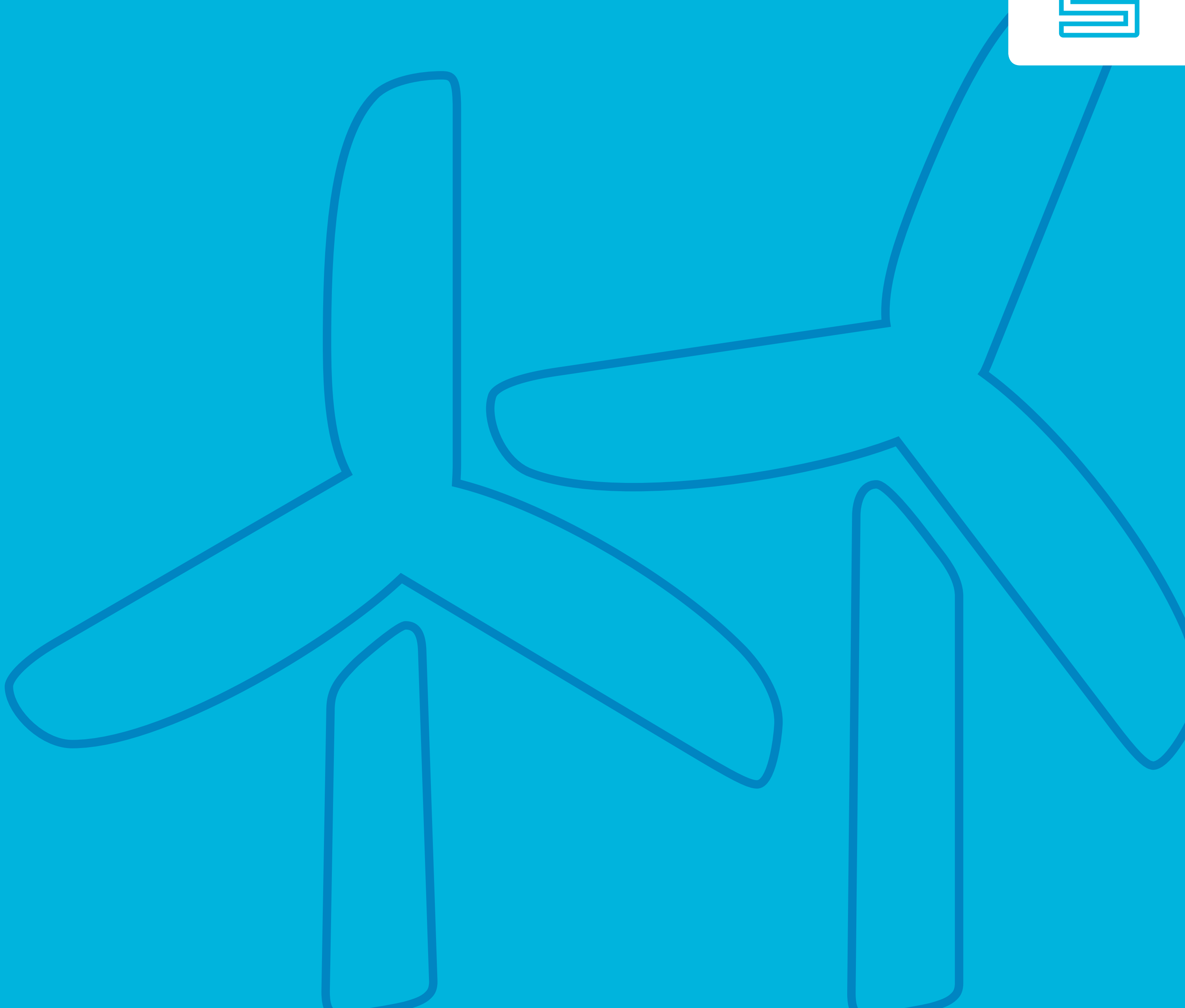
Green growth in the Netherlands 2015



Green growth in the Netherlands 2015

Explanation of symbols

Empty cell	Figure not applicable
.	Figure is unknown, insufficiently reliable or confidential
*	Provisional figure
**	Revised provisional figure
2014–2015	2014 to 2015 inclusive
2014/2015	Average for 2014 to 2015 inclusive
2014/’15	Crop year, financial year, school year, etc., beginning in 2014 and ending in 2015
2012/’13–2014/’15	Crop year, financial year, etc., 2012/’13 to 2014/’15 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: Statistics Netherlands and Textcetera, The Hague
Design: Edenspiekermann

Information
Telephone +31 88 570 70 70
Via contact form: www.cbs.nl/infoservice

Where to order
verkoop@cbs.nl
ISBN 978-90-357-2065-7

Foreword

Green growth is high on the national and international agenda. The EU has the ambition to be more resource efficient by 2020 and is investing in developing a circular economy. The OECD has placed the environment at the heart of its economic policymaking through its green growth strategy. At the global level, all countries have committed themselves to the UN's 17 Sustainable Development Goals adopted in September 2015. Some of these goals are linked directly to green growth. The green growth strategy and the ambition of a resource efficient Europe can therefore be perceived as ways to implement these aspects of sustainable development.

More statistical offices have started to measure green growth in response. Statistics Netherlands has done so since 2011, using the OECD indicators. This green growth measurement is conceptually harmonized with the Dutch sustainability monitor.

The Dutch government considers green growth essential in maintaining future growth, reducing environmental impact and dependency on scarce resources. The green growth policies of the Dutch government include the Green Deal Program, which aims to closely involve the private sector in the green transition.

In this edition Statistics Netherlands presents a broad quantitative overview of recent key developments in the relationship between the environment and the economy. The main conclusion is that the Dutch economy is turning 'greener' once again. The environmental pressure of industries has further decreased while the economy grew. However the natural asset base is still under threat. The recent earth quakes in the northern part of the Netherlands are an example of the negative side effects of natural gas extraction. Other natural assets, particularly biodiversity, are also still under pressure. Internationally the performance of the Netherlands with respect to green growth is average. Its international ranking has dropped, which means that other countries are growing green faster than the Netherlands.

Director General
Dr. T.B.P.M. Tjin-A-Tsoi

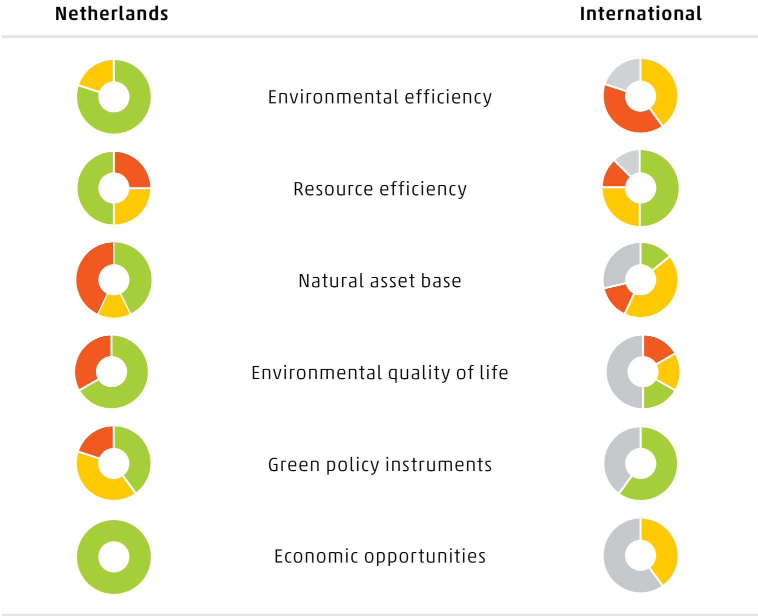
Heerlen/The Hague/Bonaire, December 2015

Contents

Summary

Overall, the Dutch economy has become 'greener' since 2000. However, this development takes place gradually and is not 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. The Netherlands performs average compared to other OECD and EU countries. Over the last years this position has not improved.

Green growth in the Netherlands: overview



National data is scored for its development towards green growth (left).
- positive development
- neutral developments
- negative development

International data is scored on the relative position of the absolute amounts (right).
- 1/3 best countries
- between 1/3 and 2/3 of countries
- worst 1/3 of countries
- no data available

The direct environmental pressure of the Dutch economy has decreased. All *environmental efficiency* indicators for emissions and waste generation overall score 'green'. This means that the pressure decreased in absolute terms, while the economy grew (absolute decoupling). Only the carbon footprint, i.e the amount of greenhouse gas emissions that result from Dutch consumption, was stable. Despite the national progress with regard to improvement of the environmental efficiency, the Netherlands scores averagely (or low) in an international context. The international position is stable with respect to other countries in the OECD or EU; other countries also grow green, and the Netherlands is not showing slower or faster progress than other countries.

Most of the environmental efficiency gains were realized in the so-called top sectors. According to the Dutch government, '*top sectors*' are central in job creation and innovation in the Netherlands. These *top sectors* comprise up to 20 percent of total value added and employment in the Dutch economy. However, their share in the *environmental pressure* is much higher, namely between 40 and 80 percent. *Top sectors* produce relatively large amounts of greenhouse gas emissions, fine dust emissions, and emissions of nutrients. Analysis revealed that top sectors 'grow greener' at an accelerated pace compared to the rest of the economy.

Regarding *resource efficiency*, the indicators show that the Netherlands is very resource efficient regarding the use of material resources. It has a very small domestic material use per capita compared to other countries and in addition has improved more compared to other countries in the past decade. For waste recycling, the Netherlands holds the highest recycling rate. Results presented in the thematic article on *urban mining* of waste of electrical and electronic equipment (WEEE) show that the amount of WEEE represents approximately 400 million euros of raw materials annually. This WEEE is not collected through official channels, and it was found that at least 73 million euros is lost, due to disposal behaviour, in waste bins. Most of this wasted value is determined by gold. The overall high recycling rates, and highly efficient material use indicate that the next step for the Netherlands could be to focus on preservation of material value.

Along with efficient use of material resources, *efficient use of energy* is also essential for a green economy. Most of the energy use is still from fossil origin, leading to significant greenhouse gas emissions. The share of renewable energy increases over time, however internationally the Netherlands still ranks among the lowest. A positive sign is that employment and value added in the sustainable energy sector increase, indicating green growth potential for the Dutch economy. The energy use itself has been increasing since 2000, however at a slower pace than the economic growth (relative decoupling). In order to measure the progress regarding the Dutch ambitions on energy saving detailed datasets and robust concepts are needed. In the thematic article on measuring energy efficiency recent research is described to develop energy efficiency indicators for the services industry on the basis of the so called client registers of the energy network companies. Preliminary results on the development of energy efficiency in primary schools are given. These results show that the available micro data offer a huge potential for analysis of energy savings in the services sector.

The Netherlands has a high population density, indicating that our *natural asset base* could be easily affected by emissions and resource use. Positive notes are that stocks of fish in the North Sea have improved, stocks of standing timber have increased and that our global biodiversity footprint decreases over time. However, Internationally compared, relatively large amounts of land are still being converted into built-up land, which is putting biodiversity under threat. Including biodiversity losses abroad due to Dutch consumption (modelled as an area where all biodiversity has disappeared) still comes down to twice the size of the country. Consequently, valuable services provided by these ecosystems, such as the provisioning of timber, air filtration and recreation, are at risk of being reduced or lost. Ecosystem accounting aims to quantify and monitor such changes in an internationally consistent manner. A pilot study on ecosystem accounting in the Limburg Province, the Netherlands, shows the strong potential of the data that are made available with this approach.

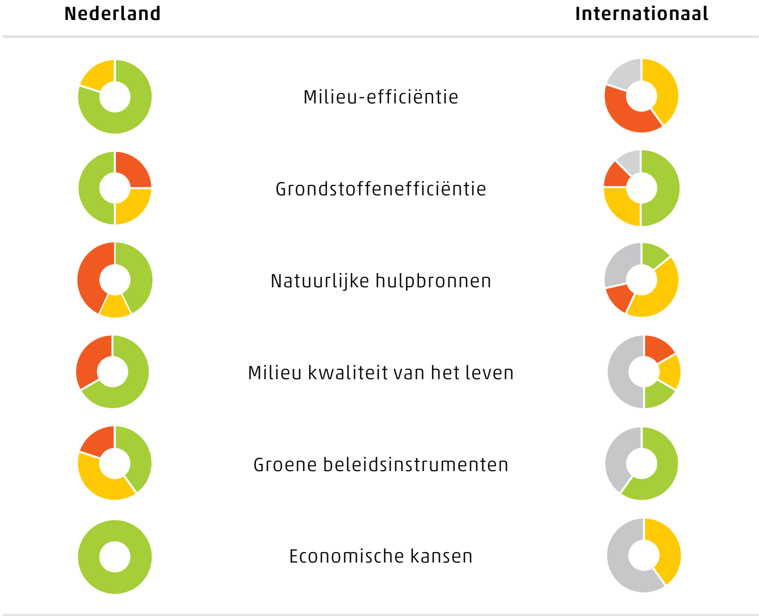
Dutch *environmental quality of life* shows both signs of improvement and deterioration over time. Exposure to air pollution decreased over time, which is positive. On the other hand, only few bodies of water meet the quality standards of the European Water Framework Directive. There has been some improvement in the ecological water quality between 2009 and 2013, but the chemical quality has deteriorated. The Dutch are less worried about the environment and are also less willing to pay for environmental protection. The latter may be related to the recent economic crisis and the improvements to the Dutch environment.

The share of environmental taxes and fees in total taxes and social contributions in the Netherlands, an important indicator for *green policy instruments*, has been falling in recent years. No major new initiatives for environmental tax reform have been undertaken since 2000. The Netherlands scores high for this theme internationally. An analysis on the *top sectors*, reveals that the industries that cause most of the pollution, pay relatively less environmental taxes. However, most resource and environmental efficiency gains were also realized here. The faster development towards green growth compared to the rest of the economy for the top sectors might be due to the relatively high resource use in *top sectors*. Any efficiency improvement could be a direct financial gain. 'Greening the economy' has led to *economic opportunities* over the last years. As an example, during the last decade, employment in the environmental goods and services sector (EGSS) increased to 126 thousand FTE at a growth rate that was much higher than the average of the economy.

Samenvatting

De Nederlandse economie is gemiddeld 'groener' geworden sinds 2000. Deze ontwikkeling is geleidelijk gegaan en geldt niet voor alle aspecten van groene groei, zoals blijkt voor de verschillende thema's in de figuur onderaan dit hoofdstuk. Nederland presteert gemiddeld ten opzichte van andere OESO- en EU-landen. In de laatste jaren is dit niet verbeterd.

Samenvattende tabel voor groene groei in Nederland



Binnenlandse gegevens over de ontwikkeling van groene groei (links).
- positieve ontwikkeling
- neutrale ontwikkeling
- negatieve ontwikkeling

Internationale gegevens over de relatieve positie van de absolute getallen (rechts).
- 1/3 beste landen
- tussen 1/3 en 2/3 van de landen
- slechtste 1/3 van de landen
- geen gegevens beschikbaar

De directe economische druk van de Nederlandse economie is afgenomen. Alle indicatoren die *milieu-efficiëntie* van emissies en afvalproductie betreffen, scoren gemiddeld 'groen'. Dit betekent dat de milieudruk in absolute eenheden is afgenomen, terwijl de economie is gegroeid (dit wordt absolute ontkoppeling genoemd). Alleen de koolstofvoetafdruk, d.w.z. de hoeveelheid broeikasgassen ten gevolge van de consumptie binnen de Nederlandse economie, was stabiel. Ondanks vooruitgang op het gebied van milieu-efficiëntie, is de score van Nederland ten opzichte van andere landen matig (of laag). De internationale positie is stabiel ten opzichte van andere OESO- of EU-landen; andere landen groeien ook groen en voor Nederland geldt dat niet sterker of minder sterk.

Het overgrote deel van de milieu-efficiëntiewinst werd gerealiseerd door de zogenaamde topsectoren. Volgens de Nederlandse regering zijn vooral deze *topsectoren* belangrijk bij het creëren van banen en innovatie in Nederland. De *topsectoren* dragen tot 20 procent bij aan de totale toegevoegde waarde en werkgelegenheid in de Nederlandse economie. Hun aandeel in de *milieudruk* ligt daarentegen veel hoger, namelijk tussen de 40 en 80 procent. De *topsectoren* produceren relatief grote hoeveelheden broeikasgassen, fijnstof en nutriënten. Uit onderzoek blijkt dat ze in een sneller tempo 'groener groeien' dan de rest van de economie.

Voor wat betreft *grondstofefficiëntie* laten de indicatoren zien dat Nederland heel efficiënt gebruik maakt van grondstoffen. Het binnenlands grondstoffenverbruik per persoon is erg laag vergeleken met andere landen. In Nederland is dit de laatste tien jaar ook meer verbeterd dan in andere landen. Op het gebied van hergebruik van afval heeft Nederland het hoogste recyclingspercentage. De uitkomsten die zijn gepresenteerd in het thema-artikel over *urban mining*, laten zien dat de hoeveelheid afgedankte elektrische en elektronische apparaten (AEEA) jaarlijks een waarde vertegenwoordigt van zo'n 400 miljoen euro aan ruwe grondstoffen. Deze AEEA worden niet ingezameld via de officiële kanalen en er werd geconstateerd dat ten minste 73 miljoen euro verloren gaat en verdwijnt in de afvalbakken door weggooigedrag. Voor het grootste deel wordt deze weggegooide waarde bepaald door goud. Gezien de hoge recyclingspercentages en het zeer efficiënte gebruik van grondstoffen zou de volgende stap voor Nederland kunnen worden om de nadruk te leggen op het behoud van materiële waarde.

Evenals een efficiënt gebruik van grondstoffen is een efficiënt gebruik van energie ook noodzakelijk voor een groene economie. De meeste energie die wordt gebruikt is nog steeds van fossiele herkomst, wat leidt tot een aanzienlijke uitstoot van broeikasgassen. Het aandeel hernieuwbare energie wordt groter, maar internationaal gezien scoort Nederland nog heel laag. Een goed teken is de stijging van werkgelegenheid in en de toegevoegde waarde binnen de duurzame energiesector; dit biedt mogelijkheden voor groene groei in de Nederlandse economie. Het energiegebruik zelf is sinds 2000 toegenomen, alhoewel dit langzamer ging dan de economische groei (relatieve ontkoppeling). Om te monitoren wat de vooruitgang is op de Nederlandse ambitie om energie te besparen, is een gedetailleerde dataset en robuuste concepten nodig. In het thema-artikel over de meting van energie-efficiëntie wordt recent onderzoek beschreven dat gaat over de ontwikkeling van indicatoren voor energie-efficiëntie in de dienstverlenende sector. Deze zijn gebaseerd op de zogenaamde klantenbestanden van de energienetwerkbedrijven. Daarbij worden ook de voorlopige resultaten over de ontwikkeling van energie-efficiëntie op basisscholen gepresenteerd. Deze uitkomsten laten zien dat de beschikbare microgegevens tal van mogelijkheden bieden voor onderzoek naar energiebesparing in de dienstverlenende sector.

Nederland heeft een hoge bevolkingsdichtheid, waardoor onze *natuurlijke hulpbronnen* gemakkelijk zouden kunnen worden beïnvloed door emissies en grondstoffengebruik. Positief is dat de visstanden in de Noordzee zijn toegenomen, de voorraden staand hout zijn toegenomen en dat onze mondiale biodiversiteitsvoetafdruk geleidelijk afneemt. Vergeleken met andere landen zijn er echter relatief grote stukken land die omgezet werden naar bebouwde gebieden, waardoor de biodiversiteit onder druk komt te staan. Als de effecten op de buitenlandse biodiversiteit worden meegeteld, is het verlies aan biodiversiteit (gemodelleerd als een gebied waar alle biodiversiteit is verdwenen) ten gevolge van Nederlandse consumptie nog altijd tweemaal de oppervlakte van

Nederland. Ecosystemen zorgen voor waardevolle voorzieningen, zoals de bevoorrading van hout, luchtfiltratie en recreatie, en die lopen nu het risico af te nemen of helemaal te verdwijnen. Via natuurlijk-kapitaalrekeningen wordt getracht om dit soort veranderingen te kwantificeren en monitoren, op een internationaal consistente manier. Een pilotstudie over natuurlijk-kapitaalrekingen in de provincie Limburg toont aan dat door deze aanpak een grote hoeveelheid aan bruikbare informatie beschikbaar komt.

Onze *milieukwaliteit van leven* laat zowel tekenen van verbetering als van achteruitgang zien. Blootstelling aan luchtvervuiling is langzamerhand afgenomen en dat is gunstig. Aan de andere kant zijn er maar weinig watergebieden die voldoen aan de kwaliteitsnormen van het *European Water Framework Directive*. Er was wel enige verbetering in de ecologische waterkwaliteit tussen 2009 en 2012, maar tegelijkertijd ging de chemische kwaliteit achteruit. Nederlanders zijn minder bezorgd geworden over het milieu en zijn ook minder bereid om voor bescherming van het milieu te betalen. Dit laatste komt mogelijk door de recente economische crisis en de verbeteringen aan ons milieu.

Het aandeel milieubelastingen en –heffingen ten opzichte van het totaal aan belastingen en sociale premies in Nederland is een belangrijke indicator voor groene beleidsinstrumenten. Deze is de laatste jaren gedaald. Er zijn geen nieuwe grote initiatieven voor hervorming van milieubelastingen ondernomen sinds 2000. Nederland scoort internationaal gezien hoog op dit punt. Uit onderzoek naar de *topsectoren* blijkt dat de bedrijfstakken die verantwoordelijk zijn voor de meeste vervuiling relatief gezien weinig milieuheffingen betalen. De snellere ontwikkeling van groene groei vergeleken met de rest van de economie voor de topsectoren komt waarschijnlijk door het relatief hoge grondstoffenverbruik in de *topsectoren*, en dus de directe relatie met de financiële winst die geboekt kan worden door op grondstoffen te besparen. 'Vergroening van de economie' heeft de laatste jaren geleid tot *economische kansen*. Neem als voorbeeld de werkgelegenheid in de milieugoederen- en dienstensector (EGSS), die de laatste tien jaar steeg tot 126 duizend fte's, een veel hogere stijging dan het gemiddelde van de hele economie.

1. Introduction

Green growth strategies focus on ensuring that natural assets can deliver their full economic potential on a sustainable basis. In 2011 Statistics Netherlands pro-actively published its first edition of *Green growth in the Netherlands* (Statistics Netherlands, 2011). The government has asked Statistics Netherlands to monitor green growth on a regular basis, and to develop consistent monitoring frameworks for sustainability and green growth, in order to monitor and evaluate Dutch government policies. In response, Statistics Netherlands compiled the monitoring part of the *Sustainability monitor*, which also featured a chapter on green growth (Statistics Netherlands, 2015a). The present edition of *Green growth in the Netherlands* provides an update of the green growth indicators in the Netherlands, the international context and detailed thematic aspects.

1.1 Green growth in the Netherlands

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, has its benefits in terms of well-being as well as negative side effects. There are various reasons to have a closer look at the nexus of the environment and economy, as most of the negative side-effects form a direct burden on the environment.

Non-renewable resources, such as fossil fuels and some metals, are becoming scarce. Renewable stocks, such as fish and forests, are vulnerable to over-exploitation. These developments can hamper future growth. 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 are past their tipping points (Rockström et al., 2009; IPCC, 2013). There is international consensus that more action is required (for example 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. According to the declaration of Rio+20, 'a green economy in the context of sustainable development and poverty eradication is considered one of the important tools available for obtaining sustainable development' (UN, 2012a, par. 56). Consequently, a proper measurement framework is required to guide and evaluate policy decisions and to evaluate current policies with respect to greening growth.

In 2011 the OECD green growth strategy was adopted by the OECD Ministerial Council (OECD, 2011a). It emphasizes that governments must embed environmental challenges in the heart of economic policy making. The green growth strategy provides a policy strategy for implementing this economic transformation and a monitoring framework with a proposed set of indicators. The ambitions and effectiveness of green growth policy have been evaluated since its launch four years ago. It shows that one third of the OECD countries have started to implement a monitoring framework of green growth, and that most OECD countries have started to implement green growth policy instruments, such as pricing pollution and providing incentives for efficient resource use (OECD, 2015).

In the Netherlands green growth is also high on the political agenda. The government sees green growth as an essential part of maintaining the ability to grow in the future, while reducing the environmental impact and dependency on scarce resources (Tweede Kamer, 2013). 'Green' can also be a source of economic growth and stimulate innovation to tackle global challenges in global markets. The government's Green Deal Program aims to involve the private sector in the green transition. In its interim report on the green growth agenda, the government focused on eight domains (energy, bio-based economy, climate, from waste to resource, and circular economy, built environment, food, mobility). Here conditions have to be shaped so as to create the opportunities to realize green growth and minimize the impact on the environment (Ministry of Economic Affairs et al., 2015).

1.2 The OECD measurement framework for green growth

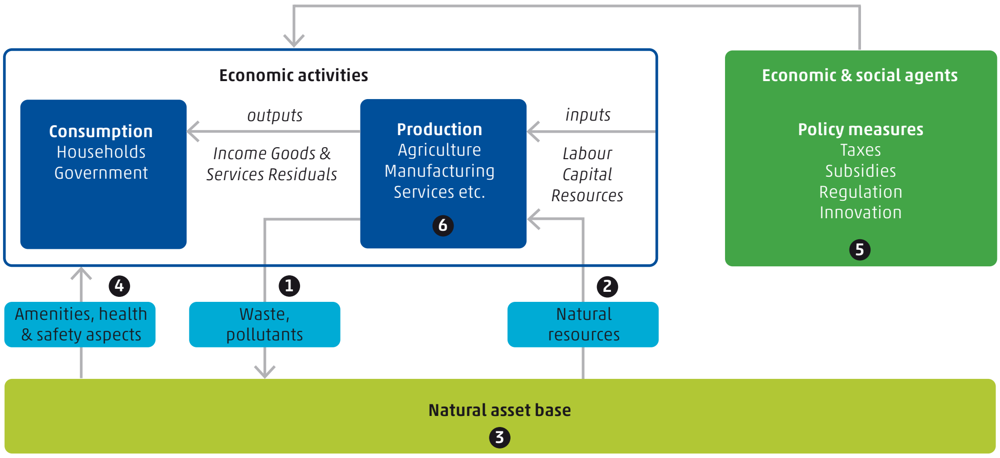
The concept of 'greening the economy' is still relatively new. Two major recent initiatives focus on the economic and ecological aspects of sustainability, namely the green growth strategy of the OECD and the green economy of UNEP. Although both initiatives broadly encompass the same topics, there are 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, for example 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 wellbeing that also captures aspects not reported by conceptual macro-economic measures (i.e. certain environment-related services, environment related health problems, and amenities). The production function approach should be supplemented by indicators on government policies and economic opportunities.

1) The OECD, UNEP, the World Bank and GGGI have taken a step in harmonising 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.

1.2.1 OECD measurement framework for green growth



1. Indicators monitoring environmental efficiency
2. Indicators monitoring resource efficiency
3. Indicators monitoring the natural asset base
4. Indicators monitoring environmental quality of life
5. Indicators monitoring green policy instruments
6. Indicators monitoring economic opportunities

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

1. Environmental and resource productivity of the economy

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 estimate worldwide environmental pressure as a result of national consumption requirements.

2. 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.

3. 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.

4. Policy responses and economic opportunities

This category combines two types 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.

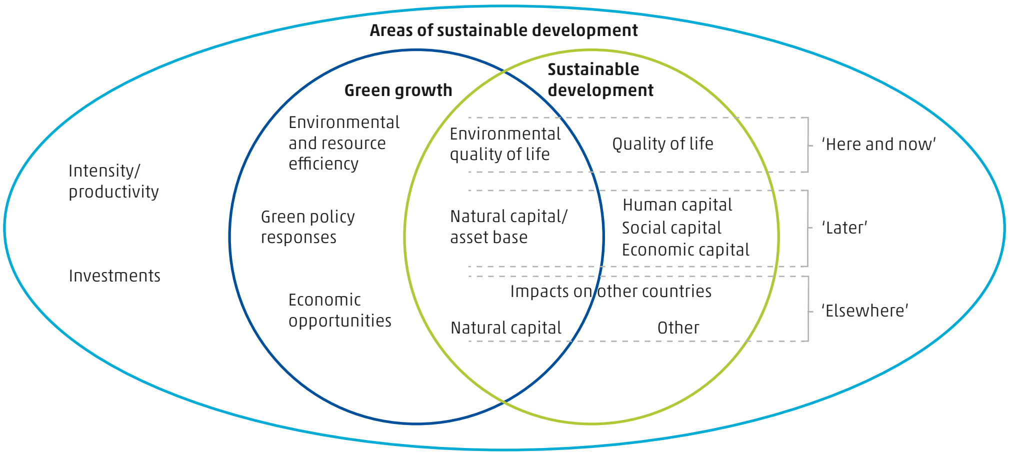
The clear message here is that green growth can be seen as a way to create economic growth. This is unlike sustainable development, which is neutral in that sense and focuses on general well-being.

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 conceptual differences. There is a clear message that green growth can be seen as a way to create economic growth, which differs from sustainable development which is neutral in that sense. Despite this contrast, 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 (Figure 1.2.2). 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 Figure 1.2.2.

A study of green growth also has special relevance to broader policy initiatives regarding sustainable development, such as the United Nations Post-2015 agenda (UN, 2012b) which is aimed at defining Sustainable Development Goals (SDG's). These SDG's are meant to replace the existing Millennium Development Goals (MDG's). Among the different SDG targets, there are several on the topic on energy consumption and emissions (especially the emissions related to climate change). Therefore, green growth policy strategies can be seen as an integral part of the Post 2015 agenda.

1.2.2 Simplified representation showing the relationship between green growth and sustainable development



1.3 Selection and scoring of the indicators

The point of departure for the Dutch green growth indicator framework is the indicator list composed by the OECD (OECD, 2011b). The first Dutch green growth edition described twenty indicators (Statistics Netherlands, 2011). In 2012 the indicator set was revised and additional indicators were selected, based on the following criteria:

A. *Coverage.* All themes of green growth must be covered sufficiently by indicators. Several new indicators were sought for the third theme of environmental quality of life.
B. *Interpretability.* Indicators should be clearly interpretable in relation to green growth.
C. *Data quality.* Indicators should meet general quality standards, namely analytical soundness and measurability.
D. *Consistency with other indicator sets.* Where possible, indicators should be coherent with the macro-economic indicators from the national accounts. Also, consistency with indicators of the Dutch Sustainability Monitor should be achieved.
E. *Relevance for the Dutch situation.* Not all indicators from the OECD list are relevant for the situation in the Netherlands. For instance, the OECD indicator 'access to sewage treatment and sanitation' is irrelevant for the Netherlands, as (almost) all households have access to these amenities. So, this indicator was omitted in favour of highly relevant indicators not included in the OECD list, such as indicators on water quality.

