre. So areas which do not contain an address do not have a 4-digit code. However, these areas may be connected by the code of the owner, which is known from the Cadastre Register.
- The BRP crop grown contour delineates the exact area where the crop is grown. This map does not assign additional areas, such as small ditches and other unpaved areas. They may be assigned to the nearest crop grown within the Cadastre parcel. Such areas are relatively small. This application has not yet been performed in this pilot study. These areas are now assigned other agricultural land by the Topographical map.
- Areas not yet accounted for. These areas have other uses than assigned by the dominance strategy and appear as 'white spots' in the resulting figures.

7.2.6 Map Topography



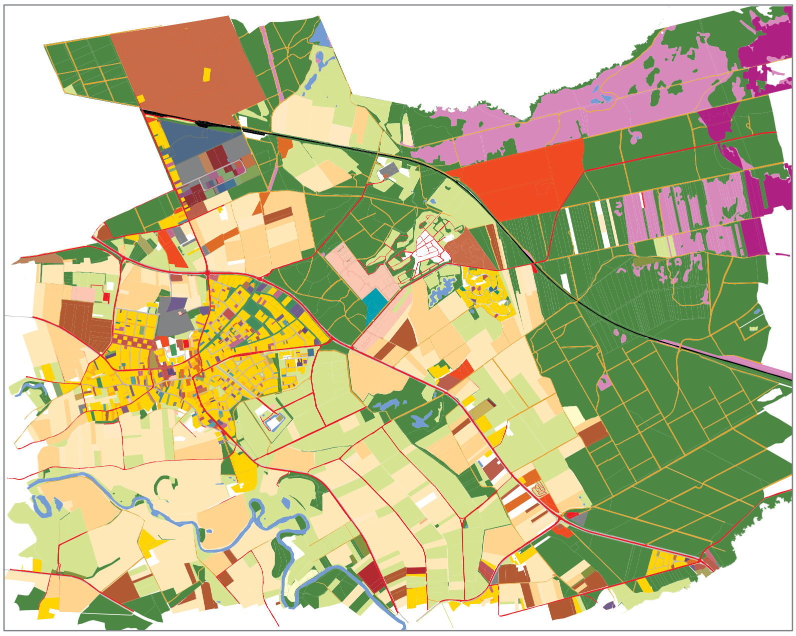
Source: Base Register Topography, Cadastre.

7.3 Results

Land use account

Figure 7.3.1 provides the main graphic result of this exercise for the municipality of Roerdalen in which an economic use category was assigned to all 17 thousand combined land parcels based on the dominance strategy described in Section 2.

7.3.1 Land by use category Roerdalen



Source: analysis. Legenda, see previous figures.

Table 7.3.2 presents the main results of land use by ISIC categories aggregated by area (ha). For this, we made a number of additional assumptions. Essentially, all land that was not directly assigned to an ISIC code and does not fall into the categories water, roads or housing, is assumed to belong to the government (ISIC 84). This comprises for instance forests, heath, sand etc. Industrial areas that were not assigned to an ISIC code have been added to industry (ISIC code C).

Statistics Netherlands also did this exercition for the municipality of Rotterdam. Tabel 7.3.2 shows large differences in the land allocation between Rotterdam and Roerdalen such as the importance of water and companies in Rotterdam (together >50 percent of total area); and agriculture and forest in Roerdalen (comprising about 65 percent). In Rotterdam we see the importance within land allocated to companies of Industry (ISIC section C), transport (Section H) and trade (Section G). In Roerdalen, we see that the most important users of land are within Agriculture, in growing cereals (ISIC 0111) and vegetables (ISIC 1113). Finally, we found that the total area of white spots remaining is 6 percent in Rotterdam and only 1.8 percent in Roerdalen.