Data for the Dutch green growth indicators originate from several different sources. Many indicators are derived from the Dutch environmental accounts (see box Environmental accounting and monoitoring green growth), which are fully consistent with macro-economic indicators from the national 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.
All indicators are grouped in a dashboard for green growth according to the themes identified in the OECD measurement framework as described above. Two themes, namely environmental and resource efficiency and policy responses and economic opportunities, have been further subdivided, resulting in six different themes for green growth in total in the dashboard.

Environmental accounting and monitoring green growth

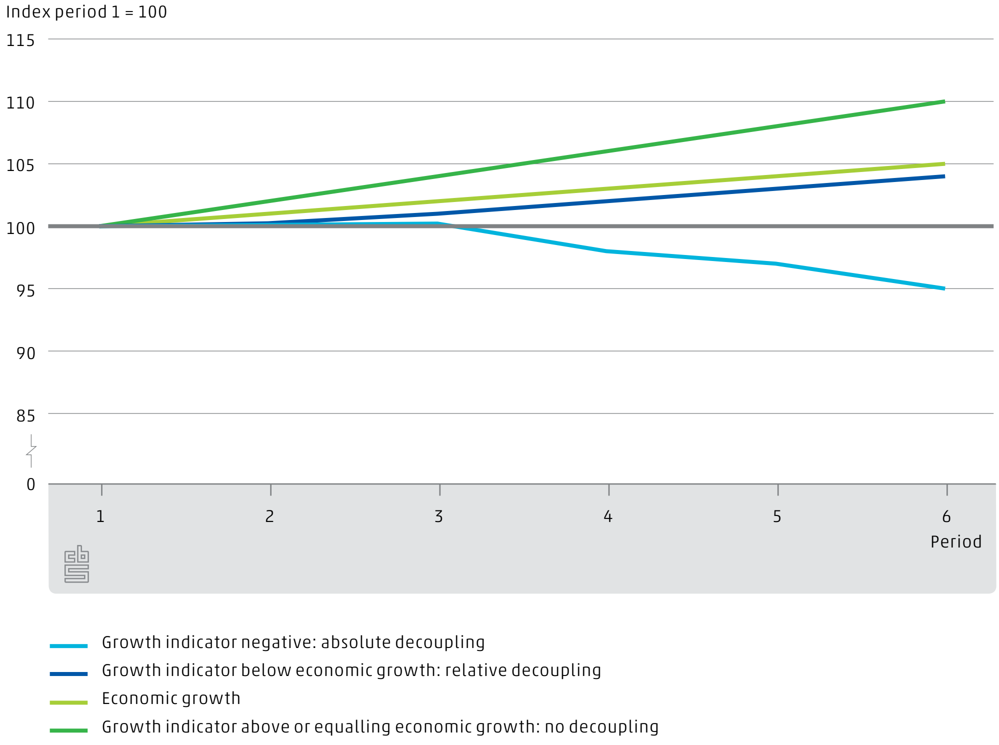
The System of Environmental-Economic Accounting (SEEA) provides a consistent, coherent and comprehensive measurement framework for green growth, as it integrates economic and environmental statistics (UN, EC, FAO et al., 2012). Both UNEP and the OECD advocate that environmental accounting is used as the underlying framework for deriving indicators. The OECD explicitly advocates that measurement efforts should, where possible, be directly obtained from the SEEA framework (OECD, 2011b).

A large number of the indicators from the OECD green growth monitoring framework can be directly obtained from the accounts of the SEEA central framework. Indicators for environmental efficiency and resource efficiency can be derived from the physical flow accounts. Combining physical information with monetary indicators from the System of National Accounts (SNA) provides information on the interaction between environmental pressure and economic growth. The asset accounts provide the basis for indicators related to the natural asset base. Environmental activity accounts offer useful information on the application and efficiency of various policy instruments, such as environmental taxes and subsidies. Finally, data from the environmental goods and services sector (EGSS) provide indicators for evaluation of economic opportunities that may be initiated by green growth.

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 (see figure 1.3.1). 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.

1.3.1 Concept of decoupling



1.4 More information

More information on the underlying indicators can be found in the publication The environmental accounts of the Netherlands 2013 (Statistics Netherlands, 2014c) and '*het compendium voor de leefomgeving*' (http://www.compendiumvoordeleefomgeving.nl/). Also data for most indicators can be directly obtained from Statline, the electronic database of Statistics Netherlands. Statistics Netherlands has also developed an interactive infographic in 2012 to inform policy makers and the general public on the status of green growth in the Netherlands. The infographic *Green growth* on Statistics Netherlands' website has been updated in December 2015. (http://www.cbs.nl/en-GB/menu/themas/dossiers/duurzaamheid/cijfers/extra/groene-groei-visualisatie.htm). It is an interactive tool which enables users to find detailed information on green growth. The infographic consists of two parts. In the left column of the infographic there are four dashboards each representing one of the four themes of green growth. Consecutively, each dashboard contains a number of theme related indicators, represented by pie charts. The colours in the pie charts illustrate the trends of the indicators with regard to 'greening growth'.

2. Green growth in the Netherlands and the position of the Netherlands in an international context

This chapter provides an overview of the status of green growth in the Netherlands. Section 2.1 sums up the most important findings for each theme of green growth. The remainder of this chapter provides details on the developments of each indicator since 2000, some background information on these developments and an assessment of the position of the Netherlands within the OECD and or Europe.

2.1 Overview

Environmental efficiency

The direct environmental pressure exerted by the Dutch economy has decreased. All environmental efficiency indicators for emissions and waste have decreased in absolute terms, while the economy grew (absolute decoupling). This shows that overall production processes have become more environmentally efficient and that, in this respect, the Dutch economy became 'greener'. Heavy metal emissions to water and nutrient emissions in agriculture have been reduced significantly due to various policy measures. Greenhouse gas emissions by industries have steadily gone down because of energy saving measures and growing electricity imports, but also because of the financial and economic crises. The carbon footprint, i.e. the amount of greenhouse gas emissions that result from Dutch consumption, was stable.

Despite this 'greener growth', the Netherlands has an average to low international ranking with regard to environmental efficiency indicators, which has not improved over the last years. This indicates that other countries in the OECD or EU are also growing green and are making similar progress. The Netherlands has the lowest ranking on the indicator nutrient surpluses. This reflects the high intensity of agricultural activities, particularly the high concentration of livestock. The Netherlands also ranks low with respect to the carbon footprint per capita. This is due to several factors including a relatively high level of per capita consumption and a low share of renewable energy production. The Netherlands ranks average on the intensity of greenhouse gas emissions. This is because of the high share of emission intensive activities, such as the chemical industry, refineries and horticulture.

Resource efficiency

Resource efficiency indicators for the Dutch economy show a mixed picture. Overall the direct use of resources has improved since 2000. While the economy grew, absolute resource use has decreased for groundwater abstraction and the domestic use of metals and minerals (absolute decoupling). After 2005 net domestic energy use first increased and then stabilised. The only indicator that has steadily increased since 2000 is the domestic use of biomass. This came about by importing more cereals, food products and wood. Despite the domestic progress in resource efficiency, the raw material footprint has increased between 2008 and 2012. So, although fewer materials are used directly in the Dutch economy, the Netherlands indirectly consumes more raw materials abroad. Internationally, the Netherlands ranks average to good with regard to most resource efficiency indicators. The use of biomass, metals and minerals per capita is low compared to other OECD countries plus the ranking has improved significantly. The Netherlands extracts relatively few raw materials, which lowers material consumption. Densely populated countries in the EU-28, such as the Netherlands, the United Kingdom, Italy and Malta, tend to consume somewhat lower amounts per capita than the EU-28 average.

Despite the recent increase of the share of renewable energy, the absolute level of 5.6 percent in 2014 is well below the European average. The Netherlands produced the least amount of total waste (excluding major mineral wastes) that ended up in landfills in the EU. Since 2000, the percentage of recycled waste has remained more or less constant, whereas incineration of waste increased at a constant pace and deposition on land decreased.

Natural asset base

The indicators for the natural asset base show positive and negative signs. Environmental assets in the Netherlands are under pressure. Natural gas reserves form the most economically relevant non-renewable resource. These were depleted even faster in 2014 as on top of the annual extraction they were affected by a substantial downward revaluation of existing reserves. The indicators for biodiversity show a mixed trend; the Red List Indicator for endangered species is stable, but the Farmland Bird Index is down. The area of built-up land has increased, which intensifies the pressure on ecosystems and biodiversity. Although the footprint of the Netherlands on global biodiversity has subsided somewhat since the year 2000, despite increased food consumption, it comprised an area of twice the country in 2010, i.e. approximately 83,000 km^2. Renewable assets, such as stocks of standing timber (forests) and fish stocks, are increasing. Stocks of standing timber have grown systematically by 1.9 percent a year since 2000 as a result of the extension in forest area and the increase in the estimated stock per hectare. The quality of marine ecosystems is measured in terms of the quality of fish stocks in the North Sea. Due to catch limits from the European Union stocks of fish in the North Sea are recovering, although not all fish species are above their precaution level.

The Netherlands has an average ranking for most indicators for which data is available. The ranking for the land conversion rate is below average. In the EU, 33 percent of all reviewed species are currently threatened or nearly threatened as tested against IUCN criteria, whereas in the Netherlands approximately 38 percent of all considered species were still threatened in 2014. The increase of stocks of standing timber scores among the highest, although the total stock is small compared to other countries.

Environmental quality of life

Production and income growth are not necessarily accompanied by a rise in well-being. Indicators for the environmental quality of life involve the direct impact of air, water and soil emissions on the quality of life. Results for these indicators show a rather mixed picture of green growth. Air quality is generally improving. In absolute terms, the exposure of the urban population to particulates decreased in 2013, however not all measurement locations met the exposure standards set by the European norms for particulate matter (PM_{10}). Only few bodies of water meet the quality standards of the European Water Framework Directive. There was some improvement in the ecological water quality between 2009 and 2013, but the chemical quality has deteriorated. The Netherlands, situated downstream of four international rivers, had the lowest ranking for the percentage of water bodies with a good ecological status in 2009. This is mainly caused by pollution and hydromorpholigical pressures (altered water courses, lack of natural habitats). The overall chemical status of Dutch waters in 2009 was moderately good. Indicators for the perception of environmental concern and willingness to pay for the environment show a sharp decline. The general public is less interested in and concerned about environmental issues.

Green policy instruments

Policy instruments are important means to achieve green growth. There has been little or no development in the application of green policy instruments since 2000.
The share of environmental taxes and fees in total taxes and social contributions in the Netherlands has been falling in recent years. The share of environmental subsidies in total government spending has been constant since 2005. Environmental expenditures as a percentage of GDP have remained fairly constant since 2001.
In recent years the budget for the main renewable energy subsidy (SDE) has increased from 1.5 billion euro in 2011 to 8 billion in 2016. On top of that, separate tenders for large off-shore wind farms have been announced. There is a substantial and uncertain time lag between the announcement of a subsidy, the actual payment and the resulting renewable energy production. It will take some years before this new policy will result in higher subsidy payments and renewable energy production (ECN et al., 2015a).
Also norms for new houses, cars and devices are important for greening the economy. These are often established through European regulations.
Despite the modest increase in green tax revenues in recent years, the Netherlands ranks high on this indicator internationally. The share of environmental taxes in total taxes and social contributions ranks among the highest in Europe, mainly as a result of high taxes on pollution (for example waste water tax and sewerage tax) and on transport (for example vehicle tax). Slightly less than 10 percent of the taxes and social contributions is environment related, while the European average is 6.4 percent. Energy use is taxed more than in other European countries. Also environmental expenditure, which is the result of stringent policy measures, scores among the highest in Europe.

Economic opportunities

'Greening the economy' has led to more economic opportunities. The share of employment of the environmental goods and services sector (EGSS) in total employment has increased. In absolute terms employment increased from 113 thousand FTE in 2001 to 126 thousand FTE in 2013. This growth rate is well above the average for the economy as a whole. The contribution of the environmental goods and services sector to GDP has increased as well. The increasing share of the EGSS in employment and GDP points to a transition towards an economy dedicated to the production of goods and services that reduces the pressure on the environment and natural resources across the world. Employment is mainly concentrated in waste(water) management and the construction industry. The sustainable energy sector, which comprises industries active in energy saving, renewable energy systems as well as industry profiles that make fossil energy relatively more sustainable, accounted for 0.66 percent of total employment in 2014.
In absolute terms, employment grew from 36 thousand FTE in 2008 to 46 thousand FTE in 2014. The share, but also the absolute number of green patent applications, has grown

significantly since 2000, indicating an upward trend in the inventiveness and knowledge intensification regarding green technologies. The share of green patent applications by Dutch parties is below average internationally. The share of environmental investments increased from 2.0 percent in 2001 to 2.7 percent in 2013. Environmental investment is a key factor in realising a greener growth path.

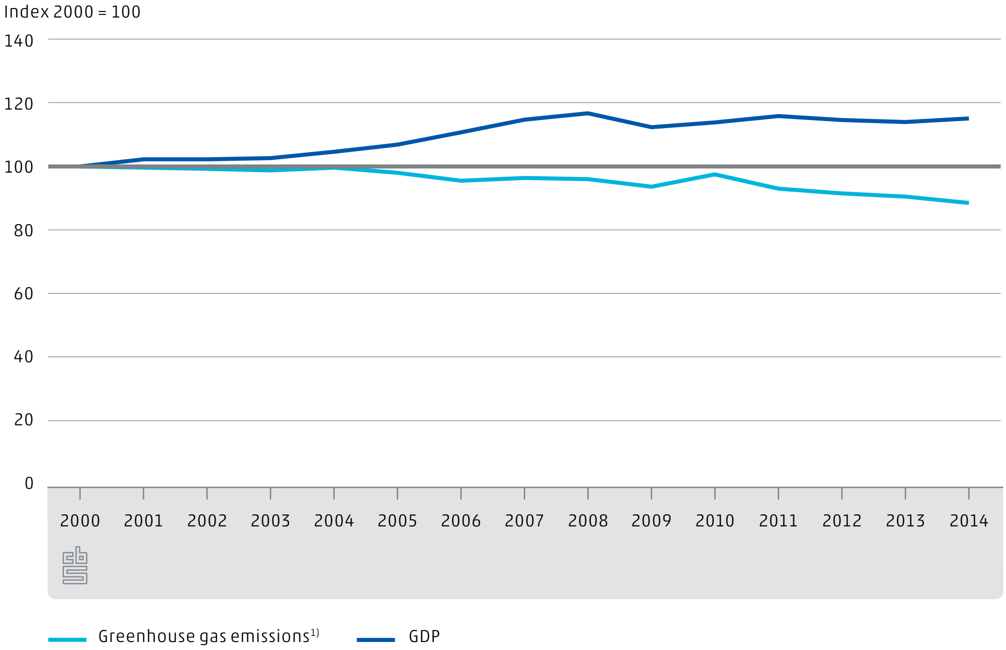
2.1.1 Scores of the Netherlands for green growth

Indicator	Time series	Trend in the Netherlands	Position in the OECD or Europe	CBS/OECD-GG Score	International comparison Int. Score
Environmental efficiency					
Production-based greenhouse gas emissions	2000–2014	absolute decoupling	2012: 12(23); 2008: 11(23)	green	yellow
Consumption-based greenhouse gas emissions	2000–2011	no significant change	2009: 20(28)	yellow	red
Emissions heavy metals to water	2000–2012	absolute decoupling	.	green	grey
Nutrient surplus agriculture	2000–2014	absolute decoupling	2012: 20(20); 2004: 23(23)	green	red
Total waste	2000–2012	absolute decoupling	2012: 12(23); 2004: 9(23)	green	yellow
Resource efficiency					
Groundwater abstraction	2000–2012	absolute decoupling	2012: 5(14); 2001: 3(15)	green	yellow
Domestic use of biomass	2000–2014	no decoupling	2013: 6(22); 2000: 12(21)	red	green
Domestic use of metals	2000–2014	absolute decoupling	2013: 4(22); 2000: 9(20)	green	green
Domestic use of minerals	2000–2014	absolute decoupling	2013: 1 (22); 2000: 3(20)	green	green
Net domestic energy use	2000–2013	relative decoupling	2013: 16(34); 2000: 14(34)	yellow	yellow
Renewable energy	2000–2014	improvement	2013: 21(22); 2004: 19(22)	green	red
Raw materials footprint	2008–2012	deterioration	.	red	grey
Waste recycling	2000–2012	no significant change	2012: 1(24); 2010: 1(24)	yellow	green
Natural asset base					
Energy reserves	2000–2014	deterioration	2014: 8(13); 2000: 4(11)	red	yellow
Stocks of standing timber	2000–2015	improvement	2010: 8(32); 2005: 13(32)	green	green
Stocks of fish	2000–2015	improvement	.	green	grey
Land conversion into built-up land	2000–2010	deterioration	2000-2006: 18(22)	red	red
Red list indicator	2000–2014	no significant change	2000: 8(18)	yellow	yellow
Farmland birds	2000–2014	deterioration	2005: 13(21)	red	yellow
Biodiversity footprint	2000–2010	improvement	.	green	grey
Environmental quality of life					
Urban exposure to particulate matter	2000-2013	improvement	2012: 12(24); 2000: 9(14)	green	yellow
Chemical quality of surface water	2009-2013	–	2009: 6(21)	red	green
Biological quality of surface water	2009-2013	–	2009: 21(21); 2007: 17(17)	green	red
Concentration of nitrate in groundwater	2000-2012	improvement	.	green	grey
Level of concern	2000-2012	improvement	.	green	grey
Willingness to pay	2000-2012	deterioration	.	red	grey
Green policy instruments					
Share of environmental taxes	2000–2014	deterioration	2013: 3(20); 2000: 2(19)	red	green
Implicit tax rate for energy	2000–2013	improvement	2013: 5(21); 2000: 9(20)	green	green
Share of environmental subsidies	2005–2013	no significant change	.	yellow	grey
Mitigation expenditure by central government	2007–2013	improvement	.	green	grey
Environmental costs	2001–2013	no significant change	2011: 4(19); 2000: 17(19)	yellow	green
Economic opportunities					
Employment evironmental goods and services sector (EGSS)	2001–2013	improvement	.	green	grey
Employment sustainable energy sector	2000–2014	improvement	.	green	grey
Value added environmental goods and services sector (EGSS)	2001–2013	improvement	.	green	grey
Green patents	2000–2009	improvement	2011: 23(34); 2000: 23(34)	green	yellow
Environmental investments	2001–2013	improvement	2011: 7(20); 2000: 9(19)	green	yellow

2.2 Production-based greenhouse gas emissions

Since 2000, greenhouse gas emissions by Dutch production activities saw a 12 percent decrease while GDP grew. So there has been an absolute decoupling of greenhouse gas emissions in the Dutch economy. The carbon dioxide emissions, the main greenhouse gas by production activities, decoupled relatively from 2005 to 2012 and absolutely from 2013 onwards.

2.2.1 Greenhouse gas emissions and GDP



[1)] CO_2 equivalents according to IPCC guidelines (2006).

Production-based greenhouse gas emissions are equal to the total emissions of the six gases targeted in the Kyoto Protocol caused by economic production activities (in CO_2 equivalents). This includes greenhouse gas emissions by resident production activities that occur abroad (for example emissions by airlines or seafaring ships). Direct emissions by households are excluded.

The issue

Combustion of fossil fuels, deforestation, but also specific agricultural activities and industrial processes are the main drivers of the increased greenhouse gas emissions. Enhanced concentrations of greenhouse gases in the atmosphere will raise global temperatures by radiative forcing. Climate change is of global concern because of its effect on ecosystems and social economic developments across the planet. A key aim of green growth is therefore to improve the emission efficiency of production in industries and of the economy as a whole.

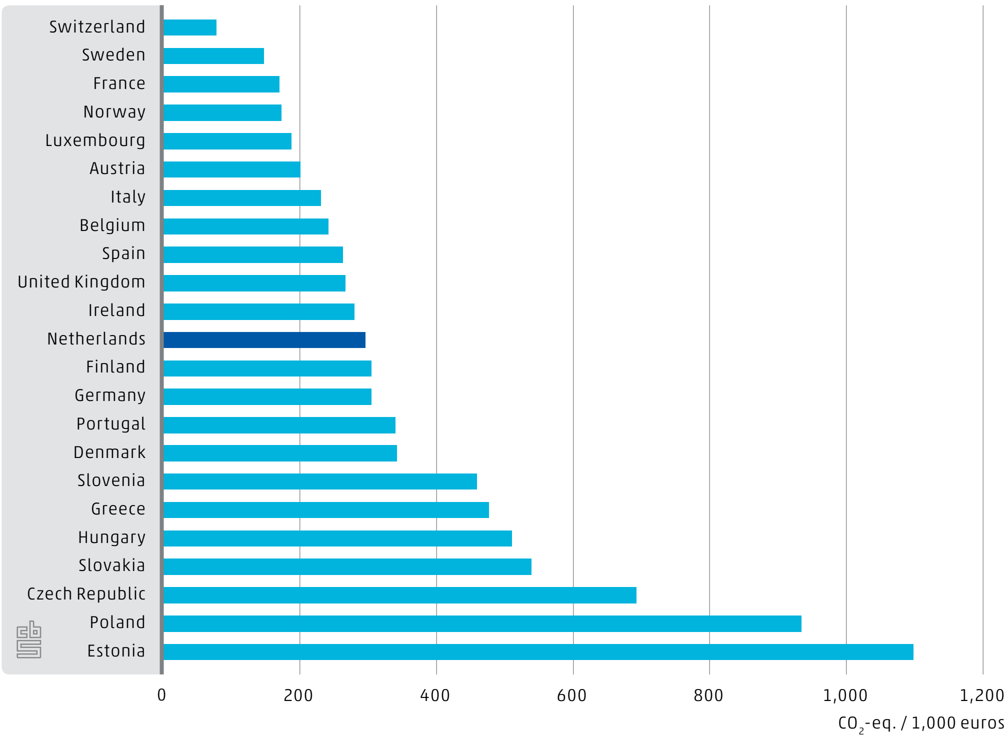
Analysis

Since 2001 total greenhouse gas emissions from production activities have started to decrease. Energy saving, higher imports of electricity and the financial and economic crisis are important reasons for the decline of production-based greenhouse gas emissions. Also the on-going shift to a more service-based economy affects the emission of greenhouse gases. Since the production of services tends to be much less emission-intensive than the production of goods, the rise in the production of services has caused the economy as a whole to become less emission-intensive. The Netherlands achieved the Kyoto target of a 6 percent reduction of greenhouse gas emissions in the period 2008–2012 (PBL, 2013). Electricity companies and refineries realised the largest reduction.

International comparison

The Netherlands has an average position in terms of the intensity of greenhouse gas emissions[1)], compared to other OECD countries (ranking 11 out of 23 countries in 2008). From 2008 to 2012 these OECD countries lowered their greenhouse gas intensity by 9 percent on average, but the Netherlands achieved only 2 percent, slightly lowering the country's ranking to 12 out of the 23 countries in 2012.

2.2.2 Greenhouse gas emission intensity, 2012*



Source: Statistics Netherlands/Eurostat.
*) Gross domestic product (GDP) in 2010 market prices and CO_2 equivalents according to IPCC-guidelines (2006).

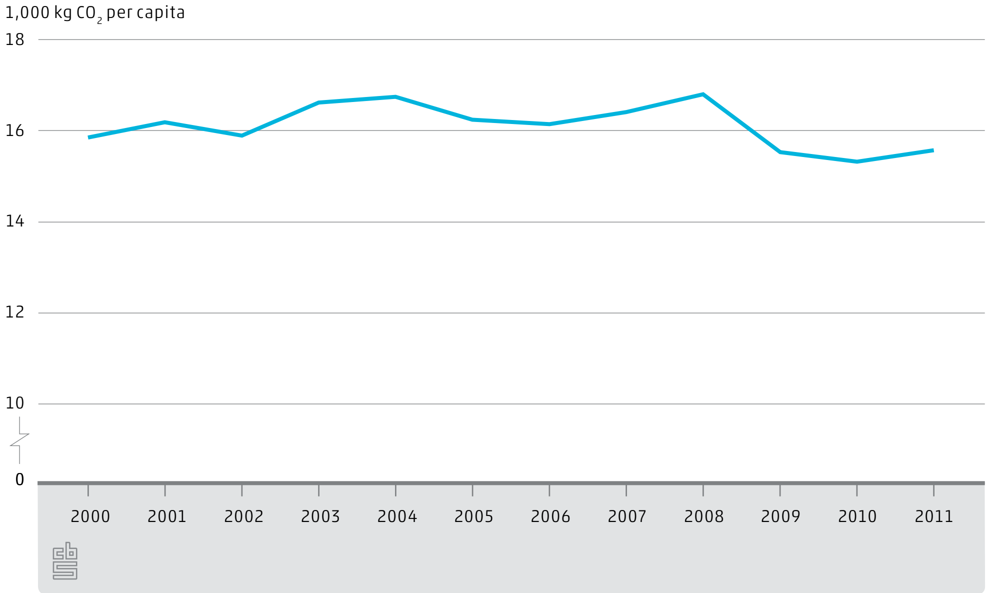
1) Gross domestic product (GDP) in 2010 market prices.

The chemical sector and refineries, which are relatively emission-intensive, take up a prominent position in Dutch manufacturing. Agriculture (horticulture and intensive livestock farming) also causes relatively more greenhouse gas emissions. Estonia, Poland and the Czech Republic still have relatively high CO_2 emission intensities as their manufacturing is still relatively energy inefficient. In addition, electricity in these countries is mainly produced by burning coal or lignite, which results in high carbon dioxide emissions. Denmark also has a high emission intensity, as it has sea shipping as an important economic activity. Austria, Sweden and Norway produce a lot of renewable energy (hydro power) and so their economies are less emission intensive. Italy and Portugal have the advantage of needing less energy for heating offices and shops during the winter months. This offsets their higher use of electricity needed for air conditioning in summer, lowering their overall emission intensity.

2.3 Carbon footprint

The total amount of carbon dioxide emissions as a result of Dutch consumption, called the carbon footprint, amounted to 15,600 kg CO_2 per capita in 2011. The carbon footprint has been stable since 2000.

2.3.1 Carbon footprint



Source: PBL.

The carbon footprint consists of the total greenhouse gas emissions that occur along the supply chain in order to produce goods and services that are used in Dutch final demand (consumption and investment). They consist of domestic (direct and indirect) and foreign emissions.

The issue

With increasing globalisation and complex supply chains, emissions embodied in trade are becoming more important in the global impact of Dutch consumption. The consumption perspective is important for green growth considerations as it indicates the extent to which the needs of Dutch consumers contribute to increased emissions of greenhouse gases into the atmosphere and – indirectly – to climate change.

Analysis

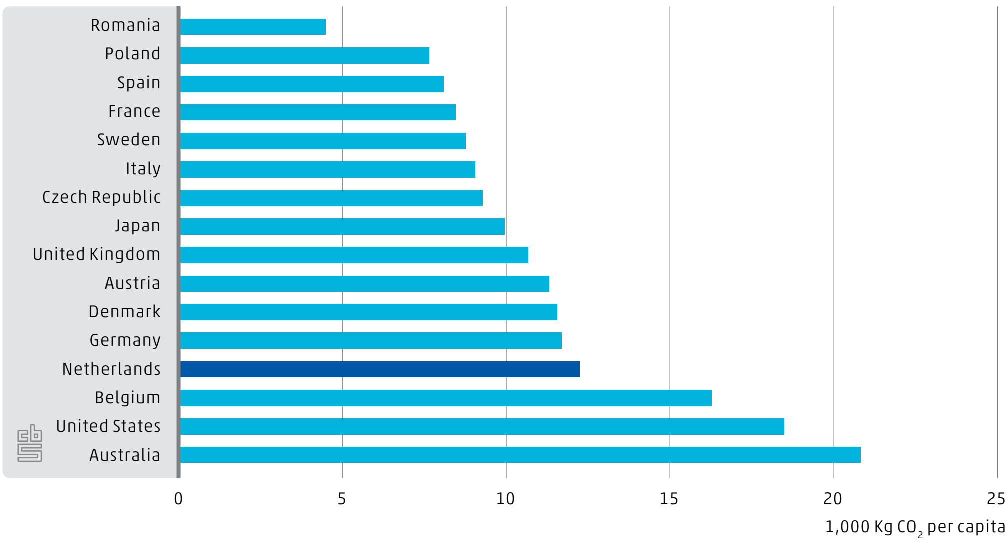
The carbon footprint increased slightly between 1995 and 2008, but has since decreased. This is due to the economic stagnation and reduced consumption by households. Direct emissions by households have decreased over the years, primarily as a result of less use of natural gas for heating. Import related emissions have increased, indicating that more of our consumption related emissions take place abroad. These emissions primarily originate in China, followed by Germany and Russia.

International dimension

The Netherlands ranks low with respect to the carbon footprint per capita. Out of 28 OECD countries, the Netherlands has the 20th position. Australia, the United States and Belgium have a larger carbon footprint while most other European countries have a smaller one. This is due to several factors including a relatively high level of per capita consumption and a low share of renewable energy production in the Netherlands.

(For more information on this subject, see the article *Towards a MRIO based national accounts consistent carbon footprint* (Statistics Netherlands, 2013a). Statistics Netherlands reports on its research to provide provisional estimates of the Dutch carbon footprint using a publicly available multi-regional input output table which has been made consistent with Dutch national accounts and environmental accounts.)

2.3.2 Carbon footprint per capita, 2009

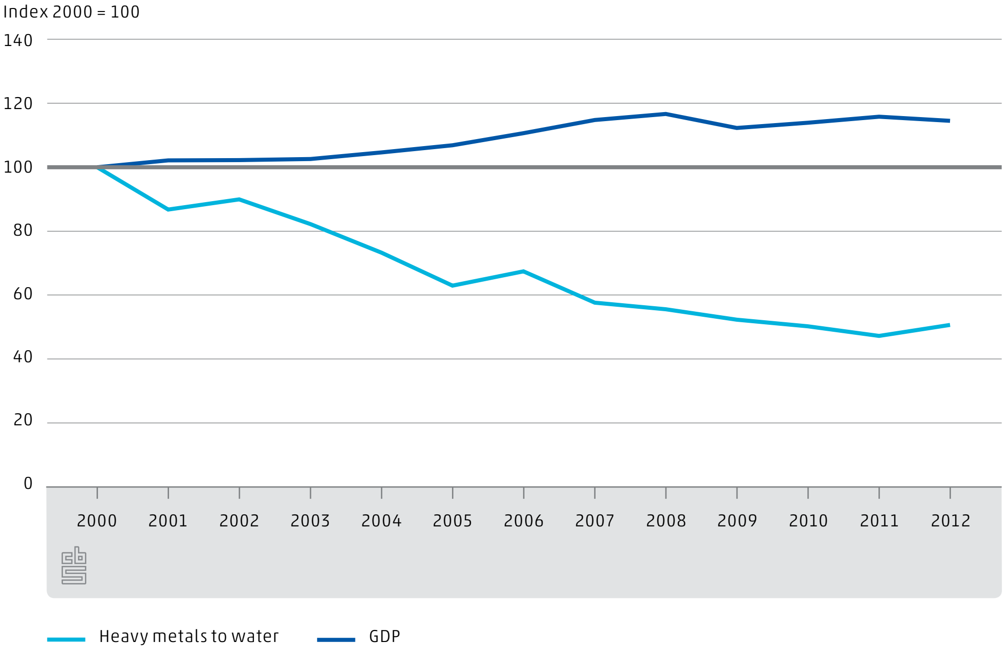


Sources: Footprint for the Netherlands based on SNAC; other countries based on unadjusted WIOT; population data: http://databank.worldbank.org/; Not all researched countries are shown.

2.4 Emissions to water, heavy metals

Between 2000 and 2012 emissions of heavy metals to water fell by 50 percent, while the economy grew by almost 15 percent. This implies that overall the Dutch economy improved its environmental efficiency in terms of water emission intensity.

2.4.1 Emissions to water of heavy metals and GDP



Emissions of heavy metals to water reflects the emission of a group of metals with high toxicity, such as arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc. The indicator is calculated in equivalents, which means that the extent of toxicity of each metal is taken into account (Adriaanse, 1993). Emissions related to run-off and seepage are excluded because these two sources are very dependent on weather conditions.

The issue

The availability of clean water is essential for humans and nature. However, everyday surface waters are exposed to discharges of harmful substances by industries and households, which could cause severe damage to ecosystems in rivers, lakes and coastal waters. Heavy metals occur naturally in the environment, but are toxic in high concentrations. In the light of green growth, the development of emissions of heavy metals by industries and households is relevant, because of its impact on water quality.

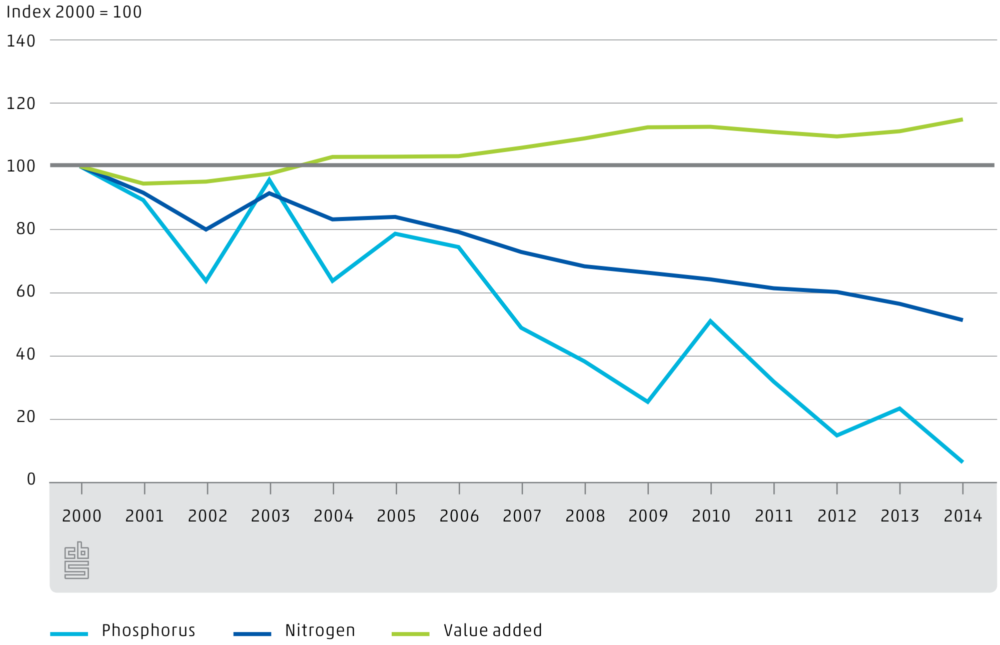
Analysis

Emissions by manufacturing have halved since 2000 through all kind of technical measures. The emission intensity has greatly improved in several industries, including the basic metal, the food and the chemical industries. In addition, waste water treatment plants have improved their purification efficiency. In 2012 emissions increased with respect to 2011. The increase of heavy metals emission in 2012 was primarily caused by the industries 'manufacturing of metal products' and 'manufacturing of 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.

2.5 Nutrient surpluses

In spite of continued growth in the production and value added of agriculture, the surpluses of nitrogen and phosphorus in agriculture have decreased significantly in the Netherlands since 2000: nitrogen by 49 percent and phosphorus by 94 percent. Despite these considerable decreases, there are still surpluses.

2.5.1 Nutrient surpluses and value added in agriculture



The nutrient surplus is calculated by subtracting the removal (harvested crops and fodder) from the supply (for example manure and mineral fertilisers). Value added is used as a measure of agricultural output.

The issue

The sustainability of agro-food systems is at the centre of green growth considerations. One of the main challenges in agriculture is to better the management of nutrients. Lower nutrient levels have a positive effect on the quality of the soil, groundwater and surface water, which in turn has a positive effect on biodiversity. Moreover, a lower reliance on nutrients is desirable as phosphorus is becoming increasingly scarce and the production of nitrogen fertilisers from elemental nitrogen is very energy intensive.

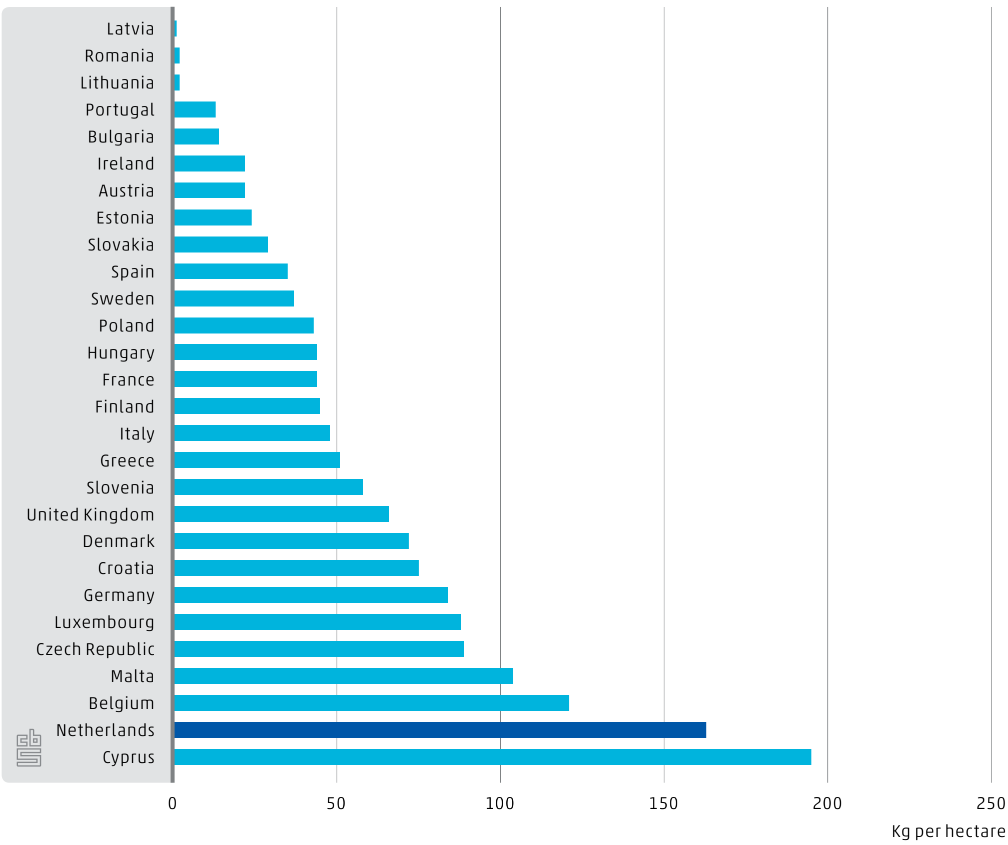
Analysis

Intensive livestock farming is the main generator of nitrogen and phosphorus surpluses in the Netherlands. As a result of effective government measures following the implementation of the EU Nitrates Directive, the nutrient surpluses have fallen ever since 2000. The most effective measures were the implementation of different levies, the decrease of nutritional content in fodder, and improved fodder conversion. Although there is a positive trend – absolute decoupling – surpluses are still considered too high (RIVM, 2012).

International comparison

Due to its small land area and relatively high concentration of livestock, the nitrogen surplus in the Netherlands is one of the highest in the European Union. The significant decrease in nutrient emissions described above has not yet changed the high emission intensity compared to other EU countries.

2.5.2 Nitrogen surplus, 2012[1)]

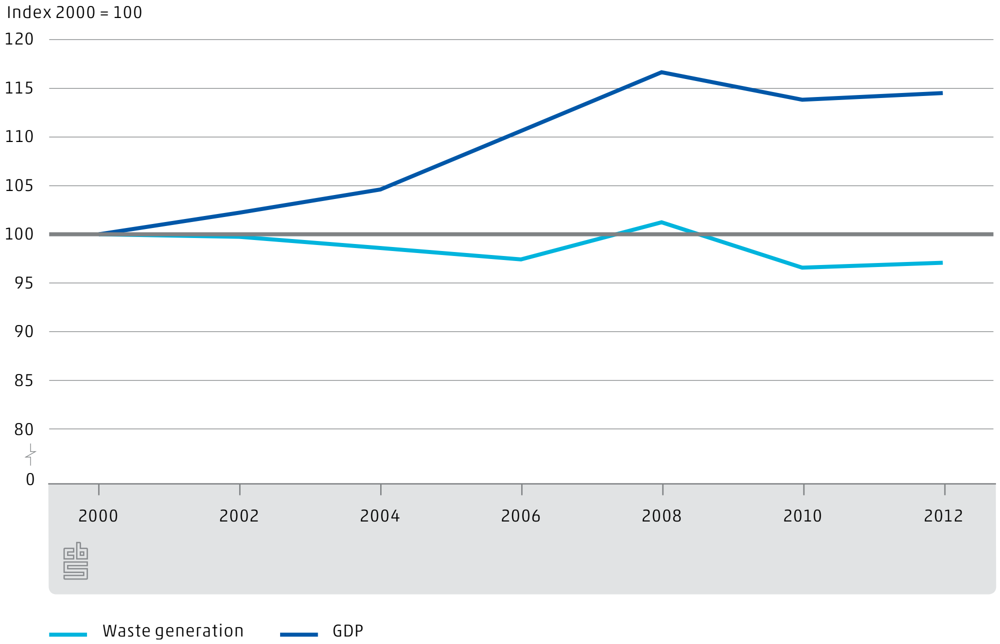


Source: Eurostat.
[1)] The values for Sweden and Ireland are from 2011.

2.6 Waste generation

During the last decade, waste generated by industries and households fell by nearly 3 percent. This can almost completely be attributed to a reduction of mineral waste, which is the largest waste category. The generation of chemical and metal waste still increased. At the same time the economy grew by almost 15 percent. So, there is absolute decoupling with regard to waste production.

2.6.1 Domestic waste production and GDP



Waste includes all 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. Materials that are directly re-used at their place of origin are not included.

The issue

Treatment of solid waste involves recycling, incineration and disposal on landfill sites. Each treatment method causes different kinds of environmental problems. Waste incineration results in environmentally damaging gaseous emissions, while disposal on land takes up space and requires years of maintenance. Recycling causes less stress on the environment, but still requires energy, and could result in a lower grade material. One approach is therefore to reduce waste generation and therewith increase productivity of the production process.

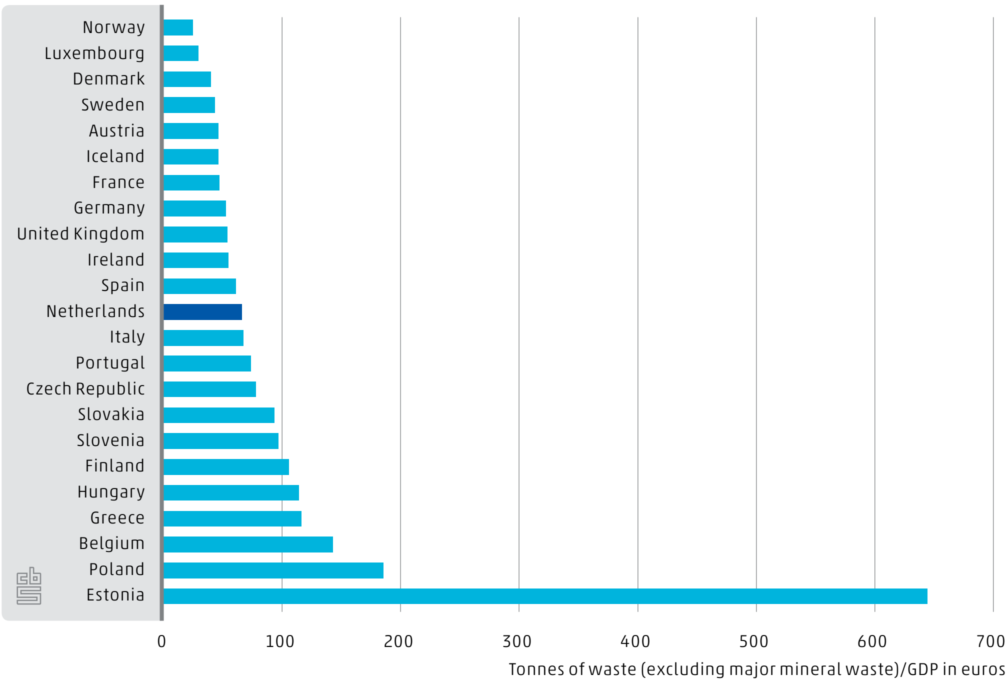
Analysis

Until 2008, in spite of economic growth and increased consumption, the total amount of generated waste remained more or less stable. In 2009 and 2010 the economic crisis led to a decrease in waste production. Waste production was reduced in the chemical industry and the basic metal industry, but the largest reduction took place in the construction and demolition sector as a result of reduced building activity due to the economic crisis. The amount of waste stayed fairly constant from 2010 to 2012.

International comparison

The Netherlands scores average for the waste intensity within Europe, showing a similar waste intensity as most other European countries. The extremes in the ranking reflect the business structure. Much of the waste generated in Estonia is related to the extraction of oil from oil shale. In 2012, the highest levels of waste generation in Europe were recorded for households and manufacturing activities. Their developments followed a different pattern over time: households generated similar amounts of waste in 2012 as in 2004, whereas the waste generation of the manufacturing industry fell by 26 percent during that period.
The same pattern was also found for the Netherlands. This resulted in an improvement of the waste intensity (tonnes of waste generated per GDP) from 78 tonnes/euro in 2004 to 66 tonnes/euro in 2012. However, other European countries have also improved their waste intensity considerably. As a result the Netherlands, which ranked 8th in 2006 fell to the 12th position in 2012.

2.6.2 Waste intensity for several countries, 2012

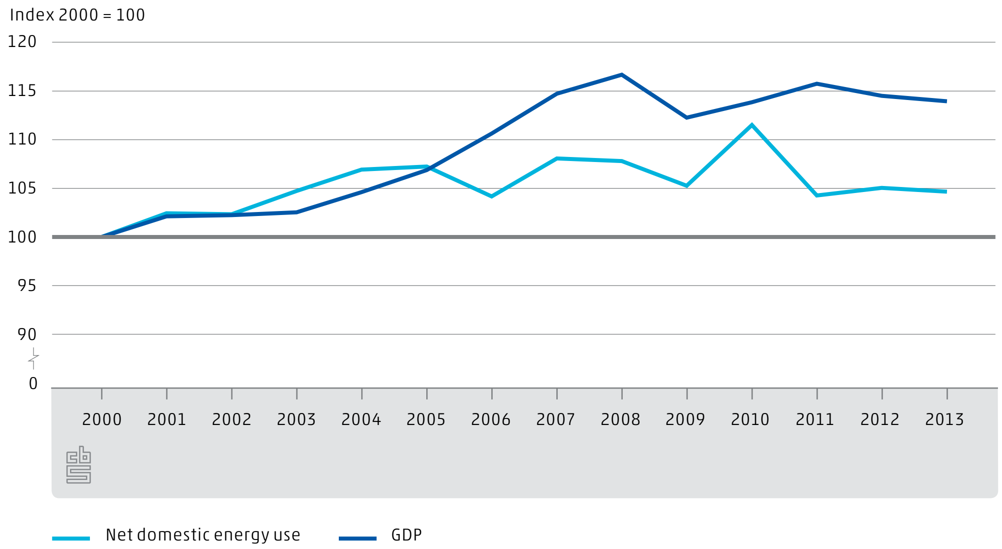


Source: Eurostat.

2.7 Net domestic energy use

The net domestic energy use of industries has gone up by 5 percent between 2000 and 2013 while GDP rose by 14 percent. So there is relative decoupling between energy use and economic growth. Since 2005, total energy use has stabilised. Net energy use increased in transport, the chemical sector, and government and healthcare whereas it fell in agriculture, the manufacturing of food products and the electricity producers.

2.7.1 Net domestic energy use and GDP



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. Energy use for production activities is included while energy use by households is excluded here.

The issue

Energy is essential to the economy as input for production processes and as a consumer commodity. The production and use of non-renewable energy often have a negative impact on the environment (emissions of CO_2 and other air pollutants) and are directly related to the depletion of these energy resources. So improving energy efficiency and decoupling energy consumption from economic growth are key objectives for green growth.

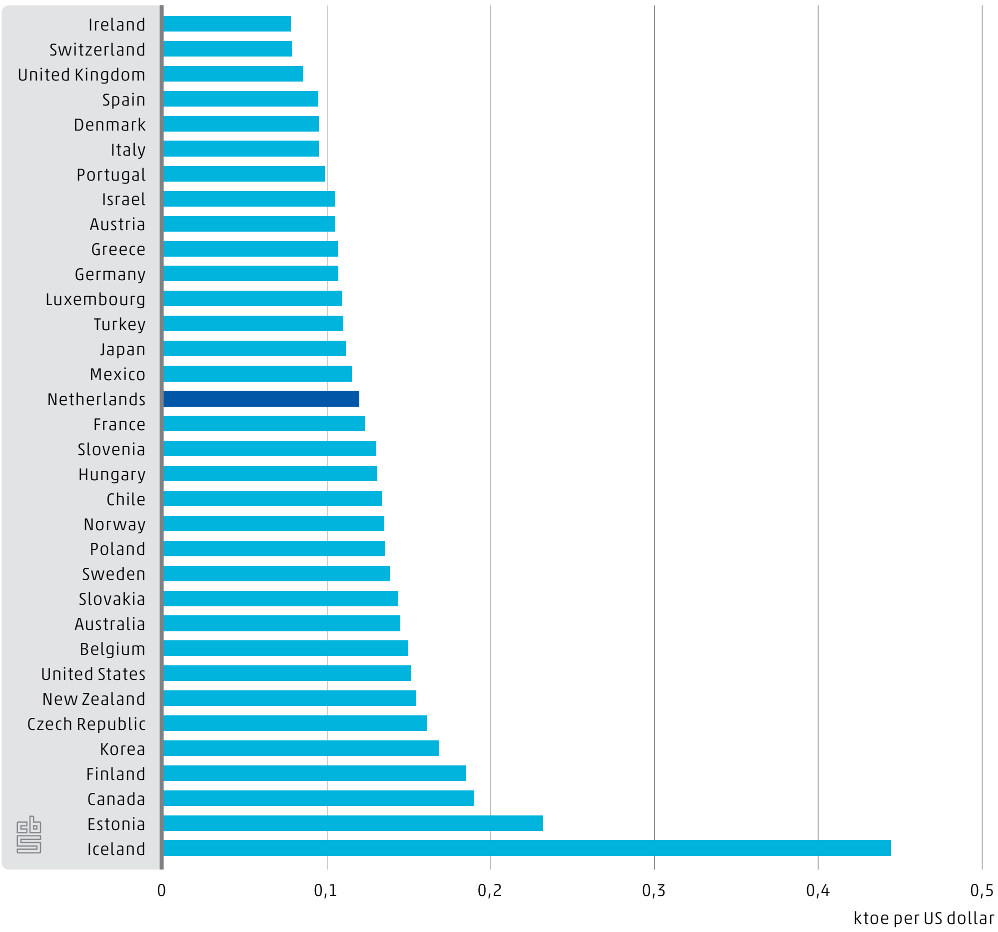
Analysis

Between 2000 and 2008 economic growth has been the driving force of the increase of net energy use by industries, which was only partially negated by an increase of energy efficiency of production processes. Since 2008 net energy use has stabilised. The economic crisis is only one of the factors responsible for this. Companies have implemented various energy conservation measures, resulting in more efficient energy use in their production processes. The effects of higher energy standards for buildings, vehicles and installations have become visible in an improved energy intensity. The overall result is an 8 percent decrease in energy intensity, the energy use per euro value added, since 2000. Energy intensity improved in agriculture, manufacturing of metal products, manufacturing of machines, energy supply and construction.

International dimension

The Netherlands ranks average with regard to its energy intensity. The Dutch economy is characterised by relative many energy intensive industries compared to most other countries, such as refineries, chemical industries, horticulture and transport sector. However, due to all energy saving measures, the energy intensity of many production processes has decreased over the years. Countries with a higher energy intensity include Iceland, Sweden, Finland and Norway, where more energy is needed to heat buildings due to the colder climate. The Unites States and Australia have lower energy saving standards and energy efficiency processes in manufacturing and energy supply than the Netherlands. Spain, Italy and Greece have a lower energy intensity primarily because of the warmer climate. The energy intensity of Germany and the United Kingdom is lower because their economies are characterised by relatively less energy intensive activities. The Netherlands has dropped in rank with regard to its energy intensity to 16 in 2013.

2.7.2 Energy intensity for OECD countries, 2013

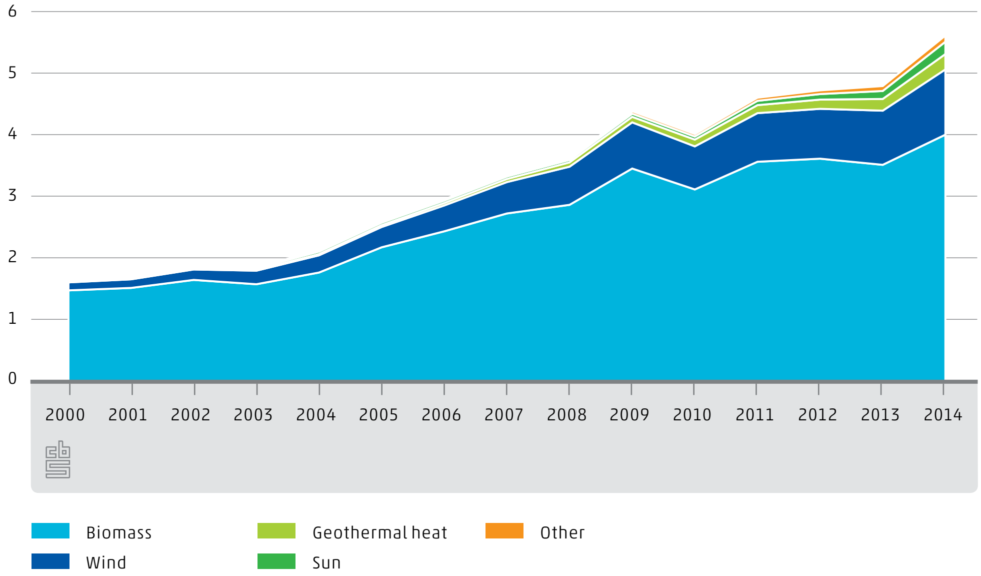


Source: OECD.

2.8 Renewable energy

The share of renewable energy sources in Dutch final energy consumption increased from 1.6 percent in 2000 to 5.6 percent in 2014. Renewable energy is primarily produced from biomass.

2.8.1 Share of renewable energy sources in total energy use



The share of renewable energy is defined as the percentage of total gross final energy consumption accounted for by renewable energy. Apart from biomass, wind, geothermal heat and solar energy, renewable energy sources include hydropower and aerothermal heat.

The issue

The production of renewable energy plays a key role in greening the energy sector, and thereby the energy supply for the whole economy. Renewable energy together with energy efficiency reduces carbon dioxide emissions. It also improves energy reliability, because renewable energy is produced locally or imported from different regions than fossil fuels are. However, currently, renewable energy is much more expensive than fossil energy and needs government support in the form of subsidies or obligations.

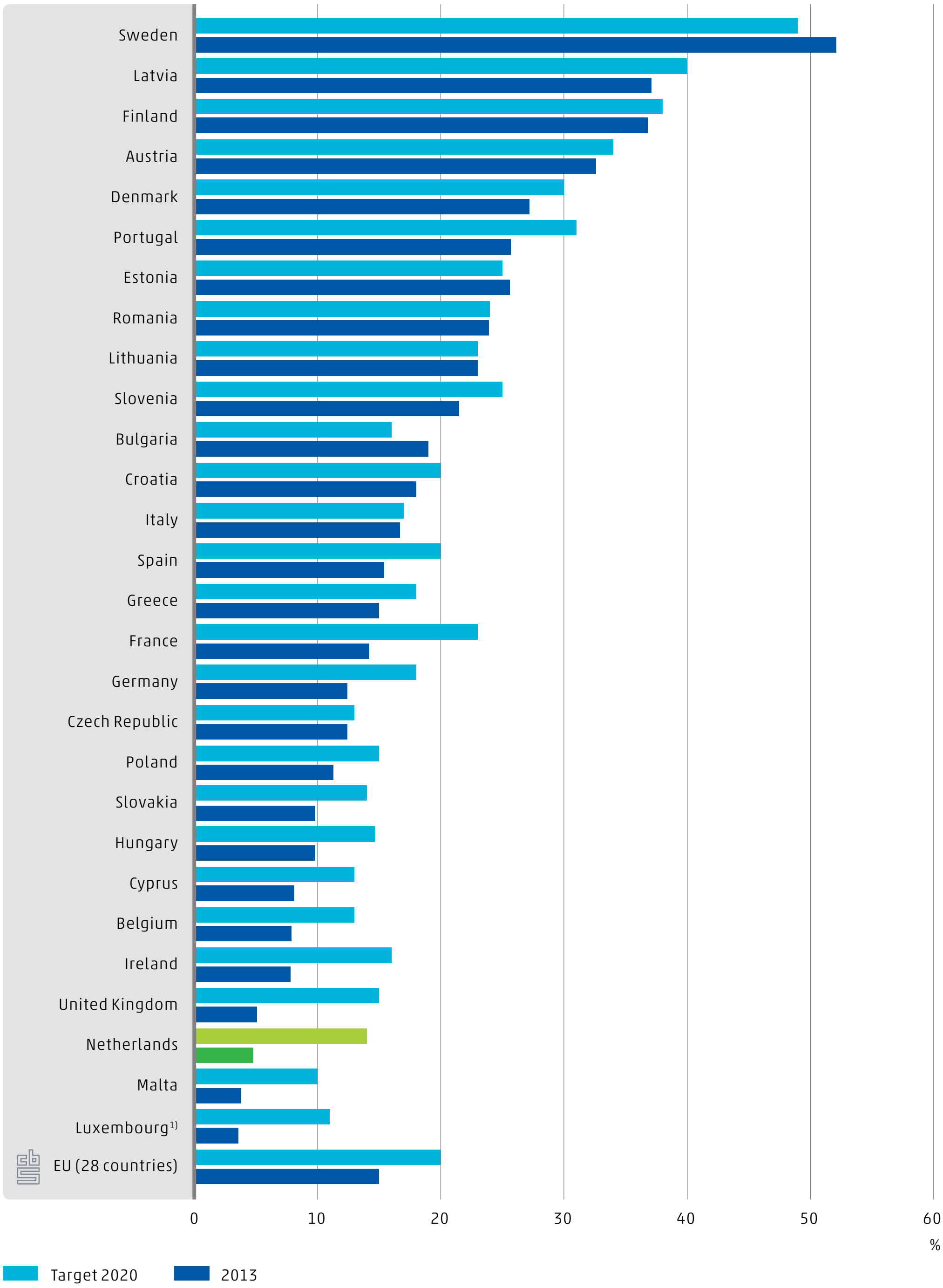
Analysis

Between 2003 and 2009, the share of renewable energy rose thanks to subsidies for the production of renewable electricity and the introduction of the obligation for suppliers of petrol and diesel to blend biofuel. Growth slowed down between 2010 and 2013, partly because subsidies for new projects were not available between 2006 and 2008 which hampered the initiation of new projects. In 2014 the share of renewable energy rose substantially from 4.8 to 5.6 percent. To a large extent this was due to the decrease in total energy use as a result of the warm weather in 2014. The use of renewable energy for heating also increased, because of the new subsidy possibilities.

According to calculations by PBL (the Netherlands Environmental Assessment Agency) and ECN (the Energy Research Centre of the Netherlands) for the Netherlands National Energy Outlook (ECN, PBL, CBS and RVO, 2015), the current and foreseen policies embedded in the Dutch National Energy Agreement may lead to a renewable energy share of 12 percent by 2020 and 16 percent by 2023. This would imply that the EU Renewable Energy Directive target set for the Netherlands, namely of 14 percent by 2020, will not be met in time.