7.3.2 Land use in Roerdalen and Rotterdam by economic activity

Description	ISIC section	Specific ISIC code	Roerdalen		Rotterdam	
			area	share	area	share
			ha	%	ha	%
Growing of cereals (except rice), leguminous crops and oil seeds	A	0111	1,654	18.6	159	0.5
Growing of vegetables and melons, roots and tubers	A	0113	1,002	11.3	77	0.2
Growing of fibre crops	A	0116	3	0.0	9	0.0
Growing of other non-perennial crops	A	0119	33	0.4	4	0.0
Growing of pome fruits and stone fruits	A	0124	77	0.9	0	0.0
Plant propagation	A	0130	63	0.7	24	0.1
Raising of cattle and buffaloes (for milk)	A	0141	25	0.3	2	0.0
Raising of cattle and buffaloes (not for milk)	A	0142	7	0.1	7	0.0
Raising of sheep/goats	A	0145	0	0.0	0	0.0
Raising of swine/pigs	A	0146	15	0.2	0	0.0
Raising of poultry	A	0147	1	0.0	0	0.0
Raising of other animals	A	0149	0	0.0	1	0.0
Mixed farming	A	0150	12	0.1	0	0.0
Support activities for crop production	A	0161	23	0.3	22	0.1
Support activities for animal production	A	0162	1	0.0	0	0.0
Forestry and logging	A	02	52	0.6	0	0.0
Fishing and aquaculture	A	03	0	0.0	0	0.0
Manufacturing	C		45	0.5	3,637	11.2
Electricity, gas, steam and air conditioning supply	D		0	0.0	83	0.3
Wholesale and retail trade; repair of motor vehicles and motorcycles	E		0	0.0	60	0.2
Construction	F		13	0.1	319	1.0
Wholesale and retail trade; repair of motor vehicles and motorcycles	G		43	0.5	1,112	3.4
Transportation and storage	H		10	0.1	1,240	3.8
Accommodation and food service activities	I		35	0.4	798	2.5
Information and communication	J		8	0.1	79	0.2
Financial and insurance activities	K		12	0.1	412	1.3
Real estate activities	L		11	0.1	35	0.1
Professional, scientific and technical activities	M		17	0.2	371	1.1
Administrative and support service activities	N		4	0.0	144	0.4
Public administration	O	84	4,359	49.1	4,600	14.2
Other services	P-S		163	1.8	910	2.8
Water	–		78	0.9	11,100	34.2
Roads	–		387	4.4	1,963	6.1
White spots	–		162	1.8	1,949	6.0
Households	–		558	6.3	3,311	10.2
Total			8,873	100.0	32,429	100.0

7.4 Towards ecosystem accounting

In this section we illustrate the potential of having a land use account for ecosystem accounting applications. The first example uses information directly available from the land use account in order to estimate provisioning services. The second example shows the potential of overlaying the land use account with information about modelled spatially explicit ecosystem services. We will restrict ourselves to the municipality Roerdalen in both examples.

Provisioning services

The information about the various types of agricultural land use can be used to estimate several provisioning services of crop types for Roerdalen. This can be done by multiplying the different crop areas (7.3.2) by their average yields, where we have used existing information collected by the agricultural census (LEI and Statistics Netherlands). As the crop growth data are from 2012 we have used the yield factors for 2012.

7.4.1 Provisioning service selected crops Roerdalen

	Cereal yield	Area	Total yield
	ton/ha	ha	ton
Winter wheat	9	137,789	1,199
Spring wheat	7	15,396	111
Winter barley	8	8	0
Spring barley	7	7	0
Rye	5	2,143	10
Oats	6	1,808	11
Triticale	6	1,952	12
Grain maize	12	15,547	191
Silage maize	46	232,957	10,716
Corn Cob Mix	11	5,902	64
Brown beans	3	1,630	5
Rape	4	2,161	8
Flax	6	2,065	13
Linseed	1	37	0
Chicory	43	2,962	126
Hemp	8	1,302	10
Ware potatoes on clay	50	47,442	2,353
Ware potatoes on sand or peat	52	20,361	1,049
Seed potatoes on clay	38	35,248	1,339
Seed potatoes on sand or peat	37	4,712	175
Starch potatoes	44	43,796	1,923
Sugar beet	79	73,155	5,772
Sowing onions	64	21,261	1,356

It should be stressed here that the yield factors are averages for Limburg and do not specifically apply to Roerdalen. It is apparent that silage maize is the largest provisioning service in Roerdalen. Time series should be developed as yield factors change between years.

One of the difficulties in assigning agricultural land to ISIC is that farm land is usually split up into several parcels:
- A parcel with the farm and stables, which can be assigned directly to an ISIC code using BAG address linked to Regiobase;
- Parcels that yield the various crops (BRP crop grown areas);
- Other non-assigned paved parcels usually in the neighbourhood of the cadastral parcel containing the address (these would be classified as white spots in 7.3.2).

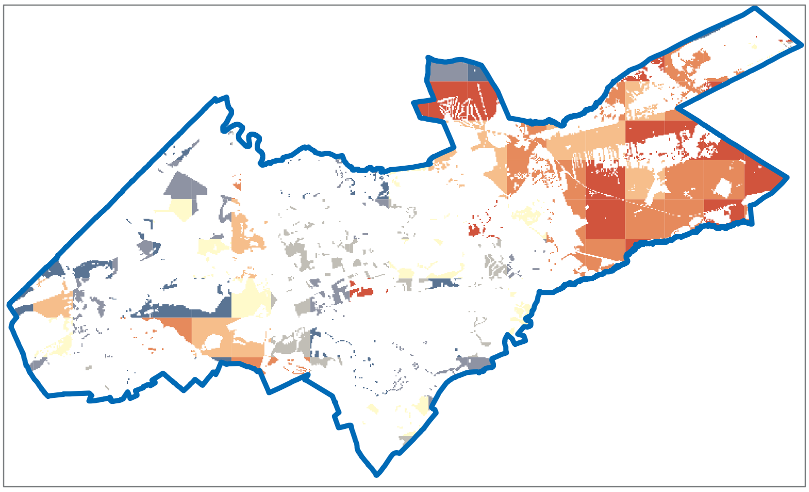
When farmers grow different types of crops on different parcels (or grow different types of crops on the same parcel), the following issue arises: from the perspective of economic statistics, the total land use should be assigned to the dominant ISIC category i.e. as contained in the Regiobase. At the same time from an ecosystem accounting

perspective, we would also like to have information of land use by crop type in case of secondary production in order to estimate provisioning services.[2)]
In the ISIC attribution of Table 7.3.2, the individual crop acres are each assigned to their respective ISIC codes. Technically, this implies that we have split up the statistical unit into various local kind of activity units. It is technically possible, however, to allocate crop areas to dominant ISIC category using information about who is responsible for paying taxes/ownership data. Ultimately, this choice will depend on the context of use of the information.

Regulating services

By overlaying the GIS land use map by data about ecosystem services, we are able to assign these services to ISIC codes. Figure 7.4.2 shows this graphically, using modelled data about carbon sequestration.[3)]

7.4.2 Carbon sequestration per hectare (kgC/ha yr-1)

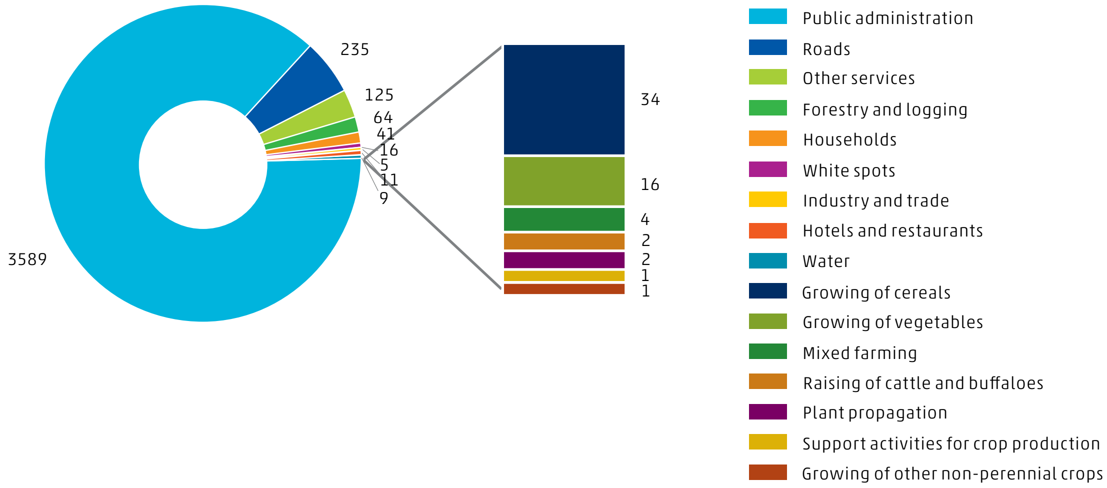


Deposition kgC/ha yr-1
- less than 1250
- 1250–1350
- 1350–1500
- 1500–1600
- 1600–1750
- 1750–1875
- 1875 or more

We find that 2,488 hectares of Roerdalen lie within the model outcomes. In a first step, these modelled ranges can be attributed to land use categories. In a second step they can be attributed to ISIC categories. In Figure 7.4.3 we have taken an average of the modelled ranges in order to estimate total sequestration figures, and allocate them to ISIC.

2) N.B.: this issue only arises when we want to display land use (see Remme et al. 2014) by agriculture subsectors.
3) Data were provided by R. Remme of Wageningen University, (see Remme et al. 2014).

7.4.3 Carbon sequestration (tonC) by ISIC and additional categories



We find that of the more than 4 kton C, almost 86 percent is sequestered by ISIC 84 Public administration; followed by ISIC 2 Forestry and logging; and ISIC 01 Agriculture. Within agriculture, the main activity is ISIC 0111 Growing of cereals (except rice), leguminous crops and oil seeds.