International comparison

2.8.2 Share of renewable energy in gross final energy consumption



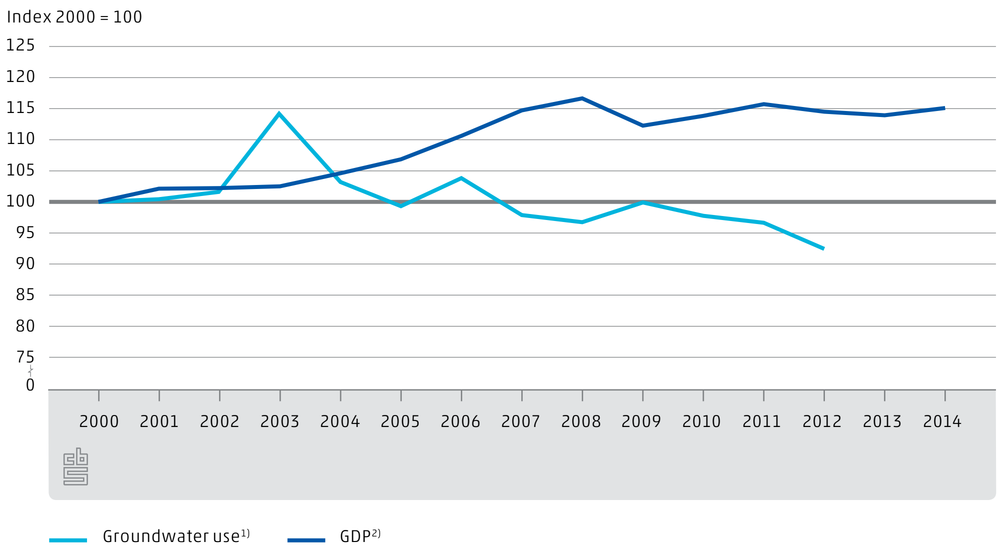
Source: Eurostat; Statistics Netherlands.
[1] Estimated figure for Luxembourg.

In the Netherlands the share of renewable energy in the total gross energy consumption is relatively small compared to other European countries. In the EU28 the Netherlands ranks third from the bottom. In the Netherlands 4.8 percent of all energy consumption is produced from renewable sources (2013); Sweden ranks highest with 52.1 percent. There are three reasons for the low ranking of the Netherlands. Firstly, there is little hydropower due to the slow-moving rivers. Secondly, households rarely use wood to heat their houses (or for cooking) simply because most households are linked to the gas supply. Thirdly, government support for renewably energy elsewhere has been much more generous than in the Netherlands.

2.9 Groundwater abstraction

About 7 percent less fresh groundwater was abstracted in 2012 than in 2000. Manufacturing has reduced its groundwater abstraction from the environment by 28 percent. The abstraction by water supply companies has gone down by 6 percent. Groundwater use in agriculture is largely dependent on the weather conditions. This caused high abstraction levels in 2003 and 2006 and although to lesser extent, also in 2009.

2.9.1 Groundwater abstraction for production activities and GDP



1) 2000, 2001 and 2002 data are based upon water time series project.
2) GDP time series based upon ESA 2010 guidelines. 2014 are provisional figures.

Groundwater abstraction intensity, defined as the amount of ground water abstracted per unit of GDP (in constant prices), is an indicator for the burden to fresh groundwater resources from economic production.

The issue

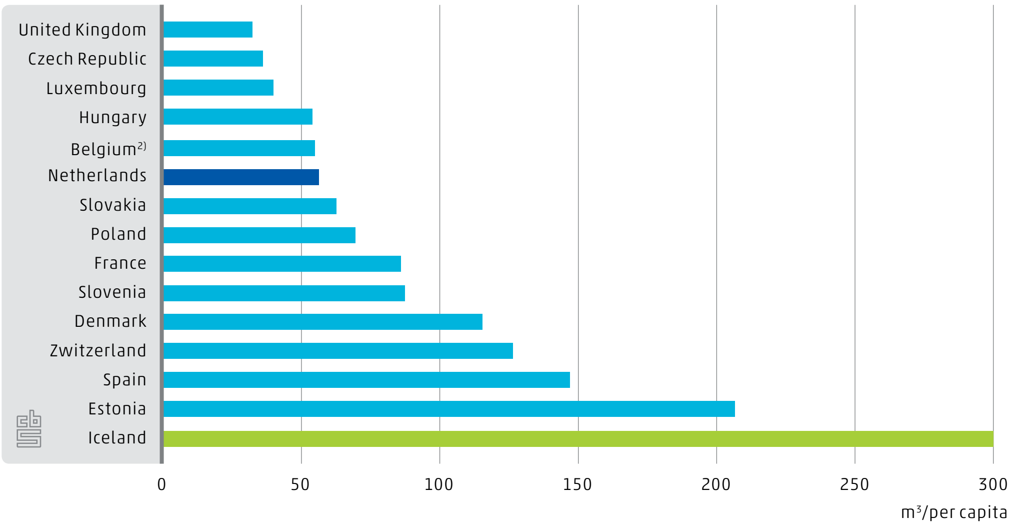
One of the key aspects of green growth is how efficiently producers use natural resources, in particular scarce resources. Although fresh water itself is not scarce in the Netherlands, fresh groundwater stocks in particular are under increased pressure both the number and the frequency. This is caused by competing uses, especially in periods with lasting warm and dry conditions which have occurred more frequently in recent years, predominantly in the higher and sandy regions. This also affects the actual quality of the water required for drinking water preparation. Minimum quality standards are exceeded easily. The lower groundwater tables and the resulting desiccation have an impact on nature conservation and biodiversity and on emissions from soil in certain areas.

Analysis

On average, groundwater intensity of the Dutch production activities, measured as groundwater abstraction (in litres) per euro of value added generated by the Dutch economy, decreased from more than 2.05 litres per euro in the year 2000 to 1.62 litres per euro in 2012, an improvement of almost 20 percent. This improvement is largely explained by the economic growth of water extensive activities, and to a lesser extent by the result of water efficiency measures for water intensive activities (such as agriculture and the manufacture of basic metals and paper).

International comparison

2.9.2 Groundwater abstraction by country, 2012[1)]



[1)] For a number of European OECD countries no data on groundwater abstractions are available.
[2)] For Belgium the 2011 value is used as there were no 2012 values yet.

In 2012 the Netherlands ranked above average with respect to the rate of groundwater abstraction per capita (6th out of 15 other OECD countries). Between 2005 and 2012 these OECD countries have lowered their groundwater abstractions per capita by an average of 7 percent.[2)] The Netherlands did so by 9 percent but this had no impact on its ranking since 2005. But its ranking is clearly worse than in 2000, when the abstraction rate was among the lowest. The ratio between the abstractions to the available resources, and

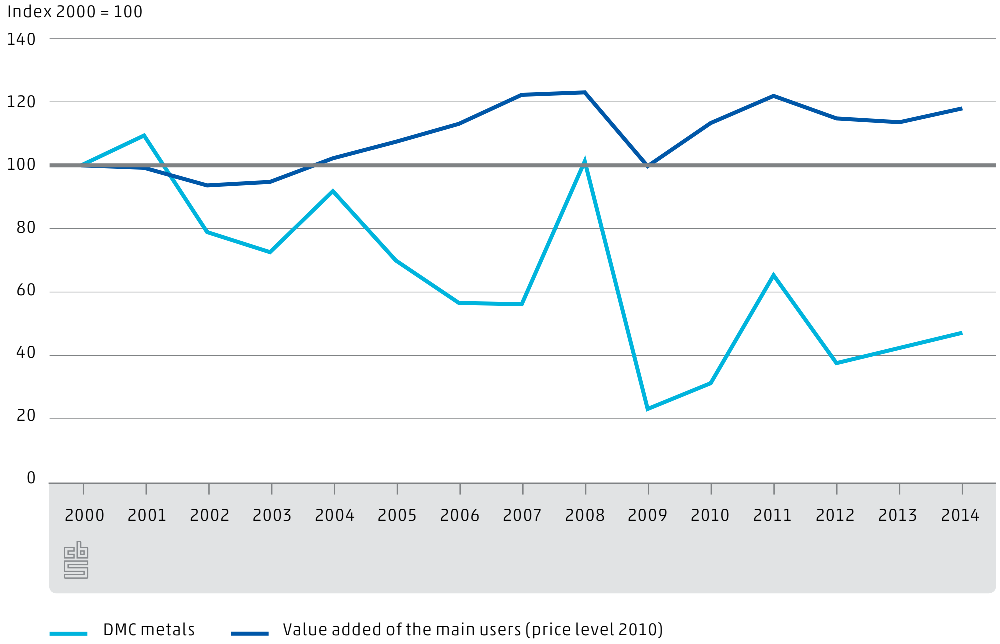
[2)] Due to data restrictions in previous years, the comparison was made for a selection of just 11 countries.

the possibilities for renewal of the resources in place, determine the extent of situations of water stress. These are largely the result of geographic, climate and soil conditions. Some countries, with a high per capita abstraction rate withdraw large amounts of water for the use in highly productive agriculture, particularly for the dryer regions. Other countries, with abundant fresh groundwater resources also show high abstraction rates, for example for public water supply, as there are hardly any or no restrictions to abstraction.

2.10 Domestic metal consumption

The domestic use of metals has fluctuated substantially since the year 2000, in particular between 2007–2009. Absolute decoupling took place until 2007, which was accompanied by increased metal intensity. Domestic metal use and metal intensity have shown a steady increase since 2009, indicating a deterioration of the efficiency of metal use. But although metal efficiency has recently deteriorated, overall efficiency is still much higher than in 2000.

2.10.1 Domestic metal consumption and value added of main users of metals



Domestic use of metals is calculated as the domestic extraction plus imports minus exports of metal products. Metal intensity is the domestic use of metals and metal products divided by value added (in constant prices) of the main users of metals (manufacture of basic metals, metal products, computers, electrical equipment, machinery, motor vehicles and other transport equipment).

The issue

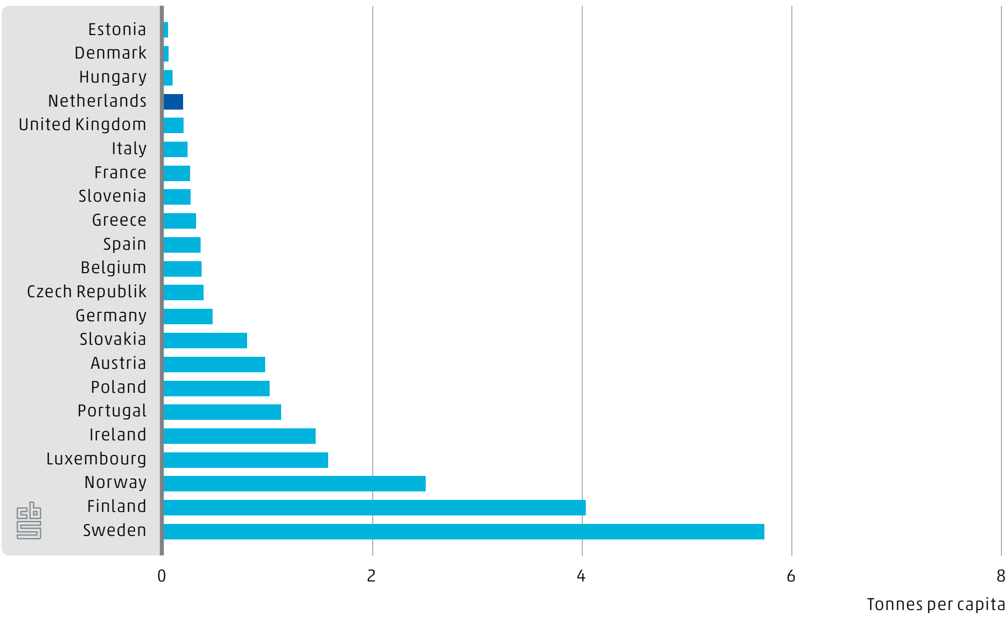
Material resources provide essential raw materials and other commodities to support economic activities. Worldwide population growth and increasing wealth have led to a greater demand of natural resources. One of the main challenges in the transition to green growth is to ensure that materials are used efficiently at all stages of their life-cycle. This can be monitored in terms of material intensity.

Analysis

There is no extraction of metals in the Netherlands. Both metal imports and exports show fluctuations, superimposed on an increasing trend since the year 2000. Domestic metal use fell because imports increased at a slower rate than exports. Domestic metal use fell sharply (-80 percent) in 2008 due to the economic crisis which caused a strong reduction in the imports of raw metal ores and metal products (cars, construction vehicles). The national and international demand for raw metal ore processing fell rapidly, construction activities dwindled and vehicle sales dropped.
Metal intensity decreased rapidly between 2000 and 2007, indicating that less metal was needed to create an equal amount of value added. From 2007 onwards, metal imports, exports, domestic metal consumption and metal intensity increased.

International comparison

2.10.2 Domestic use of metals per capita in European countries for 2013



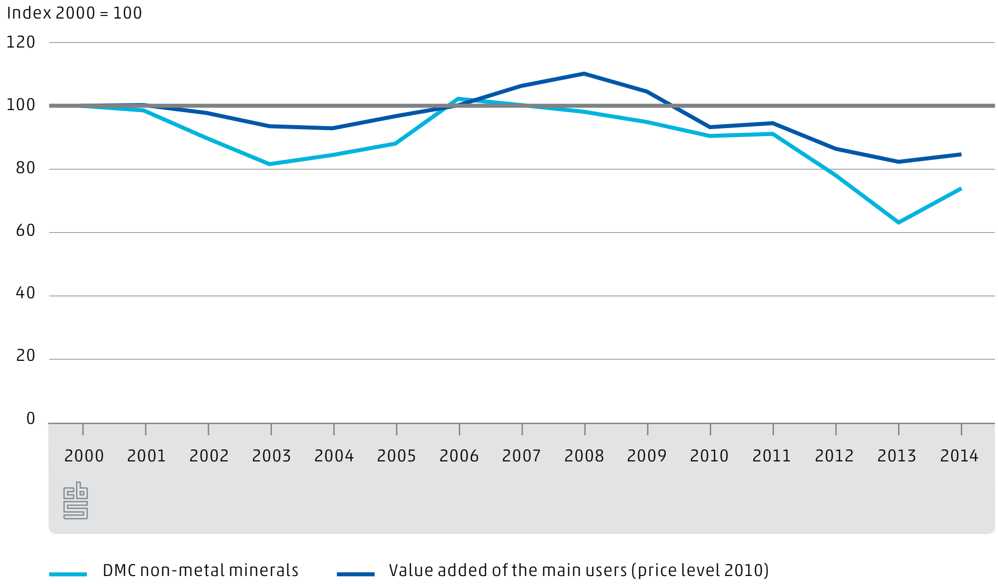
Source: Eurostat.

With a value of 0.19 tonnes per capita, Dutch metal consumption in 2013 ranked among the highest in Europe. This value has fluctuated strongly in the past though, reaching a maximum of 0.7 ton per capita in 2009. The Scandinavian countries persistently rank lowest in the comparison, which is related to the intense iron ore excavation and related industries in these countries. The production of ores is characterized by enormous differences between the mass of the extracted gross ore and the mass of the final products. We may therefore expect considerable upstream flows of these materials left behind as wastes in the economies that extract them.

2.11 Domestic mineral consumption

The domestic use of non-metal minerals fell sharply between 2006 and 2013. After 2008, value added of the main users of minerals also decreased. Mineral intensity fluctuated between 2000 and 2014, which was 12 percent lower. Overall domestic use of minerals has decreased somewhat faster than value added since 2000. However, there is no consistent pattern of improved resource efficiency.

2.11.1 Domestic mineral consumption and value added main users of minerals



Domestic consumption of minerals is calculated as the domestic extraction of minerals plus imports minus exports of mineral products. Excavated soil (used for for example land reclamations, construction of dikes and dams for infrastructure) is excluded in this analysis since it primarily reflects the activities on large infrastructure projects (for example tweede Maasvlakte, Rotterdam harbour). Mineral intensity is the domestic use of non-metal minerals divided by value added (in constant prices) of the main users (manufacture of non-metallic mineral products, construction of buildings and roads).

The issue

Material resources provide essential raw materials and other commodities to support economic activities. Worldwide population growth and increasing wealth have led to more demand of natural resources. One of the main challenges in the transition to green growth is to ensure that materials are used efficiently at all stages of their life-cycle. This can be monitored in terms of material intensity, which is defined as kilos minerals consumption per euro value added of the main users.

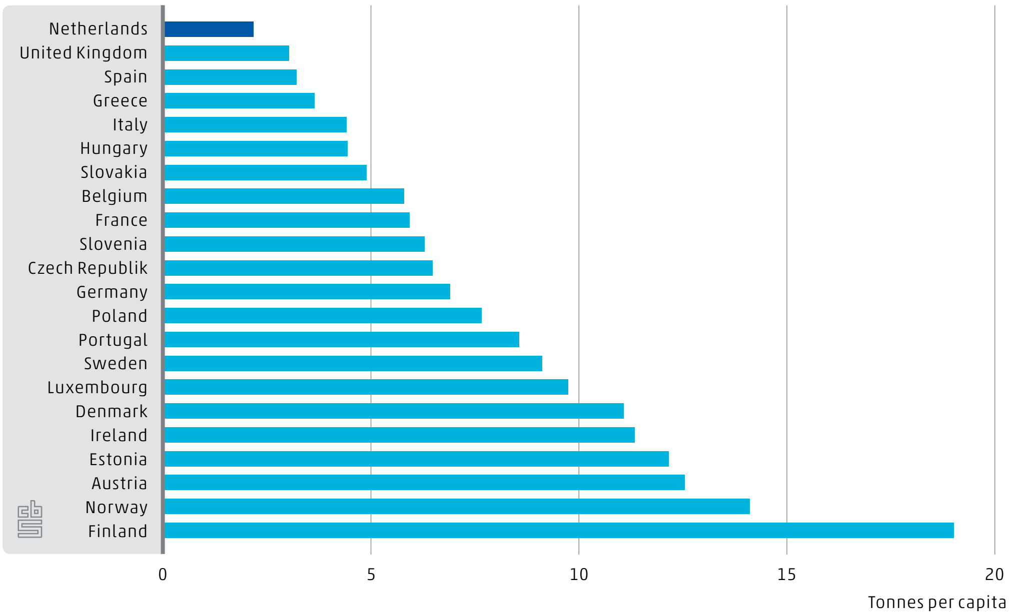
Analysis

Since 2000 the domestic consumption of minerals has varied strongly, reaching a peak value in 2006 (2 percent higher than in 2000) and a low of minus 37 percent in 2013. The minerals included in the analyses are mainly sand and gravel, which are primarily used as input for the production of construction materials. Because of the economic crisis construction activities dwindled after 2008 which also resulted in a decrease in value added of the construction industry. Mineral intensity fluctuated around the level of 2000, with no clear trend. Therefore, although the level of consumption in 2014 was considerably lower than in 2000, it is unclear whether resource efficiency has improved since that time.

International comparison

The Netherlands has been ranked first or second in the comparison of mineral consumption per capita with other European countries since 2000. This is at least partly due to the high population density. High population density leads to a lower per capita requirement of built infrastructure.

2.11.2 Domestic use of minerals per capita in European countries for 2013

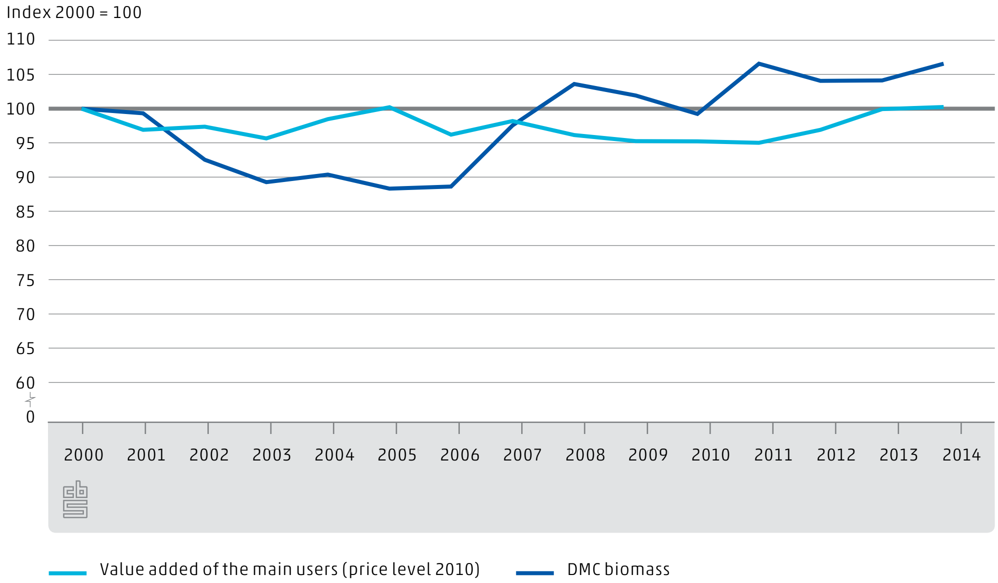


Source: Eurostat.

2.12 Domestic biomass consumption

The level of biomass consumption decreased between 2000 and 2006, then increased by 9 percent in 2007. This was mainly due to increased imports of cereals, food products and wood (in order of importance). Since then the domestic consumption of biomass has remained above the level of 2000. After 2007, biomass intensity also remains at a level above the value in the year 2000. This implies that in 2014, the resource efficiency for biomass was lower than in 2000.

2.12.1 Domestic biomass consumption and value added of main users



Domestic use of biomass is calculated as the domestic extraction of biomass plus imports minus exports of biomass products. Biomass intensity is the domestic use of biomass divided by value added (in constant prices) of the main users (animal farming and other agriculture, manufacture of foods products and manufacture of wood and paper).

The issue

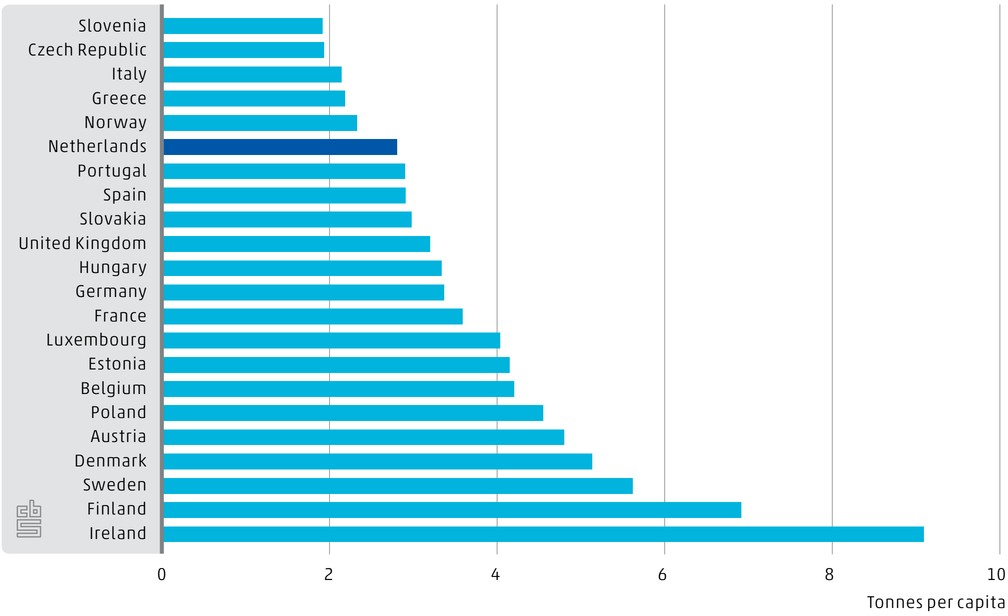
Natural resources provide essential raw materials and derived commodities to support economic activities. Worldwide population growth and increasing wealth have led to more demand of natural resources. One of the main challenges in the transition to green growth is to ensure that materials are used efficiently at all stages of their life-cycle. This can be monitored in terms of material intensity.

Analysis

The imports and exports of biomass have increased gradually since 2000, whereas extraction has remained relatively stable. Exports exceed domestic extraction, indicating that a large proportion of the imported goods is re-exported. In 2007 and 2008, imports of biomass peaked, primarily because of higher imports of cereals, food products and wood. This caused a shift of consumption levels from well below the 2000 level to up to 7 percent above that level. As a consequence, biomass intensity also changed from low to much higher values after 2006. This means that, after a period of six years of decline since 2000, more biomass is now needed to create the same amount of value added.

International comparison

2.12.2 Domestic use of biomass per capita in European countries for 2013



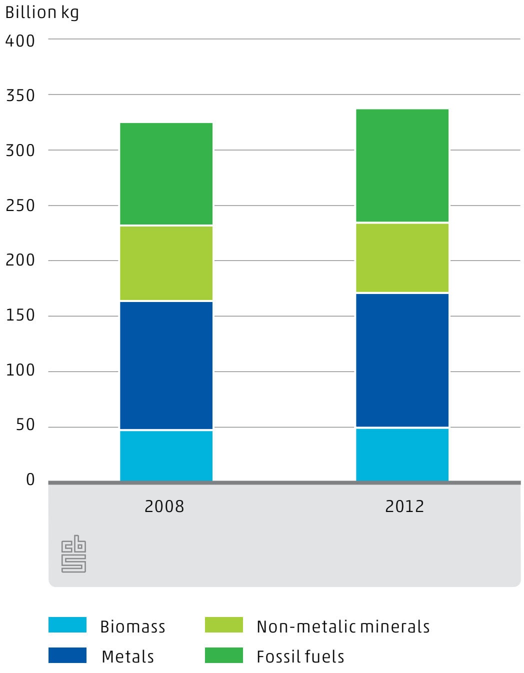
Source: Eurostat.

With a value of 2.8 tonnes per capita, the Dutch biomass consumption in 2013 ranked relatively high in comparison to other European countries. The value has fluctuated in the past though, reaching a value of 3.2 in 2011. For the Netherlands population density, and thus per capita availability of land area, functions as a limiting factor for the domestic extraction of biomass, whereas in Ireland, Sweden and Finland the lack of such a limitation allows for exceptionally high levels of per capita biomass extraction. Domestic extraction in Sweden and Finland is determined by forestry and in the case of Ireland by grassland based agriculture.

2.13 Raw materials footprint

The raw material footprint (or raw material consumption, RMC) has increased between 2008 and 2012. Although fewer materials are used directly in the Dutch economy (domestic material consumption, DMC, see chapters 2.10, 2.11 and 2.12), Dutch people indirectly consume more raw materials abroad.

2.13.1 Raw materials footprint (RMC)



The raw materials footprint (or *raw material consumption – RMC*) indicates the volume of raw materials used in the world to make all products that are consumed in the Netherlands.

Footprint indicators are calculated by using RME coefficients and the RME tool provided by Eurostat. These coefficients and tools are still being developed.

The issue

Economic production and growth depend on the environment for inputs of natural resources such as energy, water and basic materials. Therefore, *resource efficiency* and its development over time is a central benchmark of green growth. 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 that estimate worldwide environmental pressure as a result of national consumption requirements. It also indicates the dependence of the economy on materials outside the country.

A footprint indicator relates national consumption to the environmental burden and the use of resources in the entire world by considering the production chains. This means that the environmental burden caused outside the national boundaries for the production of imported goods and services for the Netherlands is also taken into account, while leaving out the environmental burden caused within the Netherlands for the production of exported goods and services.

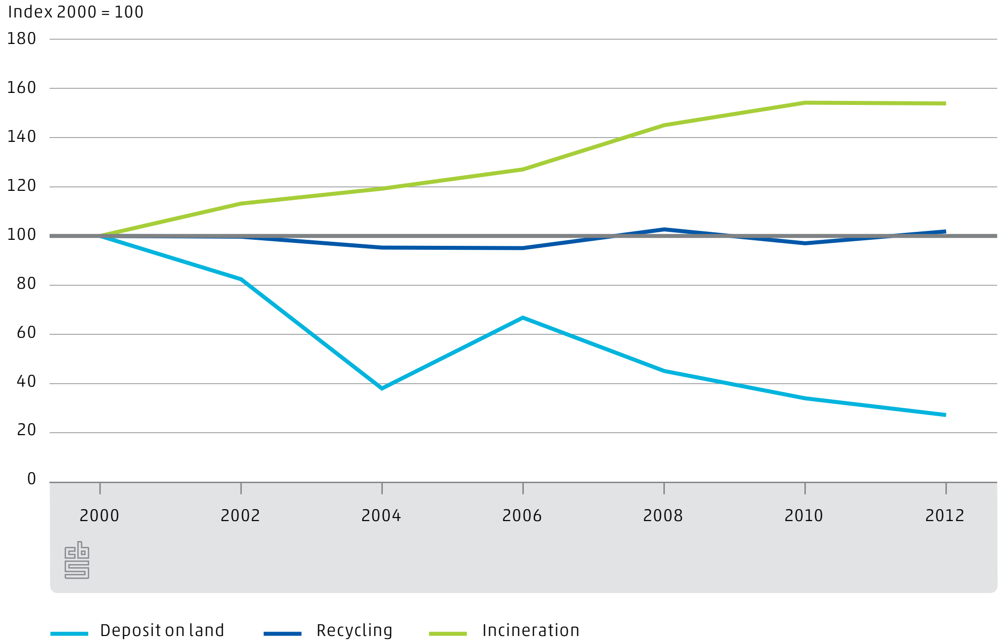
Analysis

The raw material footprint increased by about 4 percent between 2008 and 2012. This can be attributed largely to fossil energy carriers. Non-metal minerals showed a decrease in RMC. The direct use of materials (or *domestic material consumption – DMC*) in the Netherlands, without considering the raw materials used in the production chain, fell sharply though. This is mainly because the physical trade balance has become less negative: as we cut down on the import of minerals and metals. The reason why the raw material footprint increased is that more kilogrammes of raw materials are required for one kilogramme of imported product. This indicates a shift to where raw material intensive products are increasingly manufactured abroad.

2.14 Waste recycling

Since 2000, the percentage of recycled waste has remained more or less constant. Incineration of waste increased at a constant pace while deposition on land decreased. After 2010 the amount of incinerated waste seems to stagnate.

2.14.1 Waste treatment



Total generation of waste in the Netherlands (excluding dredging spoils) is divided into several treatment methods and presented as an index based on its weight. Waste can be disposed on land, incinerated or recycled. Recycling excludes incineration with the purpose of generating energy. Incineration with the purpose of generating energy is part of incineration in these figures.

The issue

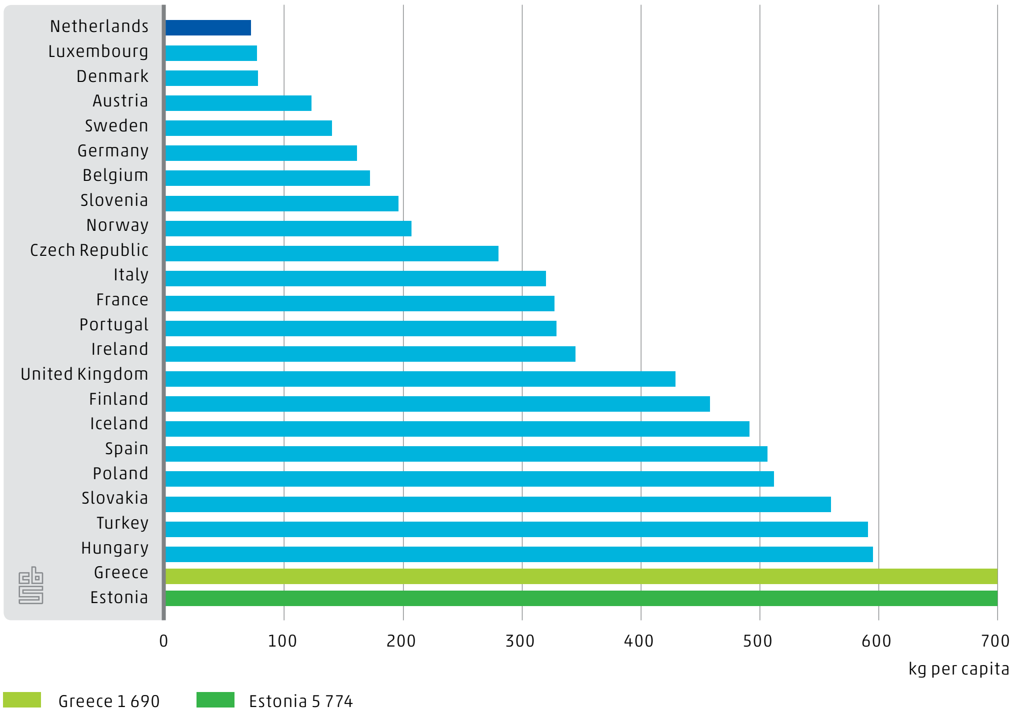
The volume of generated waste is only partly indicative of its pressure on the environment. According to the waste treatment hierarchy of prevention, reuse, recycling, recovery, energy recovery, incineration and, least favoured, deposits on land, the shift from landfill to recycling and recovery results in lower pressure on the environment. Moreover, effective recycling and the reuse of waste are important in the green growth strategy, as using recycled materials often have a lower impact on the environment than using primary materials. Recycling generally creates more jobs than other waste treatment methods and preserves the intrinsic material value.

Analysis

Over the past decade a large shift has taken place from deposition on land to incineration. This shift is mainly driven by stricter national legislation on the minimum standard for waste treatment, formulated in the national waste management plan (www.lap2.nl). Currently it is mainly waste with little recovery potential that is deposited on land. This is favourable for the environment, as the potential damage of waste is reduced when it is incinerated instead of deposited on land. Recycled material reached 81 percent in 2012, a high share that has been fairly constant over the years. This may indicate that the recycling percentages are close to their achievable maximum. Further societal transitions need to be made towards creating more value from the recycled waste, which must be accompanied by new data and indicators.

International comparison

2.14.2 Waste deposited on land (excl. major mineral wastes), 2012



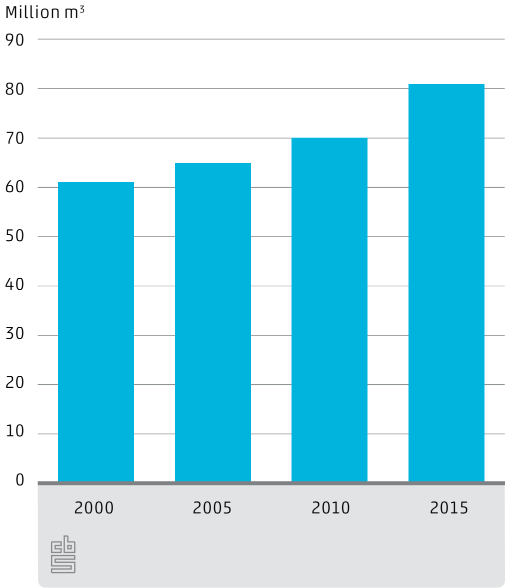
In 2012, the Netherlands showed the least amount of total waste (excl. major mineral wastes) that was land filled waste in the EU. This was also the case for 2010. However for the land filled total waste (excl. major mineral wastes) increased to 72 kg per capita in 2012 from 52 kg per capita in 2010. Contrarily, the average in the EU was stable, and many neighbouring countries showed a reverse trend, namely to lower amounts of waste land filled. The increase of land filling of this type of waste, was caused by changes in national legislation.

In January 2012, restrictions on land filling of waste were loosened. The waste market reacted directly and some types of waste were buffered until January 2012. The created buffers were land filled in the first months of 2012, which resulted in increased land fill quantities (Rijkswaterstaat, 2013a). This was especially observed for residues of soil cleaning. After this initial buffering effect, the amounts of land filled waste also increased structurally.[3]

2.15 Stocks of standing timber

Stocks of standing timber have shown a systematic increase since 2000 by over 1.3 million m^3 (over bark) annually, an average annual growth of 1.9 percent. In 2015, the standing stock amounted to 80.9 million m^3. This is the combined result of an expansion of forest areas and more recently the increase in the stock per hectare. The timber production of Dutch forests is relatively stable and moves between 0.8 and 1.0 million m^3 annually (under bark).

2.15.1 Stocks of standing timber in physical units



Source: Probos (2015).

[3] Please note that Figure 2.14.1 shows a reverse decrease of waste land filled from 2010 to 2012. This is due to different definitions. The total waste excluding mineral waste is the most suitable indicator for international benchmarking, whereas the data of figure 2.14.1 displays all waste data, excluding dredging spoils.

Developments in stocks of standing timber (live plus standing dead wood) are expressed in million m^3 of round wood equivalents (over bark).

The issue

The availability and quality of forests are key factors in economic activity and well-being and hence important for green growth. In economic terms, forestry is relatively small in the Netherlands; the main benefits derived from forests are recreation, nature conservation and biodiversity. Nevertheless, stocks of standing timber also represent other functions provided by forests such as carbon sequestration, fuel wood and pollution mitigation. The cleaning ability of forest ecosystems contributes to a cleaner environment for humans: fine dust is captured by vegetation, especially by (coniferous) trees. Forests and rows of trees can therefore contribute to improving air quality.

Analysis

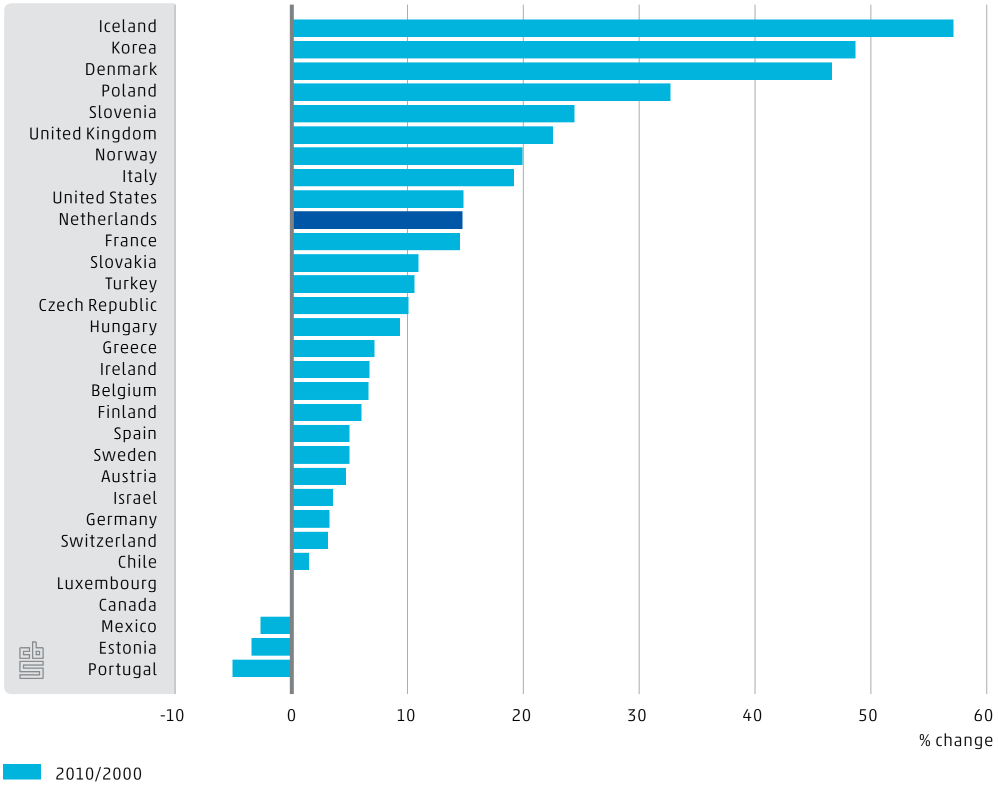
The increase in standing timber is the result of an expansion of forest area and of average stock per area. Although timber stocks have increased, imports far outweigh domestic production by a factor of 21 on average. Imports have gone up recently after a temporary slowdown due to the economic crisis. Therefore, the potentially negative environmental pressures caused by the use of timber are mainly caused abroad. The Netherlands imports most of its timber from within Europe. The environmental impact of this wood is relatively modest, as most of these forests are managed sustainably and are replanted. Tropical timber accounts for about 4 percent of imports. As a consequence of the economic crisis, the use of tropical wood has decreased since 2008.

International comparison

The stock of standing timber represents the growing stock in forests and on other wooded land. The substantial increase observed in most OECD countries is the result of an increase in forest areas and wooded land, although primarily due to an average net growth in stock per hectare. For the OECD as a whole, the area growth between 2000 and 2010 was less than 0.5 percent.[4)] For the European OECD countries this was around 2 percent over a ten-year period. This resulted in a total stock growth for the OECD as a whole by over 8 percent and for the European OECD countries by over 10 percent in the decade between 2000 and 2010; an average annual stock increase of 0.8 or 1.0 percent, respectively. Gross growth per hectare was only partly offset by the harvesting of these forests. The Netherlands has a stock growth that is slightly above average, but of course its total stock is very small compared to most other countries. Hardly any country has experienced a net decrease in the growing stock of timber, although valuable natural forest can be replaced by forest plantations. It should be noted that Canada and the United States together have over 70 percent of the growing stocks of timber on their territories of the countries shown in the figure. The Netherlands slightly improved its growth rate of stocks with an 8th position in the period 2005–2010, up from the 12th position in 2000–2005.

4) For the countries with completed data.

2.15.2 Change in growing stock of standing timber in forests and other wooded land, 2000-2010[1)2)]



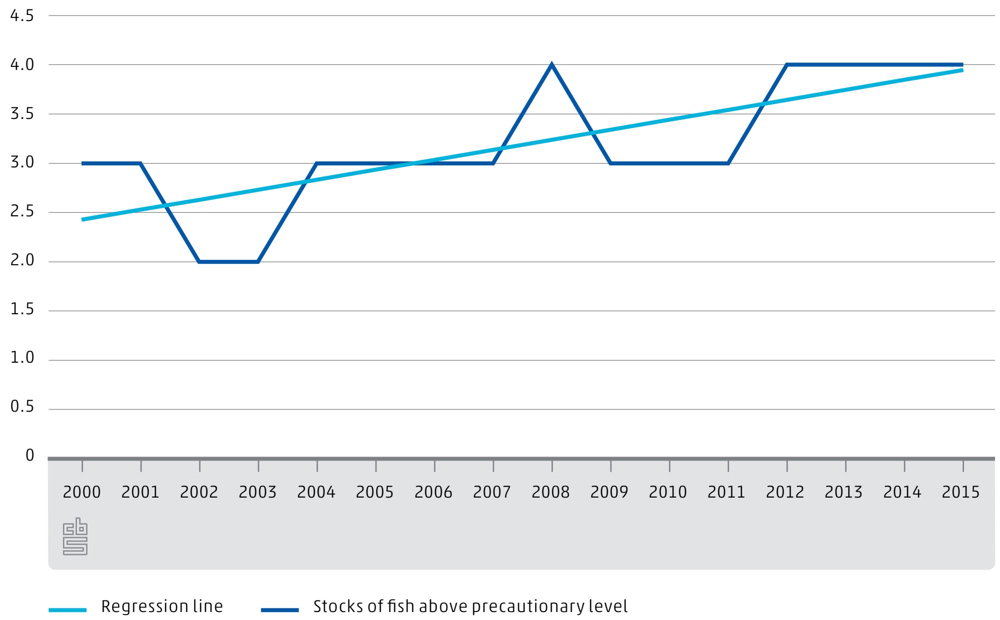
Source: FAO-STAT.
1) For Japan no change could be calculated due to missing or incomplete data.
2) Data for Canada don't show any change over time.

2.16 Stocks of fish

As a result of catch limits set for the European Union, some stocks of fish in the North Sea are recovering, but not all fish species are above their precautionary level. Constant monitoring of stocks is of great importance in controling the sustainability of fish, for the economy as well as for biodiversity.

The share of five fish species that are important for consumption (herring, cod, plaice, sole and haddock) in the North Sea that is above the precaution level. Only cod is below the precaution level.

2.16.1 Stocks of five fish species above the precautionary level



Source: ICES (2015).

The issue

Fish stocks are global commons, i.e. natural resources shared by several countries, and therefore sensitive to over-exploitation. This poses a threat to the quality and quantity of future fish stocks. Furthermore, modern fishing methods have undesirable side effects such as overfishing and damage to sea floors. The European fisheries policy is aimed at achieving sustainability by way of a balanced exploitation of the seas. The main policy instruments are restrictions on total annual catches for a number of commercially important fish species, and restrictions on the capacity and activities of the fishing fleet. The European Council and Parliament have agreed on a new Common Fisheries Policy (CFP) which has been effective since 1 January 2014: fish stocks are to be caught according to 'maximum sustainable yield (MSY)'. This should make an end to wasteful fishery practices. In addition, new opportunities must be created for employment and growth in coastal areas (European Commission, 2014).

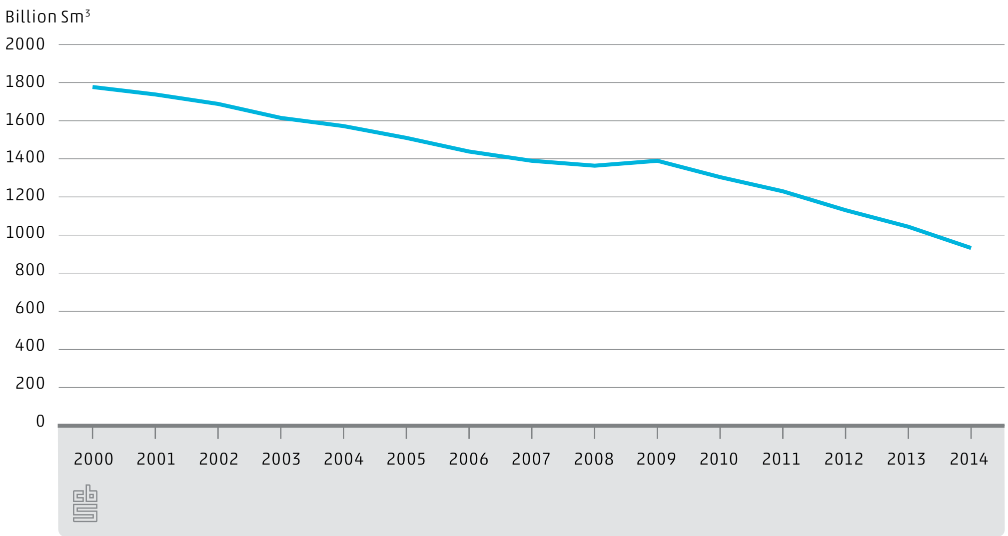
Analysis

Sustainable fishery is important for aquatic biodiversity, and plays an important role in the economy. The relationship between the economy and the quality of stocks is indicated by the share of five fish species important for consumption which are above the precaution level for reproduction. Thanks to the EU catch limits, some of the fish stocks are recovering although not all fish species are above their precaution level. There has been an upward trend since 2000. The volume of the domestic fish catch fell by 27 percent between 2000 and 2011.

2.17 Energy reserves

The remaining natural gas reserves in the Netherlands have decreased by almost 48 percent since 2000. Only small new natural gas reserves have been discovered in recent years, just 2 out of the remaining 932 billion Sm³ in 2014. The on-going depletion of existing natural gas reserves was even more severe because of the annual extraction and a substantial downward revaluation of the existing reserves. Besides natural gas, the Netherlands has some small oil deposits of up to 5 percent in total. These oil reserves have increased slightly since 2000 despite annual extractions due to revaluation of existing oil deposits.

2.17.1 Natural gas reserves, closing stock of expected producible resources of natural gas



The expected reserve is the remaining volume of gas or oil, based on geological surveys, which is assumed to be extractable with existing technology and in current prices at a given point in time.

The issue

The Netherlands still has significant quantities of natural gas as well as some smaller oil deposits. Green growth aims to avoid unsustainable pressure on natural assets. However, there are different definitions of sustainability. According to the weak interpretation of sustainability, a policy that lets stock value increase even if physical reserves decrease is deemed sustainable as it provides possibilities for substitution. Green growth, on the other hand, has more in common with the so-called strong interpretation of sustainability, which emphasis the use of physical indicators to monitor whether certain resources are reaching critical levels or even fall below certain thresholds.

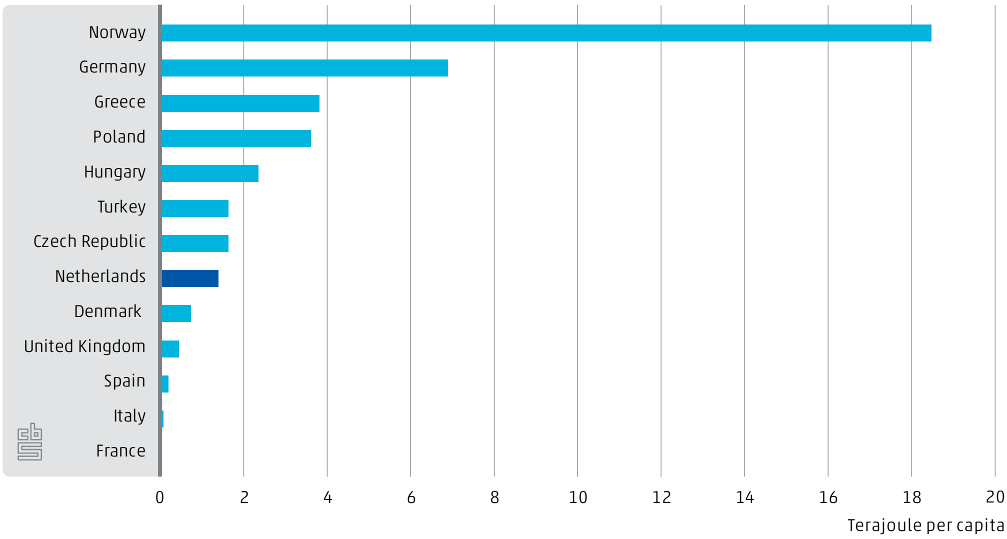
Analysis

Ever since their discovery in the fifties and sixties, the existing oil and gas reserves have been exploited. The extraction of natural gas makes a significant contribution to the Dutch treasury and to economic growth. These resources are not inexhaustible, however. Although new reserves are still discovered occasionally, these have become systematically smaller. The assumption is that much of the initial gas reserves have already been extracted. At the end of 2014, known natural gas reserves were enough for almost 14 years. This is based on the net production in 2014, which was already below the 25-year average. The decreasing total stock is perceived as an indicator of unsustainable behaviour, as conventional stocks (expected reserves) are likely to run out within few decades. The combination of extractions, negative revaluations as faced in recent years, and the absence of substantial discoveries resulted in a relatively fast declining stock in recent years.

A series of small earthquakes shook the north of the country as a consequence of the on-going extractions from the Groningen reserve. These are assumed to be too high, causing substantial harm to real estate and its value, culminating in public unrest and political hassle with compensation payments. As a policy response, limitations were placed on extraction rates of the large Groningen reserve in an attempt to mitigate these negative impacts.

International comparison

2.17.2 Energy reserves per capita in European OECD countries, 2014



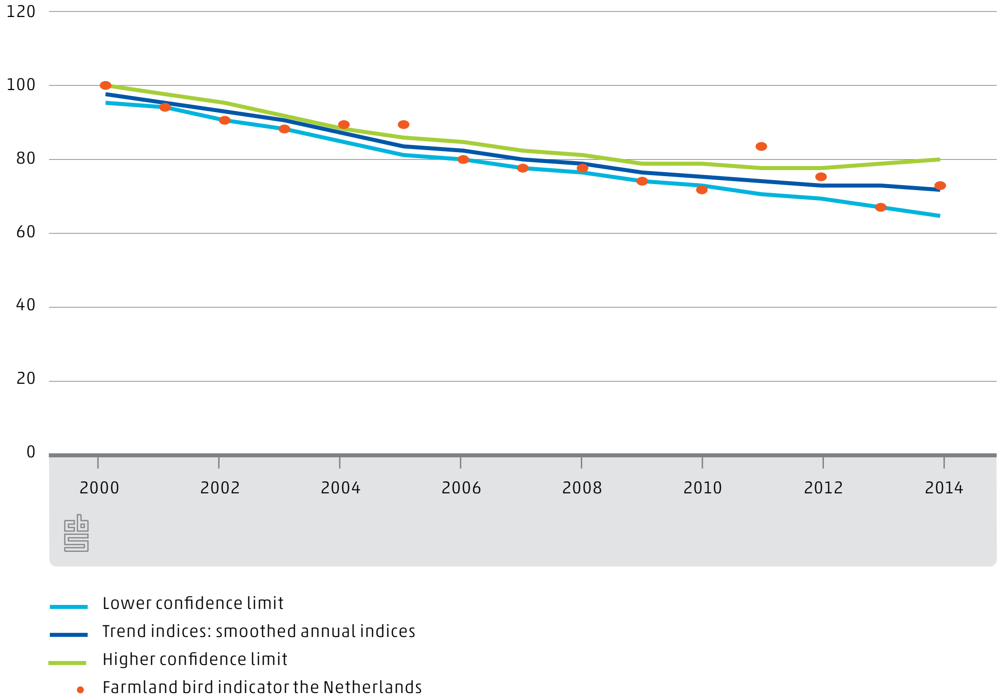
Source: OECD.

International comparison shows that the Netherlands still has significant energy reserves. To allow for international comparison, the energy reserves of the European OECD members have been converted into per capita terms. Only 13 of the 25 European OECD members have significant energy reserves, either oil, natural gas or coal, of which 7 countries have higher energy reserves per capita than the Netherlands. Norway reports by far the largest energy reserves per capita, followed by Germany (largely lignite), Greece and Poland. The reserves for Hungary, Turkey and Czech Republic also consist mainly of lignite. On average the energy reserves for these European OECD members have decreased by about 28 percent since 2000. For the Netherlands this has more than halved. So, although the Netherlands still has significant energy reserves, its above average depletion rate per capita over the last 15 years compared to other European OECD countries has resulted in a relatively fast declining stock.

2.18 Farmland birds

Changes in agricultural practices have caused the number of breeding birds in agricultural areas all around the Netherlands to dwindle. This pattern is found across the entire EU, however the trend in the Netherlands is one of the most negative in Europe.

2.18.1 Farmland Bird Indicator (FBI) the Netherlands



Source: NEM (SOVON, Statistics Netherlands).

The monitoring data of the farmland bird species of the Netherlands have been derived from the national monitoring network for breeding birds the Ecological Monitoring Network (Dijk and Boele, 2011). Annual indices of population numbers per species are determined by Poisson regression (software TRIM, van Strien et al., 2004). To calculate the FBI the annual indices of population numbers geometrically are averaged over all 27 species concerned (index 2000 = 100). Over the years, a smoothing algorithm is applied to determine flexible trends. This method is very similar to that of the Living Planet Index (WWF, 2012).

The issue

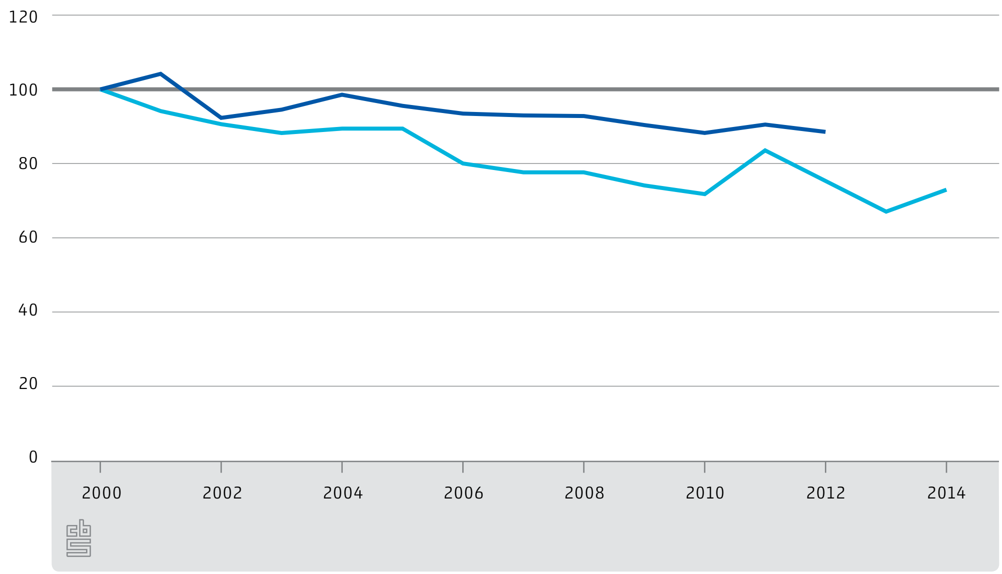
Biodiversity interrelates with changes in land use and many environmental factors, such as water pollution. In a global perspective it relates to more general themes like climate change and the growing population. Therefore, measuring biodiversity can be regarded as a central theme in green growth. In the Netherlands, agriculture is one of the main pressure factors on nature, and the FBI is therefore a representative indicator for the relation between the economy and biodiversity.

Analysis

Breeding bird populations typical of agricultural areas in the Netherlands are dwindling. The 'Farmland Bird Indicator (FBI)' has declined about 25 percent since 2000. The decrease set in earlier (taking the 1960s as a reference, there has been a decrease of more than 60 percent). This indicator is the national version of the FBI of the European Union.
27 representative farmland species common in the Netherlands have been selected. Compared to the previous edition of Green Growth, 14 species have been added. A total of 20 species are declining in number.
The decline in farmland birds in the Netherlands is predominantly due to more intensive farming methods, changes in the choice of crops and scaling up of agricultural programmes. As a result of these developments, many small elements in the landscape like hedge rows and small pieces of land unused on account of their location have disappeared. Breeding areas are also being reduced due to urbanisation, infrastructural projects and busier traffic. Measures taken in recent years, for example natural management of field edges and agricultural areas, and active nest protection have not been enough to put an end to the decline.

International comparison

2.18.2 Dutch and EU Farmland Bird Indicators compared



Farmland bird indicator the Netherlands - 27 species
Farmland bird indicator Europe - 39 species

Source: NEM (SOVON, Statistics Netherlands).

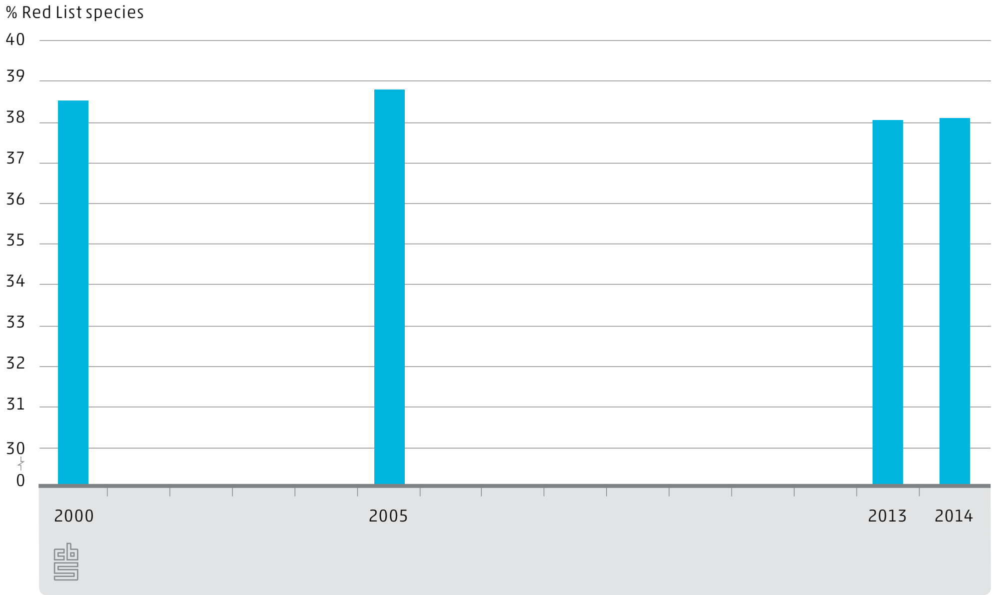
The issue

Developments in the European Union regarding farmland birds are largely the same in the Netherlands, although the decreasing trend in the EU seems to be less steep after 2004. The EU FBI covers 39 breeding bird species. Changes in the farmland bird population also apply to many other groups of species in agricultural areas. The trend in the FBI of the Netherlands is clearly more negative than in the EU indicator. However, the causes of the decline throughout the EU are roughly the same as in the Netherlands. Furthermore, habitats for farmland birds in eastern and southern Europe are lost because agricultural activities in poor areas are discontinued. Subsequently, the abandoned landscape becomes encroached by shrubs and bushes. Ranking four different EU regions according to the decrease in the FBI between 2000 and 2012 gives the following list: North (11.3 percent), West (11.0 percent), South (9.4 percent) and Central & East (8.5 percent) (www.ebcc.info, Gregory et al., 2005). It is clear that for the Netherlands, belonging to the western region, the decrease of more than 20 percent of the FBI in the same period must be considered one of the most negative within Europe.

2.19 Red List Indicator

Since 2000, the number of endangered species of mammals, dragonflies and vascular plants has fallen marginally. Since 2005 fewer breeding birds and reptile species are under threat. Butterflies and amphibians hardly show any recovery. More than one in three species in the Netherlands is still under threat.

2.19.1 Red list indicator



Source: NEM (Statistics Netherlands, PGOs).

The Red List Indicator depicts the percentage endangered species per year, relative to the total number of considered species. The percentages of the years 2000 and 2005 are compiled of data from the official Red Lists of the considered species groups which appeared around – but not necessarily in – the years 2000 and 2005. From the year 2013 onwards, data on species population and distribution were used to determine Red List status per species. The considered species groups are mammals, breeding birds, butterflies, dragonflies, reptiles, amphibians and vascular plants. Source: NEM (Statistics Netherlands, PGOs).