We also see that aggregation errors may occur due to a mismatch between the spatial units underlying the sequestration map and the map of combined land parcels (as shown by Figure 7.4.2). For instance, we see that carbon sequestration also occurs on roads (as they intersect the forests) and water areas. Such issues may be overcome by specifying minimum thresholds or by excluding certain occurrences. This is an issue that needs to be further investigated.

7.5 Discussion and conclusions

The success rate of attributing land parcels to an economic use category when using a dominant allocation strategy combining multiple sources can be considered as highly satisfactory. Coverage in rural and unpaved areas is very good, coverage in industrial paved areas is good. The allocation of land use to ISIC categories requires some further assumptions as not all parcels have an address (in case of agriculture or forests).

The number of white spots could be further decreased by performing manual allocation using tax identification numbers and aerial photographs, or applying smarter linking procedures. White spots regarding non-assigned paved parcels may be allocated to ISIC using for instance spatial queries based on proximity.

Depending on the criteria for accuracy in coupling, we do not expect too many difficulties in up-scaling of these results to the COROP level, the provincial level, or the Netherlands.

The advantage of up-scaling is that a direct link can be made with the regional accounts (in case of COROP level, or province) or the National Accounts (in case of the Netherlands). In addition to up-scaling, the next steps could consist of adding more information about the various types of ecosystem services supply (flows) and ecosystem condition (stocks). Subsequently, it could be shown how such services could be integrated in an accounting system, detailing who is supplying them and who is benefiting.

These are precisely the main elements foreseen for the follow up project that is likely to start at the end of 2014. It is clear that due to its multi-disciplinary nature, the development of a comprehensive set of ecosystem accounts requires cooperation with multiple stakeholders in the Netherlands.

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Glossary

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

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

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

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

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

Capital transfers
Capital transfers are unrequited transfers where either the party making the transfer realizes the funds involved by disposing of an asset (other than cash or inventories), relinquishing a financial claim (other than accounts receivable) or the party receiving the transfer is obliged to acquire an asset (other than cash) or both conditions.

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

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

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

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

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

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

Distributive transactions (D codes)
The D codes appear in all the sequence of accounts from the generation of income account up to and including the capital account. As their name implies, they show the impact of distribution and redistribution of income (and saving in the case of capital transfers). For all distributive transactions, the receivable entries for all sectors including the rest of the world must balance the payable entries.

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

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

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

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

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

Fine dust (PM_{10})
Air-borne solid particles, originating from human activity and natural sources, such as wind-blown soil and fires, that eventually settle through the force of gravity, and can cause injury to human and other animal respiratory systems through excessive inhalation.

Final use of energy
Use after which no useful energy carriers remain.

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

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

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

Gross domestic product (GDP)
Value of all the goods and services produced in an economy, plus the value of the goods and services imported, less the goods and services exported.

Heavy metal equivalents
Emissions of copper, chromium, zinc, lead, cadmium, mercury and arsenic can be converted into heavy metal equivalents and can subsequently be added up. The conversion into equivalents takes into account the harmfulness of the metal for the environment. Mercury and cadmium, for example, are more harmful than copper 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 covers the value of all goods produced for sale, including unsold goods, and all receipts for services rendered. Output furthermore covers the market equivalent of goods and services produced for own use, such as own account capital formation, services of owner-occupied dwellings and agricultural products produced by farmers for own consumption. The output of such goods is estimated by valuing the quantities produced against the price that the producer would have received if these goods had been sold.

Products
Materials with an economic value.

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

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

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

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

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

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

River basin
The land area drained by a river and its tributaries.

SEEA 2012
System of Integrated Economic Environmental Accounting 2012.

Sector
A distinction is made between institutional sectors and economic sectors. Institutional sectors group together residents into five mutually exclusive sectors composed of the following types of units:
g. Non-financial corporations;
h. Financial corporations;
i. Government units, including social security funds;
j. NPIs serving households (NPISHs);
k. 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
Subsidies are 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 and services that they produce, sell or import.

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

Roel Delahaye
Bram Edens
Cor Graveland
Rutger Hoekstra
Eefje Lammers
Wai King Meijer-Cheung
Albert Pieters
Maarten van Rossum
Sjoerd Schenau
Marjan Verberk
Joram Vuik
Daan Zult

With contributions of

Kees Baas
Anne Boelens
Ellen Brinksma
Arthur Denneman
Rita Gircour
Niek van Leeuwen
Otto Swertz
Karin van der Ven