The issue

The number of endangered species on the Red List can be regarded as an indicator for the state of biodiversity in the Netherlands. The Red List Indicator is used to monitor progress towards international biodiversity goals. The Ministry of Economic Affairs has incorporated the RLI in the report to the parliament explaining the national budget.

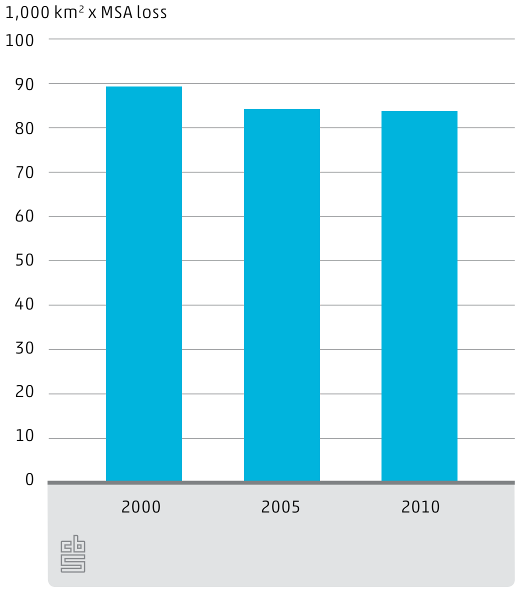
Analysis and international comparison

Population size and distribution criteria to determine Red List status were specifically designed for the Netherlands – IUCN Red List methodology was not strictly followed. Approximately 38 percent of all 1771 considered species were still threatened in 2014. While threatened species still increased in number between 2000 and 2005, the number decreased between 2005 and 2014. Vascular plants, dragonflies and mammals are performing best, whereas no improvement can be reported for butterflies and amphibians. About 50 percent of the amphibians in the Netherlands are on the Red List (compared to 22 percent in the EU), 14 percent of all reptiles (compared to 21 percent in the EU) and 37 percent of all breeding birds (18 percent in the EU). In the EU, 33 percent of all reviewed species are currently (near) threatened, as tested against IUCN criteria (source: Mid-term review EU biodiversity strategy 2020 – EEA/EU).

2.20 Biodiversity footprint

In 2010, the global biodiversity footprint of the Netherlands comprised a total area of approximately 83,000 km^2: about twice the area of the Netherlands. The footprint of the Netherlands on global biodiversity has subsided somewhat since the year 2000, despite increased food consumption.

2.20.1 The global biodiversity footprint of the Netherlands



Source: PBL.

The issue

Biodiversity is an important natural asset. The production of certain goods, especially food products, textile and timber, may have a negative impact on ecosystems. The biodiversity footprint shows the global loss in biodiversity area resulting from Dutch consumption (including the required imports, and excluding domestic production for exports). The biodiversity footprint is calculated with the GLOBIO biodiversity model, from the area needed to produce crop and livestock to satisfy the demand of Dutch consumption on the one hand, and the (modelled) extent to which the various used land use practices affect biodiversity quality on the other hand (Wilting et al, 2015).

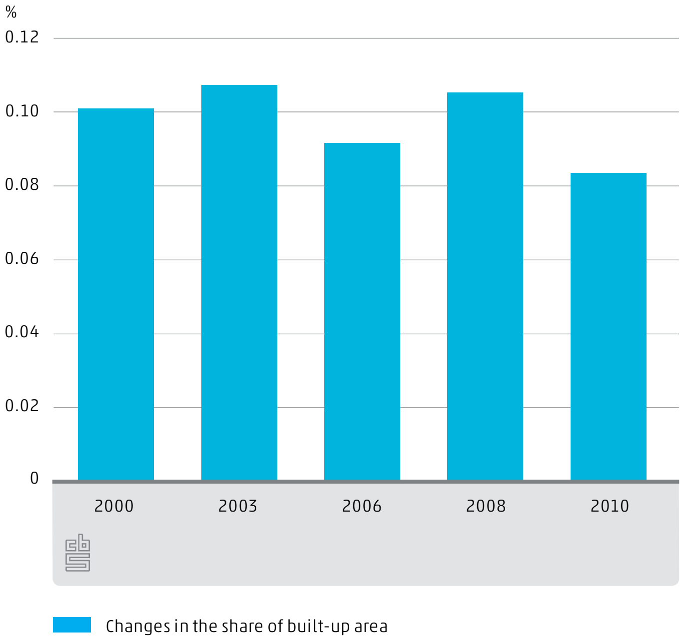
Analysis

The biodiversity footprint for the Netherlands had decreased after 2000 and stabilised between 2005 and 2010. The trend can partly be explained by the decreased demand for wood as less paper was used due to the economic crisis. The decrease since 2000 is further caused by a declining land use for food and textiles. The compulsory blending of biofuels for traffic has led to a loss of biodiversity. The current models lack recent data about the use of primary biomass as co-fuels in energy plants, the imports of ready-made wood products such as furniture and packaging, and about the import and export flows of semi-manufactured goods and final products from agricultural produce.

2.21 Land conversion into built-up land

The area of built-up land in the Netherlands is increasing steadily. The average changes in the share of built-up land in the total land area is 0.1 percent a year. Agricultural land and nature areas have decreased.

2.21.1 Land conversion into built-up land, yearly changes



Land conversion into built-up land is the change in the share of the built-up area in the total land surface.

The issue

The Netherlands is one of the most densely populated countries in the world, so space is very scarce. The competition between different uses of space is an environmental problem. Built-up areas are important for living and working. They are using up more and more space as land is still being converted. The conversion of nature, forests, and agricultural land into build-up land can be seen as a measure for the pressure on the ecosystems and biodiversity.

Analysis

The increase of built-up land mainly comes at the expense of agricultural land, but it also affects natural areas and their biodiversity. Policy will protect and improve the quality of nature (allocating and implementing plans for *Natura 2000* areas[5)]). By linking existing

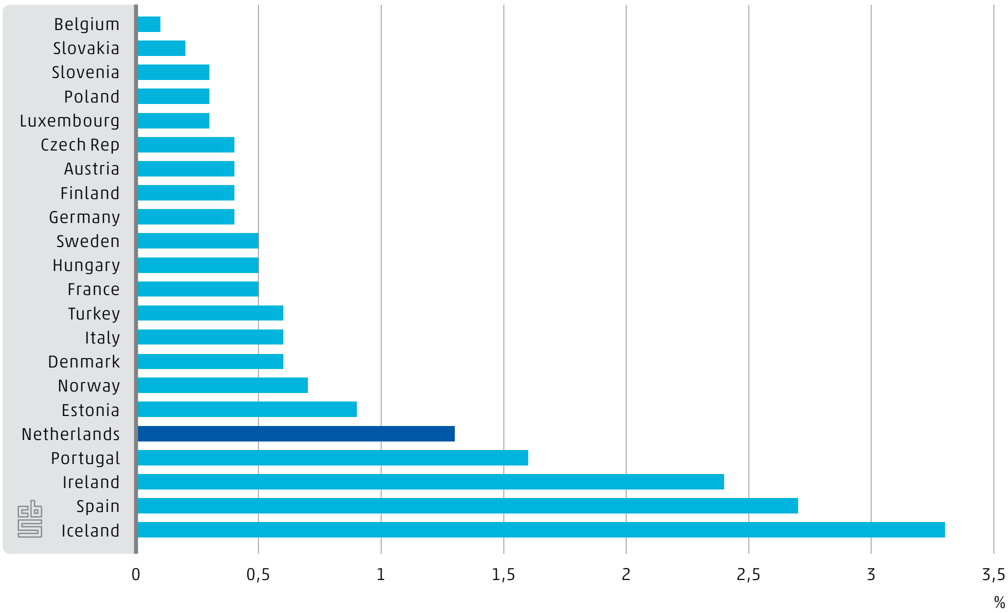
5) Natura 2000 areas are protected according to the EU Natural Habitats Directive (92/43/EC).

and planned natural areas for the national ecological network of protected areas, agricultural land was converted into nature and forest.

International comparison

Due to its small size and high population density land needed to be converted into built-up land between 2000 and 2006 in The Netherlands. The conversion percentage is among the highest in the European Union.

2.21.2 Changes in land use 2000-2006



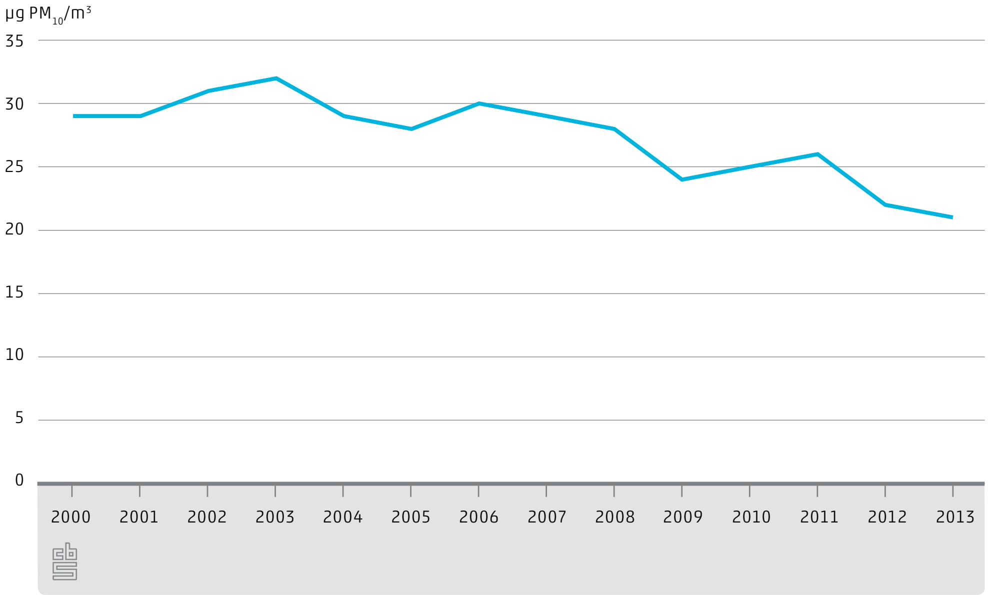
Source: OECD.

The conversion of agricultural and or nature areas into built-up land is given as a percentage of the change between 2000 and 2006.

2.22 Urban exposure to particulates

The annual average concentration of particulate matter (PM_{10}) in urban areas has decreased slightly since the year 2000. Although the trend is downward in the long term, considerable yearly differences have been observed. For instance 2006 showed an increase whereas 2008 and 2012 saw large decreases. These are mainly due to differences in weather conditions.

2.22.1 Annual average concentration of PM_{10} particles in urban areas



Source: RIVM/DCMR/GGD Amsterdam, 2014.

Particulate matter consists of particles of less than 10 micrometres in diameter. The European limit value is 40 µg for the annual average and the daily average should not exceed 50 µg more than 35 times per calendar year.

The issue

Pollution affects both human health and ecosystems. Exposure to particulate matter plays a major role in air pollution. The particles can penetrate deeply into the lungs and can cause inflammation, asthma, chronic bronchitis and cardiovascular disease. Since pollution is mostly the result of production and consumption, it is important to assess this aspect in the framework of green growth.

Analysis

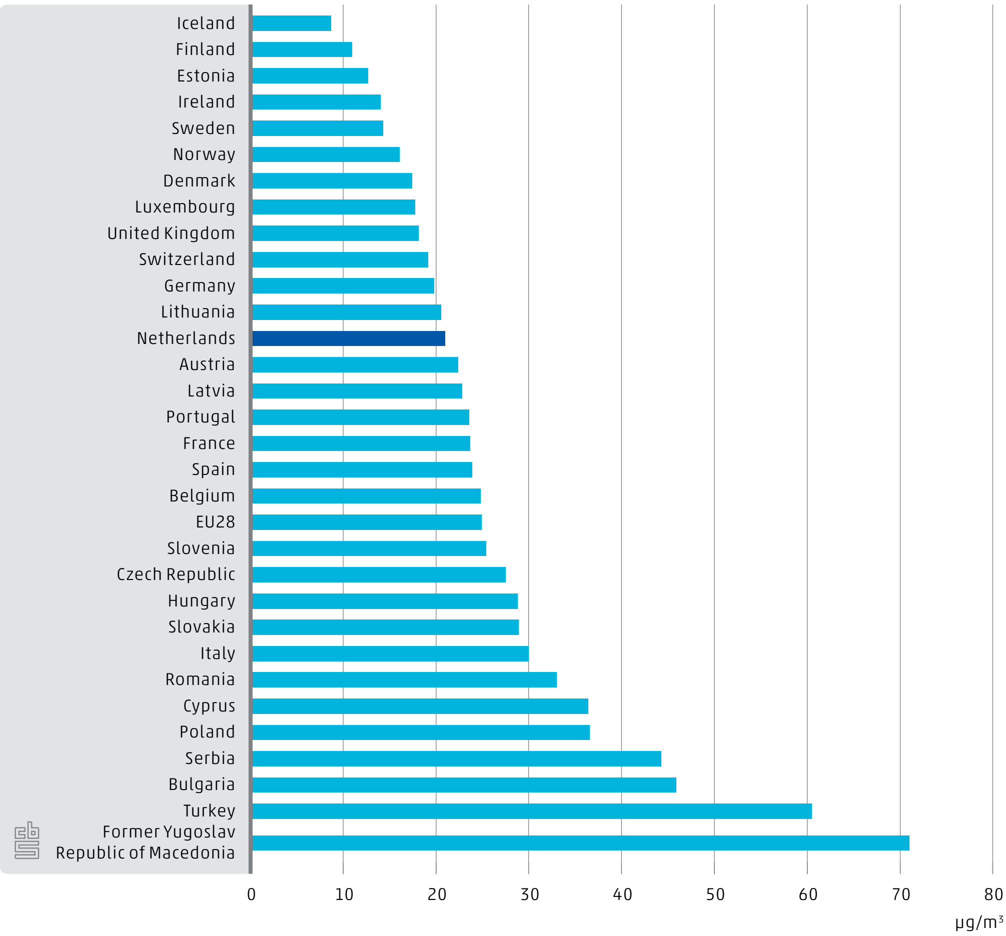
The general downward trend in exposure to particulate matter is the result of the introduction of pollution reducing technologies, such as filters, in the manufacturing and transport sectors. There are considerable deviations between years due to weather conditions. Emissions of PM10 by economic activities have been cut by 36 percent between 2000 and 2012. A large part of the PM10 resulting from human activities originated abroad.

International comparison

Compared to other European countries, the urban exposure to particulate matter in the Netherlands is below average. The usual western wind in the Netherlands transports the particulate matter from industrial areas in other countries to other directions.

Over time, the overall rank of Netherlands internationally has improved. The Netherlands still ranked 17th out of 22 countries in 2003, and slowly crept to 12th out of 24 in 2012.

2.22.2 Urban population exposure to air pollution by particulate matter, 2012

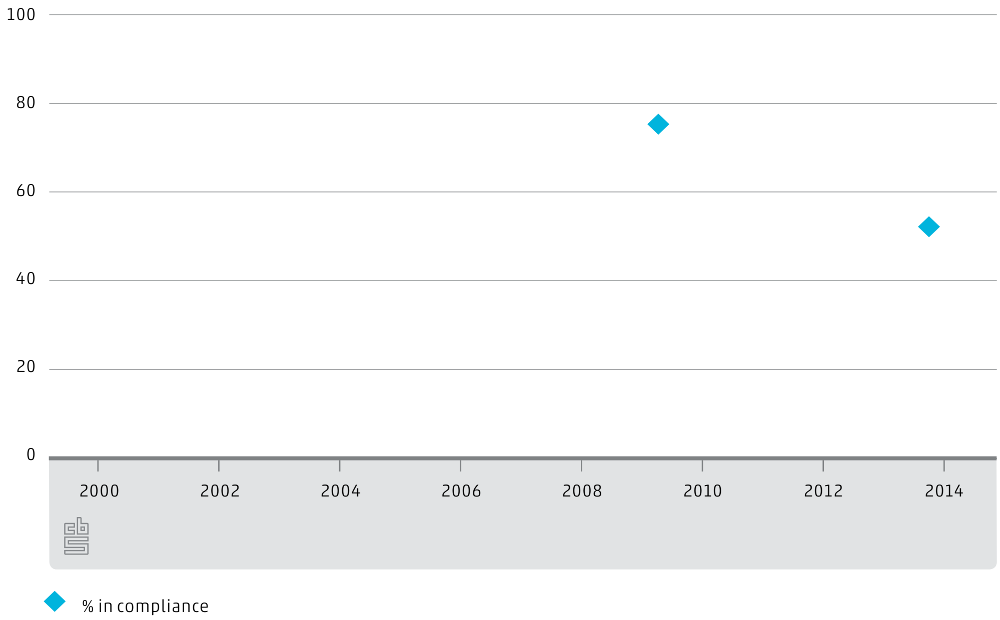


Source: Eurostat.

2.23 Chemical quality of surface waters

Preliminary results for 2013 show that 52 percent of the Dutch surface water bodies complied with the European environmental quality standards for 45 selected substances. The decrease in compliance compared to 2009 is predominantly caused by changes in the standards and in the monitoring program. The most disturbing chemical substances in this compliance check are tributyltin, several Polybrominated Diphenyl Ethers (PDBE), cadmium and five Polyaromatic Hydrocarbons (PAH's).

2.23.1 Chemical quality of surface water bodies, 2009 and 2013



Source: Informatiehuis Water, adapted by PBL (Statistics Netherlands et al., 2014).

The percentage of 700 Dutch surface water bodies complying with the environmental quality standards of the Water Framework Directive for 45 selected substances. For the Netherlands, the overall result of the chemical quality monitoring depends strongly on the substances tributyltin, PDBE's, cadmium and PAH's. The graph shows the results for 2009 and interim results for 2013. The next formal compliance check will be published after 2015.

The issue

The availability of sufficient fresh water resources of good quality is a basic prerequisite for humans and their economic activities. This works in two ways. Economic growth is only possible when sufficient reliable water resources are available. But economic growth must not lead to decreasing water quality and over-exploitation of water resources. The challenge in green growth is to find the right balance.

Analysis

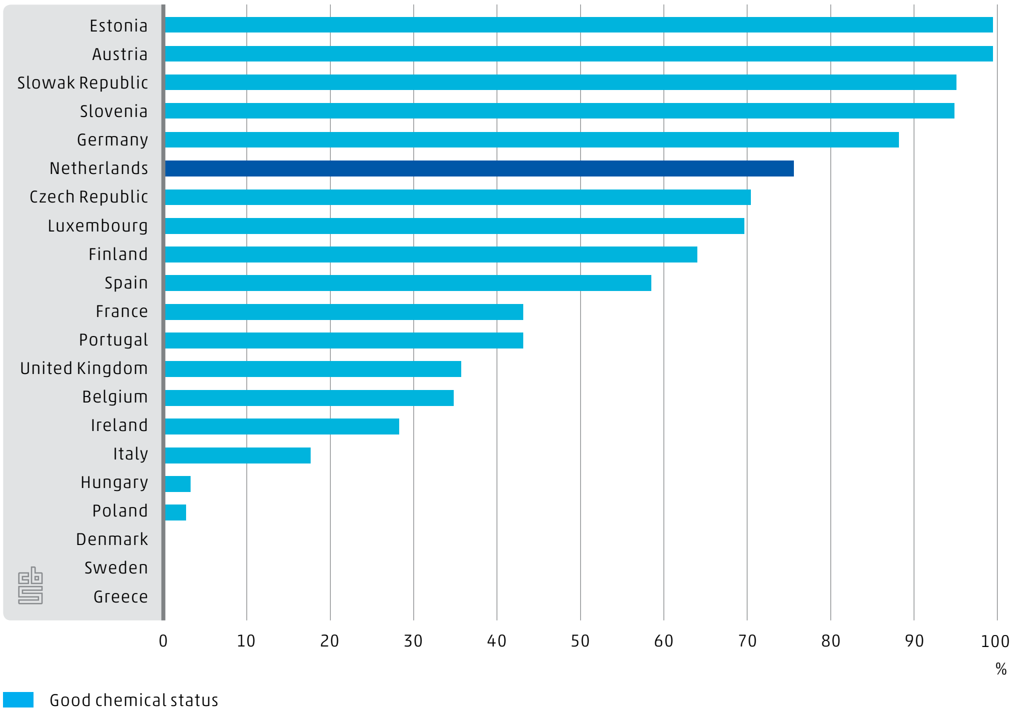
Chemical pollution of surface water threatens the aquatic environment and can lead to acute and chronic toxicity to aquatic organisms, accumulation in the ecosystem, losses of habitats and biodiversity and to threats to human health. Most pollution can be directly linked to economic activities. Measures are aimed at reducing these emissions, even to zero. The effects of these measures are still not visible in the interim results of 2013. The decrease in compliance in 2013 compared to 2009 is predominantly the result of higher quality standards and changes in the monitoring program.

The surface water bodies in the Netherlands are predominantly influenced by the upstream territories of the rivers Meuse, Rhine, Scheldt and Ems. Pollution emitted upstream negatively determines the chemical status of Dutch inland waters. However,

compared to other European countries, the overall chemical status of Dutch waters in 2009 was fairly good.
The next official comparison will be made for 2015, so it is not possible to draw conclusions on the current chemical status of European waters. Sometimes there is a remarkable reason for a low score. In Sweden, for example, nearly all surface water failed to achieve good chemical status in 2009 because of high concentrations of mercury. Its source was atmospheric deposition of trans-boundary air pollution.

International comparison

2.23.2 Percentage of surface water bodies with a good chemical status, 2009

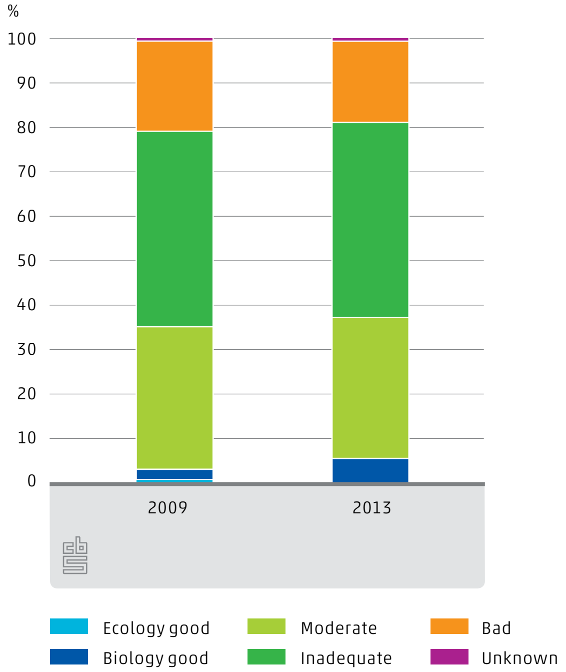


Source: EEA, Statistics Netherlands.

2.24 Ecological quality of surface waters

In 2013, zero percent of the Dutch surface water bodies complied with the European ecological quality standards according to the Water Framework Directive (WFD). The general picture of water quality remains more or less the same as in 2009. The low score is mainly due to poor biological quality, but also to exceeding concentrations of nutrients, heavy metals and other persistent pollutants. The percentage of water bodies where the biological quality is good increased from 2.6 percent in 2009 to 5.5 percent in 2013.

2.24.1 Ecological quality of surface water bodies, 2009 and 2013



Source: Informatiehuis Water, adapted by PBL (Statistics Netherlands et al., 2014).

The percentage of 700 selected Dutch surface water bodies complying with the ecological quality standards of the Water Framework Directive (intermediate results 2013). The ecological quality is determined on the basis of several tests, like biological quality (3 subtests), hydro-morphological characterization, physico-chemical quality and standards for a selection of heavy metals and toxic hydrocarbons. Water bodies with good biological quality comply with all standards except for the hydro-morphological aspects.

The issue

The ecological quality is a measure for the health of surface water. The availability of healthy fresh water resources is a key factor for green growth. Healthy water bodies can contribute in general to human well-being through their different uses such as bathing, fishing, recreational shipping, water for the preparation of potable water.

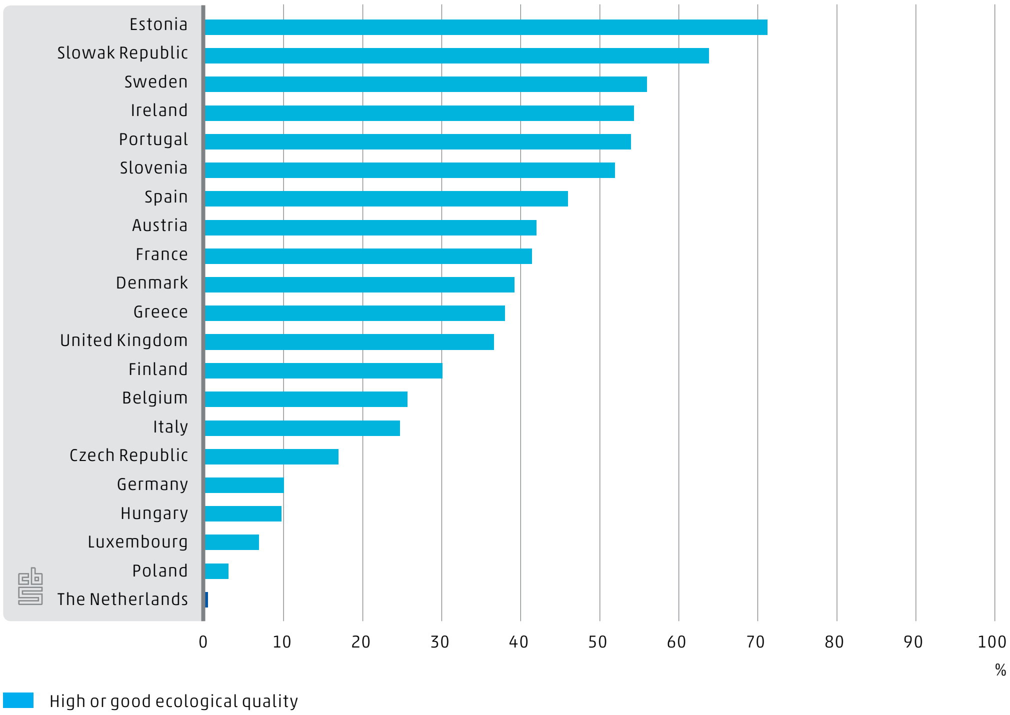
Analysis

The poor ecological quality of the Dutch surface waters is caused by the presence of persistent chemicals due to historical emissions, eutrophication caused by high nutrient concentrations, disappearance of natural habitats and natural banks due to modification of water courses and the widespread use of weirs and pumping stations, which hampers the migration of fish (Statistics Netherlands, PBL, WUR, 2014). Many measures are being taken to lower the negative impact of these causes, for instance restoring the natural courses of brooks, building fish passages near weirs and reducing pollutant discharges. The effects of these measures are still not visible in the intermediate results for 2013 but can be evaluated thoroughly in 2016, once official results for 2015 are published.

International comparison

The Netherlands, Poland, Luxembourg, Hungary and Germany face the worst ecological status or potential in river and lake water bodies (situation 2009). More than 90 percent of water bodies have a less than good ecological status/potential. The Netherlands, situated downstream of four international rivers, has the lowest scores due to pollution and hydro-morpholigical pressures[6)] (altered water courses, lack of natural habitats). The ecological status of each water body is determined by the quality element having the lowest status class, according to the one-out-all-out principle. All European water bodies that currently have a less than good ecological status must be restored to good or better ecological status through measures formulated in the River Basin Management Plans. The next official compliance check will be for the year 2015 (to be published 2016).

2.24.2 Percentage of water bodies with high or good ecological status/potential, 2009



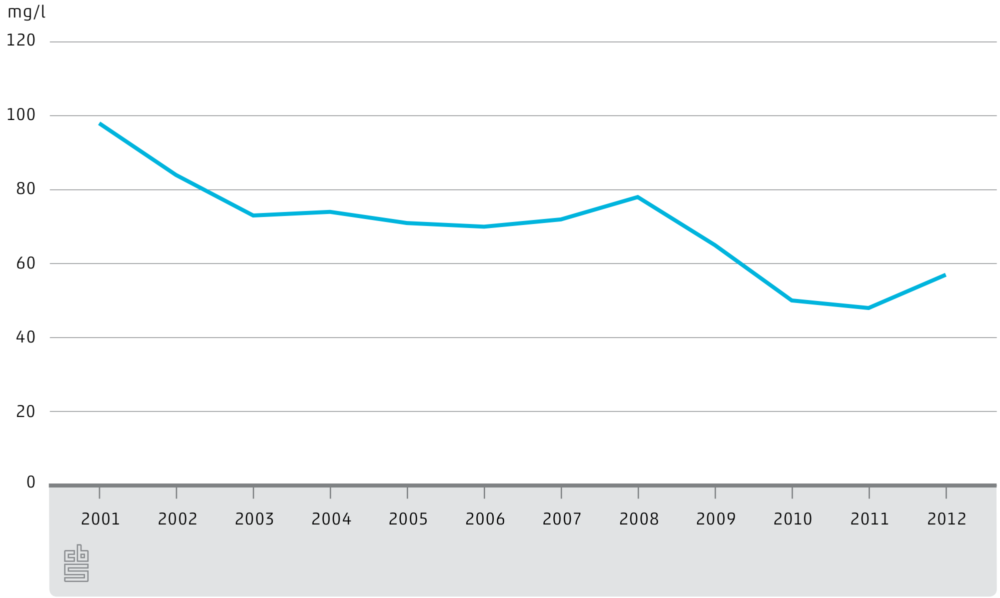
Source: EEA.

2.25 Nitrate in groundwater

The average nitrate concentration in the upper groundwater layer has fallen so much that the target value of 50 mg/l was met in 2010. Concentrations have already been below the target for several years, especially in regions with clay and peat soil. For sandy soils the target was first met in 2010, whereas concentrations are still too high in regions with loess.

6) http://www.eea.europa.eu/publications/european-waters-assessment-2012

2.25.1 Average concentration of nitrate in upper groundwater layer of agricultural sandy soils



Source: RIVM Landelijk meetnet grondwaterkkwaliteit.

The average nitrate concentration is weighted for the areas representative for the samples of groundwater. The data are corrected for variations in weather and sample composition. The higher value for 2008 can be explained by a lower precipitation surplus in that year.

The issue

Green growth requires a healthy balance with the required natural resources, like groundwater. In the Netherlands groundwater serves to prepare drinking water. Washing out of nitrogen to the groundwater threatens its quality. High concentrations of nitrate can lead to closure of abstraction points or higher purification costs. A key determinant of the nitrate concentration in the groundwater is the nitrogen surplus in the soil balance of farms. In order to reduce the load of nitrogen to soil and groundwater, the standards for applying nitrogen on agricultural soils are being accentuated stepwise. The effect on nitrate content is already visible and will improve.

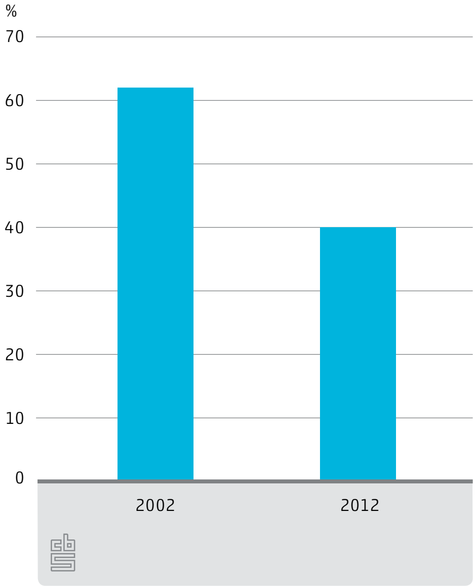
Analysis

There is a large spread in the nitrate concentrations between agricultural use, types of farm and regions with different soil types. Soils below arable farms generally have higher concentrations than soils below dairy farms. In the southern part of the sand region, the concentrations are generally higher because there are more crops and soil types that are sensitive to washing out (Statistics Netherlands et al., 2012).

2.26 Level of concern

The number of people who think that air, water and soil are strongly polluted has decreased from around 60 percent in 2002 to 40 percent in 2012. Concern for the economic situation and security/crime on the other hand has increased.[7)]

2.26.1 Level of concern



The level of concern for the environment is based on the number of persons of 18 years and older who think that air, water and soil are strongly polluted.

The issue

The environment is an important determinant of health status and general wellbeing. Subjective measures of people's perception about the quality of the environment capture other elements of green growth that indicate the social context of greening growth. This indicator measures the level of concern for the environment.

Analysis

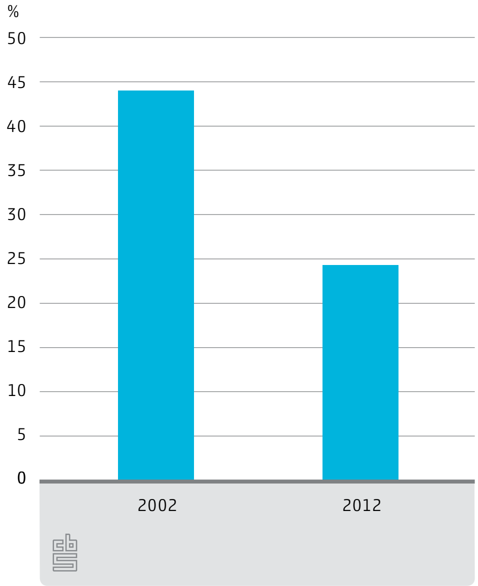
Concern for the environment dropped significantly in the last ten years. The survey results show few differences among age groups, but women are more concerned about the environment (45 percent) than men (35 percent). On the other hand, men are more willing to pay extra taxes to protect the environment (26 percent) than women (22 percent). Only 30 percent of the people who think that air, water and soil are strongly polluted are willing to pay more taxes to protect the environment. According to the OECD, the Netherlands ranked among the highest with respect to the level of concern for the

[7)] See also http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0040-Belangstelling-maatschappelijke-problemen.html?i=15-12 environment in 2011 (OECD, 2014). In the top three environmental concerns were natural resource depletion (27 percent), followed by waste generation (17 percent), and air pollution (15 percent). Remarkably, climate change and water quality were not ranked among the main concerns by the Dutch respondents.

2.27 Willingness to pay

In 2012 only 24 percent of the population were willing to pay extra taxes to protect the environment. In 2002 this was still around 44 percent.[8)]

2.27.1 Willingness to pay



The indicator 'willingness to pay' addresses the willingness of people to pay more taxes to protect the environment. The survey was conducted among persons aged over 18.

The issue

The environment is an important determinant of health status and general well-being. Subjective measures and people's perception about the quality of the environment capture other elements of green growth that indicate the social context of greening growth. This indicator shows the willingness to pay to protect the environment.

8) See also http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0040-Belangstelling-maatschappelijke-problemen.html?i=15-12

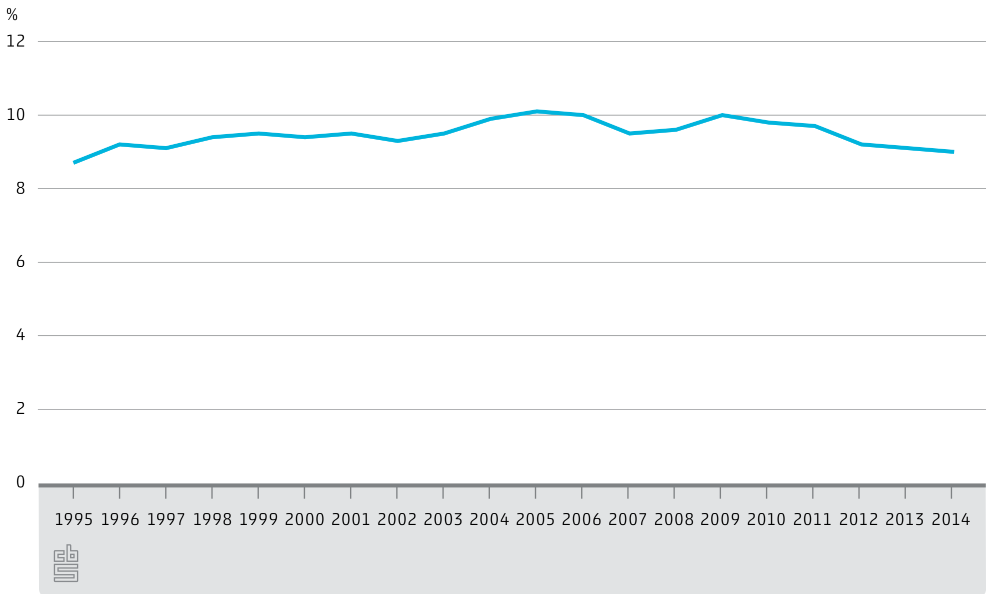
Analysis

There are large differences between income groups for this indicator. Only 17 percent of low income groups is willing to pay more taxes. For the middle incomes this increases to 21 percent, while 39 percent of the high income groups are willing to pay more taxes to protect the environment. Contrarily, the level of concern is the lowest for high incomes groups. The level of concern is comparable for low and middle incomes. The willingness to pay more taxes to protect the environment decreases from 30 percent in urban areas to 20 percent in rural areas. This is consistent with the observed concern for the environment. People in urban areas are more concerned about the environment (44 percent) than people in rural areas (35 percent). The OECD has researched willingness to pay in 11 countries (OECD, 2014). In the Netherlands the median willingness to pay for electric cars is 30 percent of the premium relative to conventional cars. This is the highest of the researched countries. On the other hand, the willingness to pay more for renewable energy is only 2 percent, one of the lowest of the researched countries. Willingness to pay for organic food is around 8 percent, which is around the average.

2.28 Environmental taxes and fees

The share of environmental taxes and fees in total taxes and social contributions in the Netherlands decreased for the fifth year in a row. In 2014, the Dutch government collected 23.9 billion euros in environmental taxes and levies. This was 9.0 percent of total government tax revenues including social contributions. In 2009 the share was 10.0 percent. Households contributed 66 percent and companies 34 percent.

2.28.1 Share of environmental taxes and levies in total taxes and social contributions



An environmental tax is a tax whose tax base is a physical unit (or a proxy of it) of something that has proven any specific negative impact on the environment. The share is calculated by dividing the sum of environmental taxes and environmental levies by the sum of total taxes and social contributions received by the government. (Please note, there are also other taxes which are partially intended as environmental measures, in particular the additional tax liability for private use of a company car. As these are not considered environmental taxes, they are not included here.)

The issue

Environmental taxes and levies can be used as a policy instrument to change behaviour: they put a price on the harmful side effects of activities on the environment or on the use of often non-renewable, natural resources and raise revenues. Environmental tax reforms aim to shift the tax burden away from taxes on income and capital and towards taxes on consumption, pollution, and the use of energy and other resources. This shift can be monitored by looking at environmental taxes as a percentage of total taxes and social contributions. See also chapter 2.29.

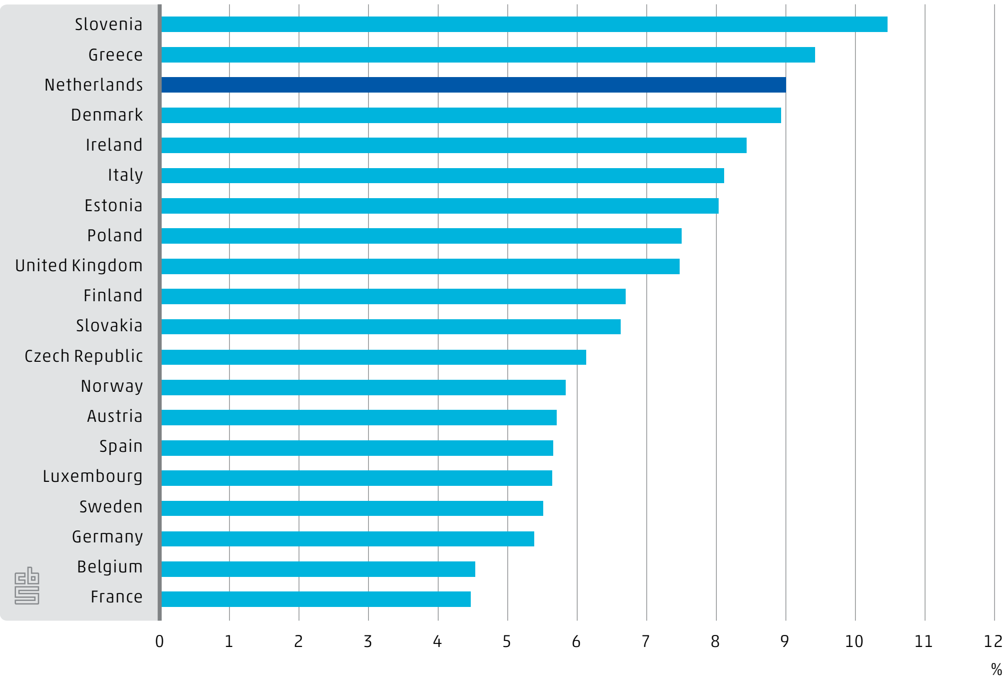
Analysis

The total amount of taxes and social contributions has increased steadily over the past five years, whereas the amount of environmental taxes and levies grew by less or decreased. As a result, the share of environmental taxes in total taxes and social contributions has dropped slightly.
No major new initiatives for environmental tax reform have been undertaken since 2000. The introduction of the packaging tax and the (temporary) introduction of a tax on air travel have had little effect on the overall share of these taxes. In 2013 a new surcharge on sustainably energy (ODE, used to finance renewable energy subsidies) has been introduced, but its revenues are still modest. Most of the environmental taxes were imposed on energy and transport. Important environmental taxes are excise duties on petrol and other motor fuels, motor vehicle tax and tax on electricity and gas use. Revenues from tax on passenger cars and motorcycles decreased substantially over the past few years, whereas revenues from motor vehicle tax increased considerably. Environmental taxes amounted to 19.4 billion euros in 2014, whereas environmental levies totalled 4.5 billion euros. The main difference between a tax and a levy is the use of revenues. Tax revenues flow in the general budget, while revenues of levies are used to cover the cost associated with particular environmental activity, like responsible waste recycling.

International comparison

The Dutch share of environmental taxes and levies in total taxes and social contributions ranks among the highest in Europe, mainly as a result of high taxes on pollution and on transport. In 2013, the Dutch score on this indicator was 9 percent comparing to an EU-28 average of just over 6 percent. Of the 20 OECD countries listed below, only Greece and Slovenia ranked higher. The Netherlands headed the list in the period 2008–2011, which illustrates that it tends to internalise the costs for pollution and other environmental damage via environmental taxes and fees more than other countries do. Belgium and France are the lowest ranking countries (4.5 percent). In 2012 The Netherlands ranked second, after Slovenia.

2.28.2 Share of environmental taxes and levies in OECD countries, 2013

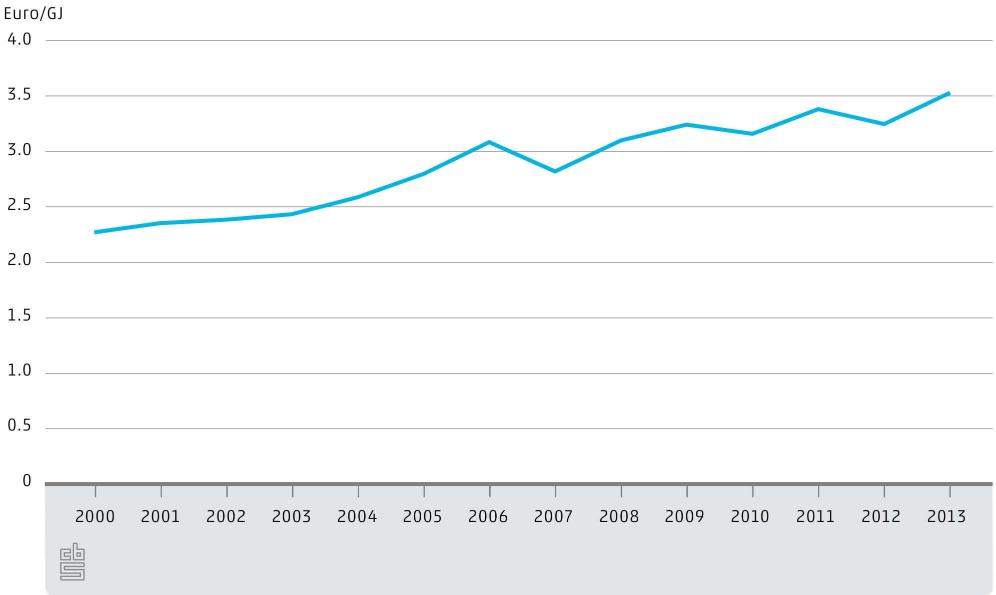


Source: Eurostat.

2.29 Implicit tax rate for energy

The implicit tax rate for energy in the Netherlands has increased almost continuously since the year 2000. The ratio went from 2.3 euros per GJ in 2000 to an unprecedented 3.5 euros per GJ in 2013.

2.29.1 Implicit tax rate for energy



The implicit tax rate for energy is calculated by dividing the energy related taxes (excise duties on petrol and other motor fuels and tax on electricity and gas use) by net energy use.

The issue

Many countries have set up energy taxes as an economic instrument aimed at implementing environmental liability and achieving the Kyoto Protocol objectives (reducing global greenhouse gas emissions by limiting emissions of six greenhouse gases). The implicit tax rate for energy gauges the development of the average tax burden on energy use. A shift in taxation from labour to energy consumption will foster energy efficiency. The indirect costs to society for pollution due to energy use (so-called externalities) are somehow compensated for by internalised taxing of energy use.
See also chapter 2.28.

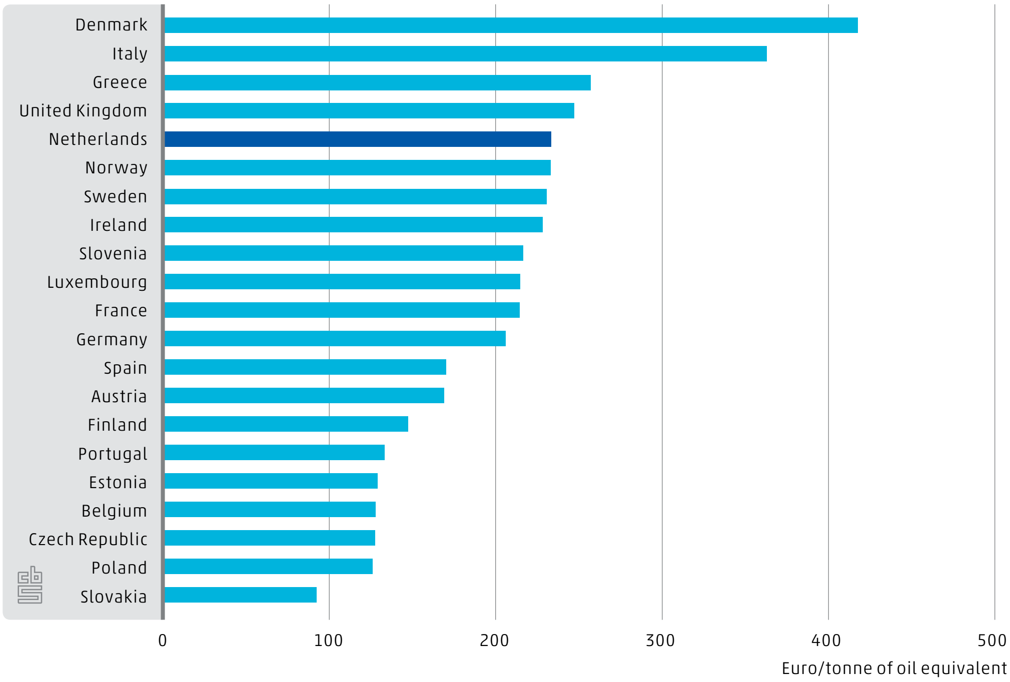
Analysis

The increase in the implicit tax rate for energy is caused by higher rates for excise duties on motor fuels and the tax on electricity and gas use, which is levied on the use of electricity and natural gas. The implicit tax rate is relatively higher for the service industries than for manufacturing, as energy tax rates for bulk users are usually much lower than for small-scale users. The implicit tax rate for energy rose until 2006. It saw a small dip in 2007 as energy tax yielded lower revenues because the winter of 2007 was relatively warm, so the demand for natural gas was lower. The small dip in 2012 was due to lower revenues from excise duties. In 2013, energy related taxes grew by well over 8 percent, whereas energy use remained fairly stable. As a result, the implicit tax rate for energy rose to an all-time high of 3.5 euros per GJ.

International comparison

To enable international comparison, Eurostat, the Statistical office of the European community, defines implicit tax rate as the ratio between energy tax revenues and final energy consumption. They measure energy tax revenues for a calendar year in euros and the final energy consumption in tonnes of oil equivalent.
In the Netherlands, energy use is taxed more than in other European countries. With 233 euros per tonne of oil equivalent, the Netherlands held fifth position among twenty-one European countries in 2013, just below the United Kingdom (247 euros per tonne) and Greece (257 euros per tonne). Denmark (418 euros) and Italy with 363 euros per tonne of oil equivalent have the highest tax burden on energy use. Over the past two decades, the Netherlands climbed from a fourteenth place (out of 19 countries) in 1995 to a ninth in 2000 (20 countries) and then a seventh in 2005 (20 countries) and a fifth place in 2010 and 2013 (21 countries reporting in both years).

2.29.2 Implicit tax rate for energy, 2013



Source: Eurostat.

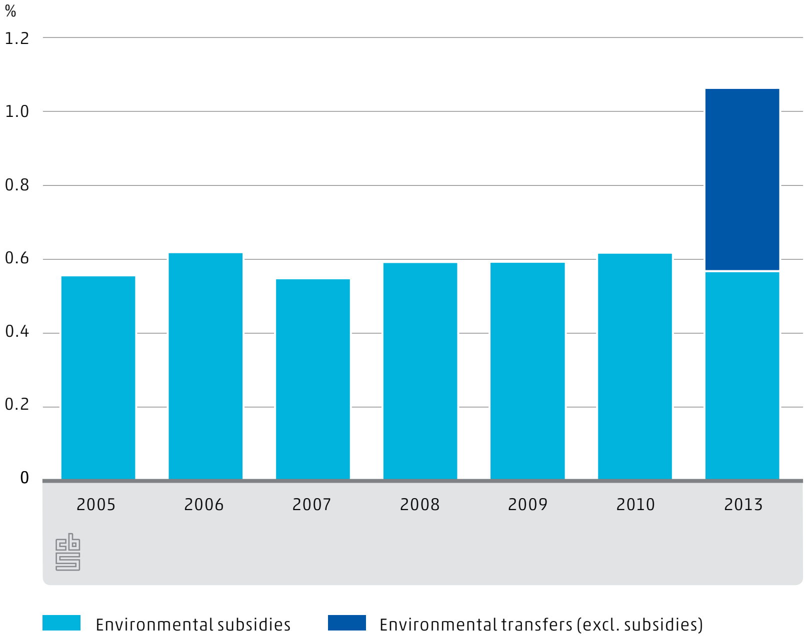
2.30 Environmental transfers and subsidies

Environmentally motivated subsidies provided by the government increased from 764 million in 2005 to 959 million euro in 2013 with a peak of 1,158 million euro in 2010. The share in central government expenditure remained more or less stable around 0.6 percent. Together the environmental subsidies and other environmental transfers account for 1.1 percent.

Environmental transfers include the different current transfers and capital transfers. Environmental subsidies include only the so called explicit (or direct) subsidies on environmental protection and resource management, which are direct monetary transfers from the government to the beneficiaries, excluding fiscal facilities etcetera.

No comparable time series for environmental transfers (excl. subsidies) is available yet.

2.30.1 Environmental transfers/subsidies as a percentage of central government expenditure[1)]



1) Figures for 2011 and 2012 have not been compiled.

The issue

Environmental subsidies are important economic instruments for achieving national environmental policy objectives and for compliance with international agreements. Explicit subsidies receive a great deal of attention in the political arena. Environmental subsidies are used to promote a wide variety of activities that aim to protect the environment, use resources more efficiently and safeguard natural resources through better management.

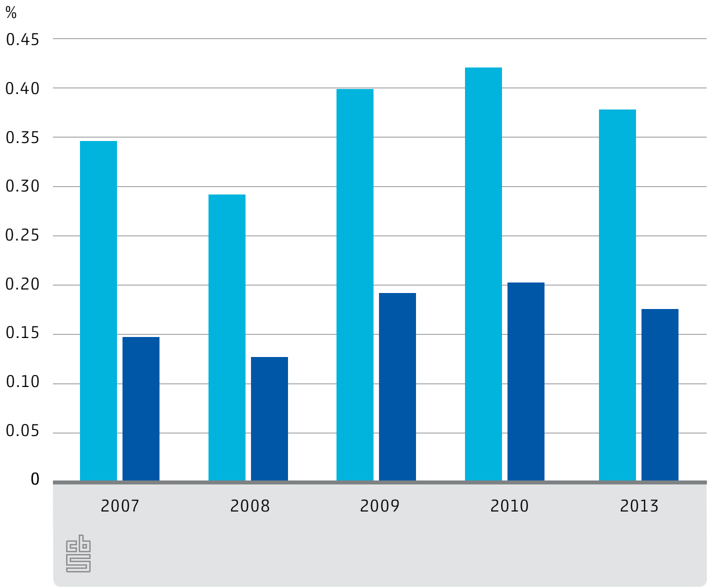
Analysis

Environmental subsidies and transfers can be allocated to the different environmental domains. The share of the production of energy from renewable resources and energy savings was just over 50 percent in 2013. The second largest objective of the total environmental transfers in 2013 is the Protection of biodiversity and landscape with 11 percent followed by the Protection and remediation of soil, groundwater and surface water with 8 percent and the Protection of ambient air and climate together with 6 percent. With a share of 88 percent the MEP/SDE scheme to stimulate the production of renewable energy by far is the most important environmental subsidy provided by the Dutch government. Environmentally motivated Implicit subsidies (foregone tax revenues due to various tax measures) amounted to 600 million euros in 2013.

2.31 Climate change mitigation expenditure by the government

Climate change mitigation expenditure by central government increased from 900 million euros in 2007 to more than 1.1 billion euros in 2013. In 2013, climate change mitigation expenditures equalled 0.38 percent of total government expenditure and 0.18 percent of GDP. Since 2007 these shares in total government expenditure slightly increased by just over 1 percent annually.

2.31.1 Climate change mitigation expenditure as a percentage of total government expenditure and GDP[1)]



Climate change mitigation expenditure as a percentage of total government expenditure
Climate change mitigation expenditure as a percentage of GDP (current prices)

1) Figures for 2011 and 2012 have not been compiled.

Climate change mitigation policy focuses on reducing greenhouse gas emissions by industries and households and attempts to limit atmospheric concentrations. In climate change mitigation, the expenditure for climate adaptation are not included.

The issue

Governments play a key role in fostering green growth by setting framework conditions that stimulate greener production activity and consumption behaviour through regulatory, economic and other instruments. The main challenges are to apply effective and efficient policies for emission reductions that limit environmental impact. Simultaneously these activities must be harnessed as a source of growth and international competitiveness, trade and employment. Important in this respect is climate change mitigation, which in essence is any activity that serves to reduce the release of greenhouse gasses to the atmosphere.

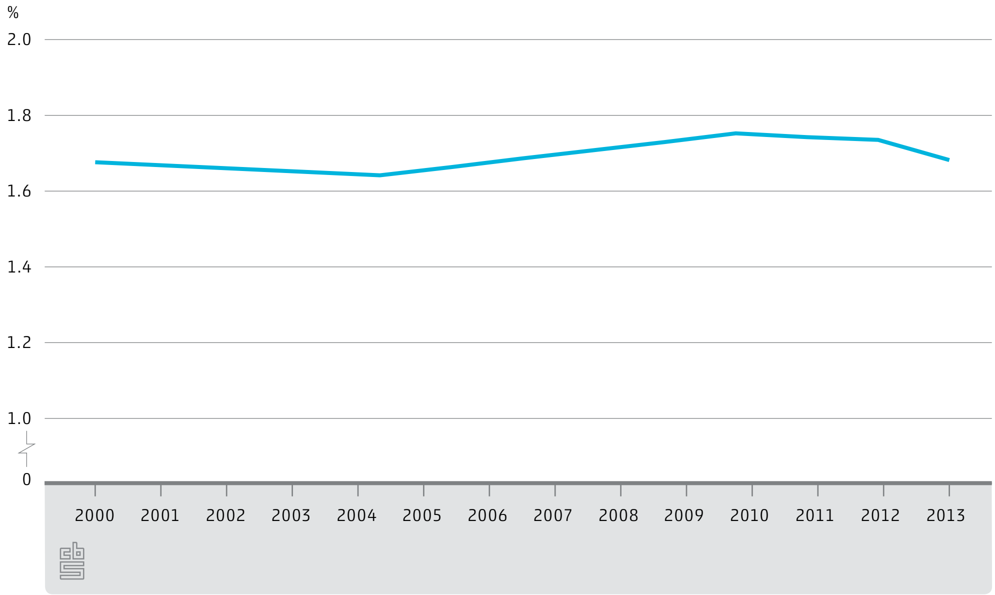
Analysis

Almost 90 percent of all expenditures to climate change mitigation activity is spent by central government. Other key players are the provinces and municipalities. Water boards play a minor role in climate change mitigation policy. Most of the budget was spent on subsidies, around 857 million euros in 2013, primarily stimulating renewable energy production. Another important category was mobility, for example stimulating fuel efficiency, home and office insulation or green seats in aviation. The mitigation policy resulted, among other things, in raising the share of renewable energy sources in total energy supply.

2.32 Environmental protection expenditures

The environmental expenditures as a percentage of GDP has remained rather constant since 2001, indicating that the financial resources that have been committed for the protection of the environment have not increased.

2.32.1 Environmental expenditures (in current prices) as percentage of GDP



Source: Statistics Netherlands (2014b).

Environmental expenditures measure the costs of implemented technologies intended to protect, restore or improve the environment. These include capital costs, current costs for operation and personnel costs.

The issue

Environmental expenditures are an important factor in realising a greener growth path. Cleaner technologies make production processes less harmful to the environment. In addition, production of environmental technologies by specialised producers may contribute to economic growth. The Dutch government, in cooperation with the private sector, takes all kinds of environmental protection measures. These result in costs for industries, households and the government itself. Environmental protection includes all measures aimed to prevent the damaging consequences of human activities or acts on the environment. It includes expenditures by measures to improve the environmental quality of air, water (including waste water), soil and groundwater, waste and noise.

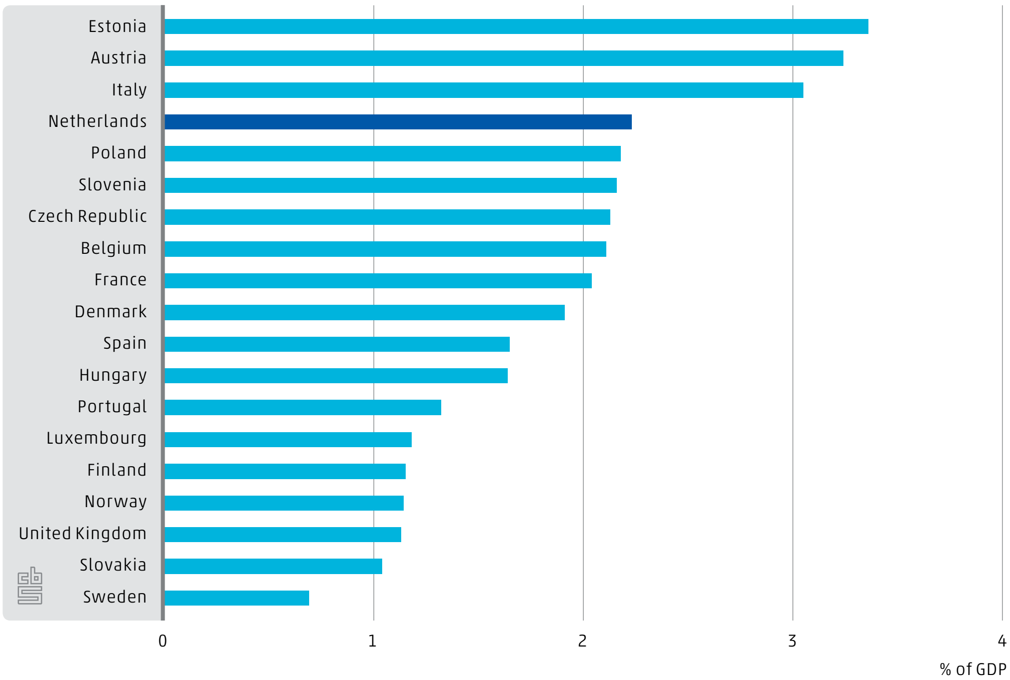
Analysis

In 2013 government and industries bore an almost equal share of the environmental expenditures: 4.5 billion euros for government against 5.1 billion euros for industries. In industries most environmental expenditure is in environmental services (companies engaged in waste management, soil sanitation etc.), and much less in manufacturing. Households pay 1.4 billion euros for waste collection services in addition 2.1 billion euros in taxes for sewerage and waste water treatment.

International comparison

Environmental expenditure as a percentage of GDP is rather high in the Netherlands compared to other countries. The environmental expenditure of the government is particularly high compared to other countries.

2.32.2 Environmental expenditure as percentage of GDP, 2011

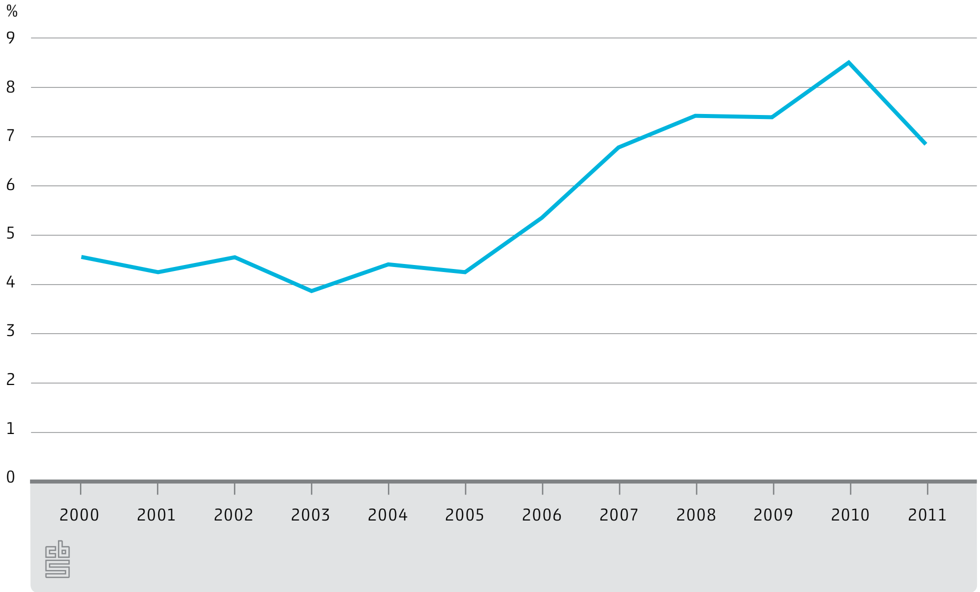


Source: Eurostat.

2.33 Green patents

The share of patent applications in total Dutch patent applications submitted to the European Patent Office (EPO) classified as green technology patents rose from 4.5 percent in 2000 to 8.5 percent in 2010. The share declined slightly to 6.8 percent in 2011.

2.33.1 Share of green patents in total patent applications submitted to EPO



Source: OECD.

Green patents are patents of technology concerning waste, wind power, geothermal energy, solar energy, tidal energy and biomass, submitted by Dutch applicants to the European Patent Office. The selection of patents in these technology areas is based on the international patent classification code.

The issue

Technological developments and innovation are important drivers for economic growth and productivity. Innovations focusing on cleaning current technologies and developing new green technologies are essential to green economic growth. As patent data give an indication of the inventiveness of a country, green patents are indicative of innovators being able to anticipate the new economic opportunities involved in greening economic growth.

Analysis

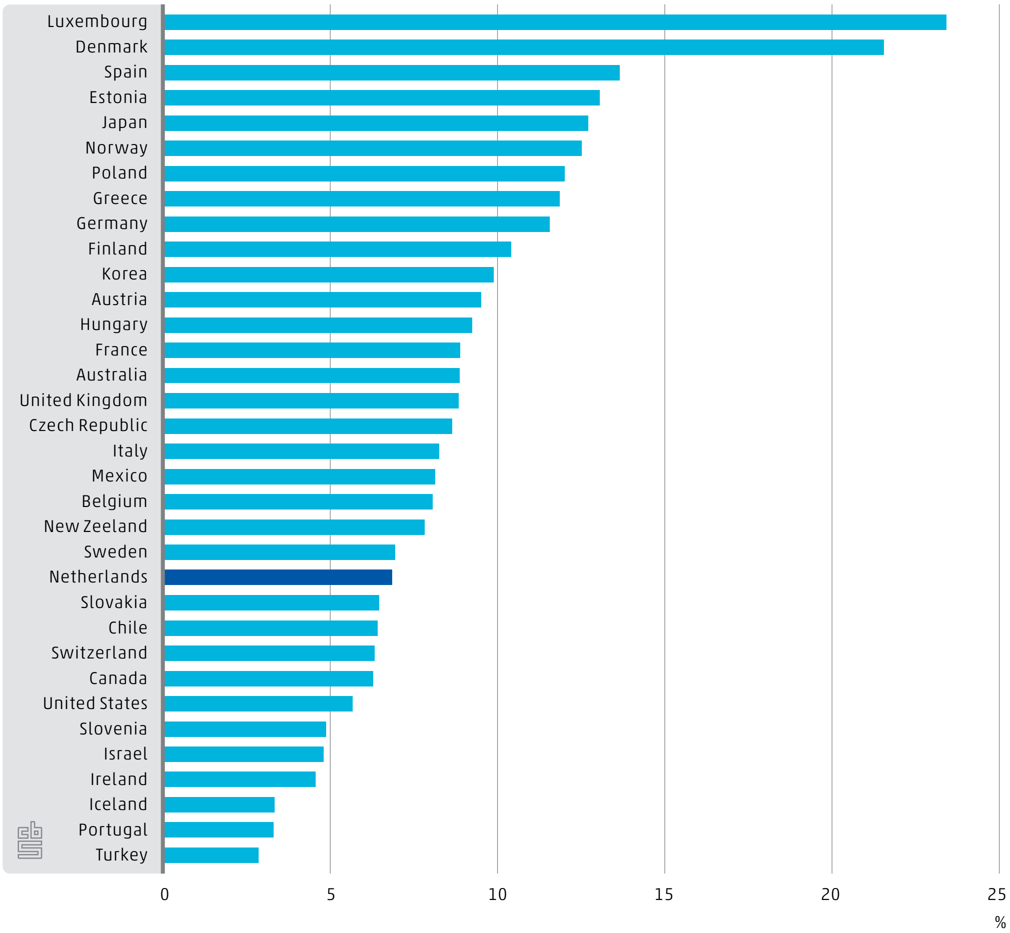
The total number of Dutch patent application to EPO has increased between 2000 and 2011, but the number of green patents has increased much faster. This can be interpreted as an increase in inventiveness regarding cleaner technologies in the Netherlands.
In addition, it can be interpreted as knowledge-intensification of the economy and associated competences of green technologies. In 2009, around 60 percent of the green

patent applications related to environmental inspection and monitoring. 10 percent relates to air pollution and 11 percent to renewable energy. Most green patent applications were submitted by manufacturing, particularly by manufacturers of chemical products, machinery and electrical equipment.

International comparison

The share of green patent applications by Dutch parties is below average internationally. The Netherlands ranked 23rd out of 34 countries in 2011. This is exactly the same position as in 2000. The rank fluctuated in the years in between 26th and 19th. Indicating that the Netherlands probably built up less intellectual property in green technology than most other OECD countries over the past decades.

2.33.2 Share of green patents in total patent applications submitted to EPO in 2011

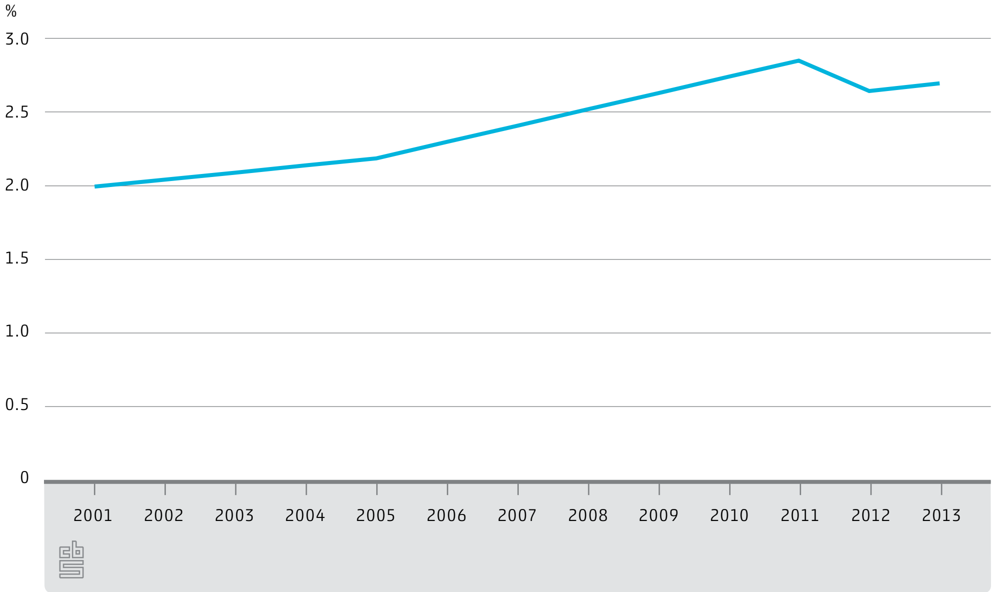


Source: OECD.

2.34 Environmental investments

In 2013 the total Dutch investments for environmental protection, as a share of total investments, had increased by 35 percent on 2001. The share of environmental investments increased from 2.1 percent to 2.7 percent. In 2012 environmental investments decreased relative to 2011, but 2013 saw again a small increase.

2.34.1 Environmental investments as a share of total investments



Source: Statistics Netherlands (2014b).

Environmental investment (gross fixed capital) is investment in capital goods intended to protect, restore or improve the environment. Included are investments by specialist producers (environmental service industry), industries (NACE 10-36) and government.

The issue

Environmental investment is a key factor in realising a greener growth path. Cleaner technologies make production processes less harmful for the environment. In addition, production of environmental technologies by specialised producers may contribute to economic growth.

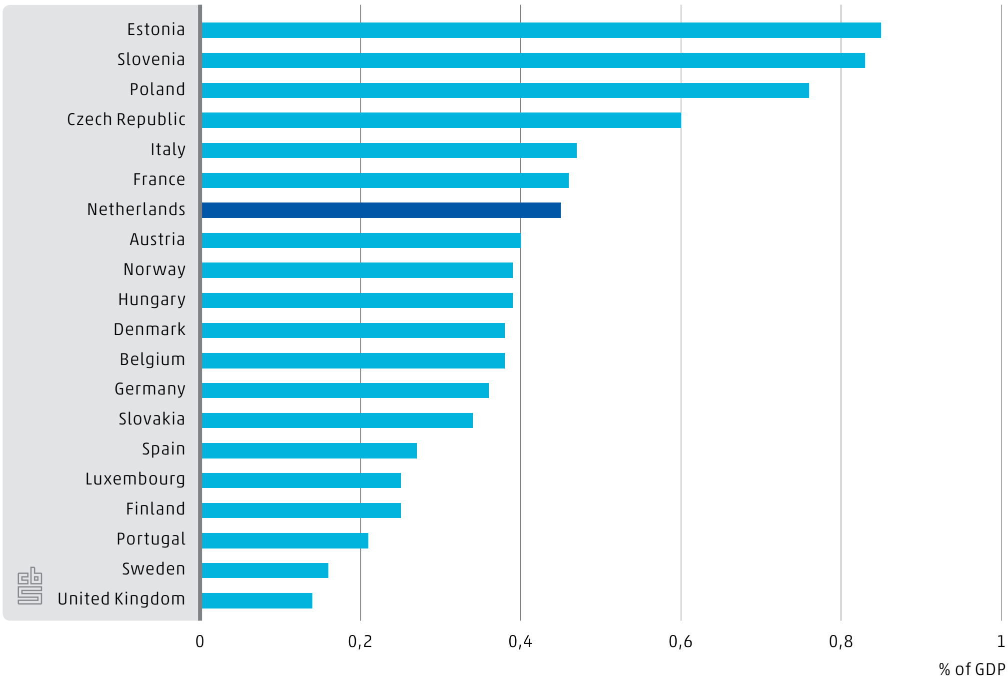
Analysis

Environmental investments are extra capital goods intended to protect, restore or improve the environment and do not repay themselves within three years. In 2013 the total environmental investments amounted to 2.1 billion euros for government and 1.0 billion euros for industries. This is much higher than in 2001 when the total environmental investments in current prices amounted to 1.4 billion euros for government and 0.8 billion euros for industries. Investments increased particularly in waste management.

International comparison

The Netherlands has an average position with regard to the percentage of environmental investments of GDP, which has not changed greatly since 2000. The percentages are higher in some eastern European countries, as they are still catching up in terms of environmental efficiency for their manufacturing and environmental service industries. The Netherlands scores higher than neighbouring Belgium, Germany and the United Kingdom.

2.34.2 Environmental investments as percentage of GDP, 2011

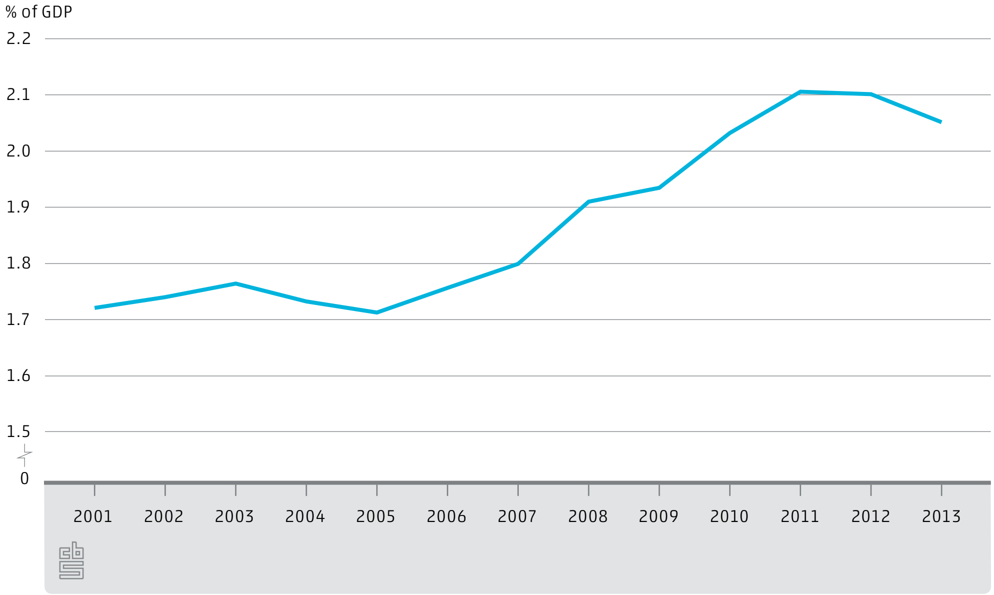


Source: Eurostat.

2.35 Gross value added environmental goods and services sector (EGSS)

The contribution of the environmental goods and services sector (EGSS) to the Dutch GDP (gross domestic product) has increased from 1.71 percent in 2001 to 2.05 percent in 2013. This is an increase from 8.2 to 13.4 billion euros in absolute terms. Despite the small decrease in 2012 and 2013, the EGSS has generally become more important for the Dutch economy since 2005.

2.35.1 Gross value added environmental goods and services sector (EGSS)



The EGSS consists of companies and institutions that produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration. Gross value added is measured in basic prices. It equals the production (in basic prices) minus intermediate consumption (in purchasing prices).

The issue

The production of environmental goods and services reflects a key aspect of economic opportunities which arise in a greener economy. The environmental sector is generally seen as a sector with great growth potential, generating wealth and creating jobs. Gross value added is mainly used to compare the income added by the EGSS to the national income, i.e. measuring the generated wealth by the EGSS. The main challenge is to foster production of the EGSS across a wide range of economic sectors and to strengthen the export competitiveness of the sector.

Analysis

Most wealth is generated by the water supply and waste management industry (21 percent) and the trade, transport, hotels and restaurants (19 percent). When looking at the type of activities (which are often spread across industries), most wealth is generated by the sustainable energy sector[9)] (34 percent), environmental services (21 percent, primarily concentrated in the waste and waste water management industry) and wholesale trade in waste and scrap (10 percent). The remainder of total value added is generated by a variety of different activities, including manufacturers of environmental equipment, environmental consulting and engineering and preparation for recycling. The production of renewable energy hugely increased its contribution to the value added of the EGSS, from not even 1 percent in 2001 to 10 percent in 2013.

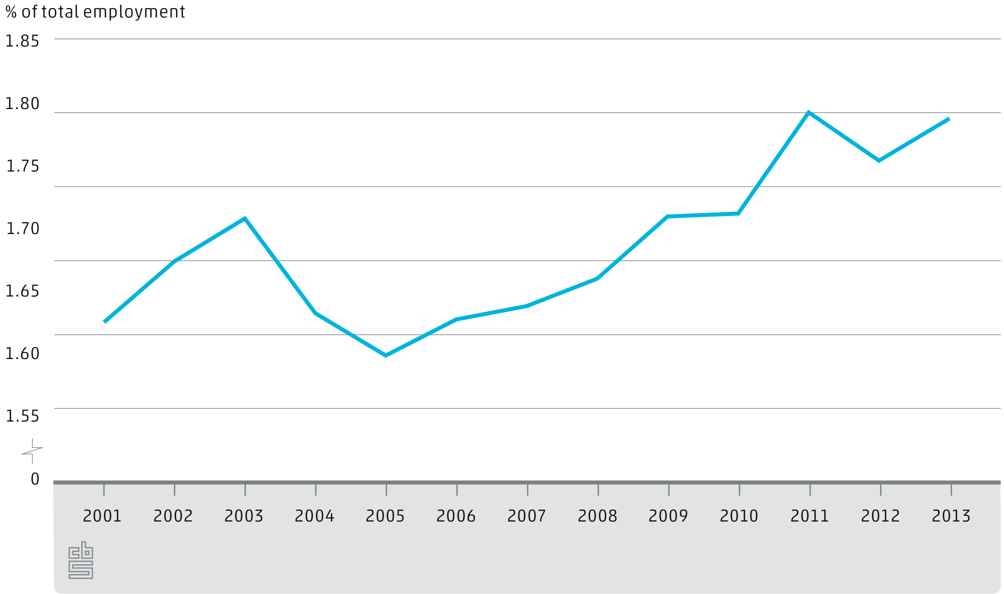
9) Energy systems and savings, insulation activities (construction industry) and production of renewable energy.

The decrease in gross value added in 2013 was related to the activities of environmental services and wholesale trade in waste and scrap.

2.36 Employment in the environmental goods and services sector (EGSS)

The share of employment of the environmental goods and services sector (EGSS) in total employment has increased from 1.66 percent in 2001 to 1.80 percent in 2013. This means an increase from 113 to 126 thousand FTE in absolute terms.

2.36.1 Contribution environmental goods and services sector (EGSS) to total employment



The EGSS consists of companies and institutions that produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration. Employment is measured in full time equivalents (FTE).

The issue

Concern for the environment not only places a financial burden on the economy (higher environmental costs), it may also create economic opportunities. With its contribution to innovation and job creation, the EGSS is an important facet of building a green economy. The EGGS framework encompasses both the greening of conventional economic activities and the growing share of green or environmental related sectors.

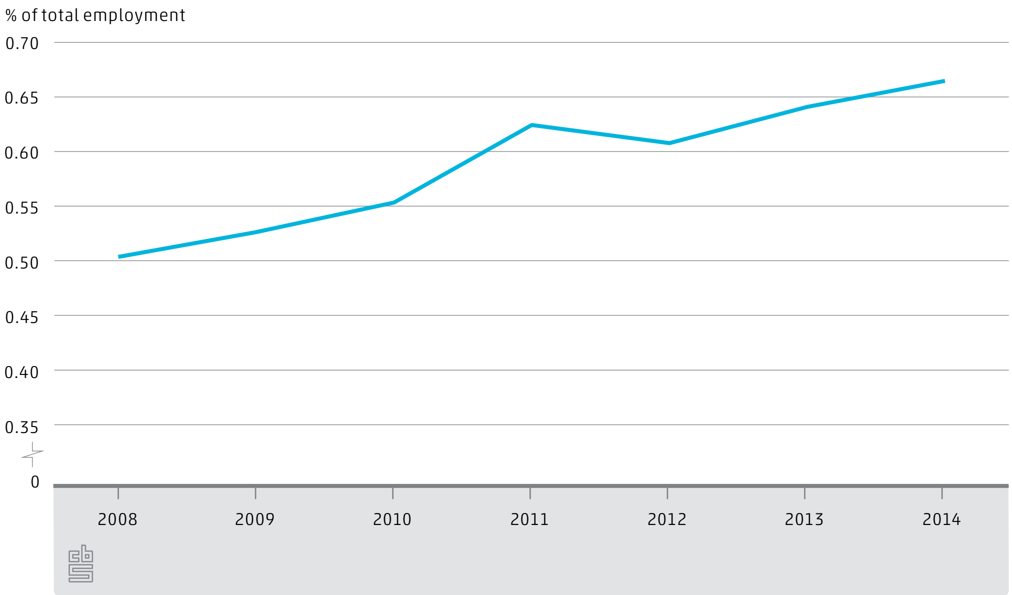
Analysis

The increasing share of the EGSS in employment and GDP (see indicator 2.35) points to a transition to an economy that is more dedicated to the production of goods and services that reduce the pressure on the environment and natural resources across the world. Employment is mainly concentrated in waste and waste water management and in the construction industry. When looking at the type of activities (which are often spread across the industries), most of the employment takes place in the sustainable energy sector[10)] (35 percent in total) and environmental services (24 percent). Though the share of the latter has decreased over the last few years. A similar declining trend is noticeable for activities in education about the environment, government administration for environment and philanthropic environmental organisations. Activities related to organic agriculture, environmental inspection and certification, and second-hand shops (not antiques), on the other hand, are increasingly contributing to the total employment in the EGSS.

2.37 Employment sustainable energy sector

The sustainable energy sector accounted for 0.66 percent of total employment in 2014. In absolute terms, the employment grew from 36 thousand FTE in 2008 to 46 thousand FTE in 2014. The share of gross value added of the renewable energy sector in GDP (gross domestic product) is relatively higher (0.70 percent), which expresses the relative labour extensive nature of the sector.

2.37.1 Contribution of the sustainable energy sector to total employment



10) Energy-systems and –savings, insulation activities (construction industry) and production of renewable energy.

The sustainable energy sector consists of companies and institutions that physically produce renewable energy (exploitation phase), as well as companies active in the value chains before or after the exploitation phase. Hence, the sustainable energy sector comprises industries in energy saving, renewable energy systems as well as industry profiles that make fossil energy relatively more sustainable (for example carbon capture and storage (CCS)).

The issue

The exhaustibility of fossil fuels and the global pressure to diminish emissions related to the consumption of fossil fuels both increase the importance of the sustainable energy sector. The sustainable energy sector is part of the environmental goods and services sector (EGSS), see indicators 2.35 and 2.36. Regarding green growth, the focus is on stimulating the use of innovative and sustainable systems for renewable energy as well as energy saving. Hence, economic, technological and geopolitical developments have the potential to make the sustainable energy sector an important and fast growing aspect of the green economy.

Analysis

In 2013, the sustainable energy sector was responsible for 35 percent of employment in the environmental goods and service sector (EGSS), see also indicator 2.36. Of this 35 percent, 32 percent took place in the activities resulting from investments consisting for more than 50 percent of energy saving activities. Even though employment in the exploitation phase may still be relatively small, it is fast growing, from 2 thousand FTE in 2008 to more than 3 thousand FTE in 2014. Of the renewable energy technologies, solar energy and wind power are generating most employment, about 12 thousand FTE (exploitation phase and employment resulting from investment). In general, the importance of the sustainable energy sector in the Dutch economy is growing, which is vital for the transition towards a green economy.

3.

Green growth in top sectors

According to the Dutch government, '*top sectors*' are key in job creation and innovation in the Netherlands. This chapter investigates whether environmental and resource efficiency and the economic performance of *top sectors* go hand in hand. This is done by scoring a selection of green growth indicators for a short period of time.

3.1 Introduction

Green growth is of great national interest, since eco-innovation may simultaneously create new types of employment and cut back on pollution and resource usage. In the Netherlands, the so-called '*top sectors*' play a central role within governmental policies aimed at promoting innovation and strengthening the Dutch economic competitiveness. *Top sectors* are active in areas where Dutch businesses and research centres excel internationally. *Top sectors* are knowledge-intensive and export-oriented, and can make a substantial contribution to solutions for global social problems. The government wants to fully optimise the earning potential of these *top sectors*' and enhance Dutch competitive strength and the economy.[1)] The nine *top sectors* include:

- Top sector Agri & Food
- Top sector Chemicals
- Top sector Creative Industry
- Top sector Energy
- Top sector High Tech Systems and Materials
- Top sector Life Sciences & Health
- Top sector Logistics
- Top sector Horticulture and Propagating Stock
- Top sector Water

Since 2010, Statistics Netherlands has monitored the economic performance of *top sectors*, commissioned by the Dutch Ministry of Economic Affairs. The scope of the *top sectors* and several economic and innovation variables are monitored, including production, value added, employment and research expenditure (Statistics Netherlands, 2015c). In 2013, a study was made to determine indicators focused on green growth in *top sectors* for one year (2010) (Statistics Netherlands, 2013b).
In this chapter we present an update of the aforementioned green growth study and the results of a small time series starting from 2010. This allows the first assessment of green growth indicators for *top sectors*, although the time series available are still short (3–4 years).

3.2 Method

Fourteen indicators of green growth, categorised according to the green growth themes formulated by the OECD, were calculated for nine *top sectors*. The green growth indicators were estimated by means of an approximation ('top-down' method) applied

[1)] Www.topsectoren.nl.

to aggregated data compiled from statistics of Statistics Netherlands. The methodology is described in detail in two background documents (Statistics Netherlands, 2012b and 2013b). A quality test of this method showed that it usually delivers fairly accurate results. If the method did not deliver accurate results on the trend in time, only an average of the investigated years was presented.

There are, however, uncertainties associated with this method. The most important one is the definition of *top sectors*, which sometimes makes it difficult to interpret the outcomes of the green growth indicators. An enterprise can be assigned to zero, one or several *top sectors*. For green growth, we must consider only those parts of the enterprise that deal with green technology or the parts that pollute the most. This can therefore make it hard to interpret some of the outcomes.

The data for the green growth indicators for *top sectors* are compared with data on other sectors and the average of the Dutch economy. The green growth indicators for *top sectors* were assessed in the same way as for the whole economy:

- indicators for environmental and resource efficiency are scores based on the degree of decoupling between environmental pressure and value added in constant prices;
- indicators for green policy instruments and economics opportunities are scored based on the evaluation of trends with respect to green growth (see also chapter 1).

3.2.1 List of investigated green growth indicators, per theme

Theme	Indicator
Environmental efficiency	Production-based GHG emissions Emissions of PM_{10} Emissions heavy metals to water Emissions of nutrients Total waste
Resource efficiency	Net domestic energy use Water use Domestic use of biomass Domestic use of metals Domestic use of minerals
Green policy instruments and economic opportunities	Share of environmental taxes Implicit tax rate for energy Value added (EGSS) Employment (EGSS)

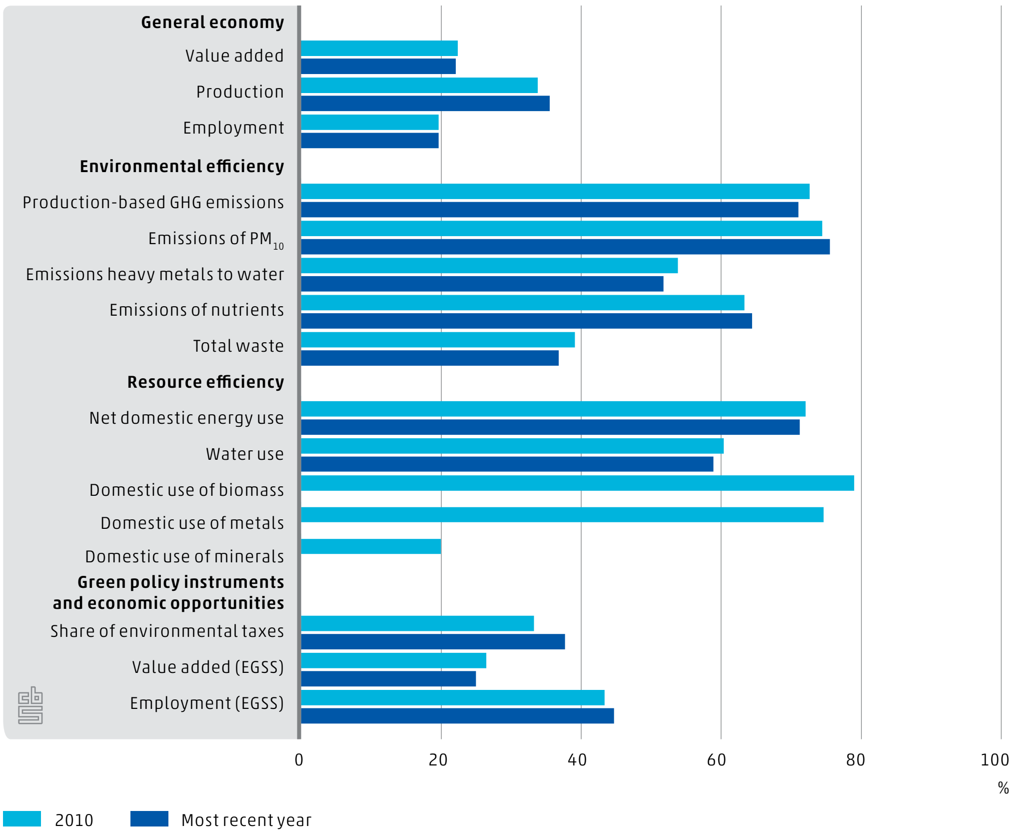
3.3 Results

Green growth of all top sectors together

The share of *top sectors* compared to the rest of the economy is constant for most green growth indicators over the years, as figure 3.3.1 shows. This is partly due to the short time series available. *Top sectors* make up 20 percent of total of value added and employment in the Dutch economy. Their share in the *environmental efficiency* indicators is much higher, namely between 40 and 80 percent. *Top sectors* produce relatively large amounts of emissions of greenhouse gas, fine dust and nutrients. The same is true for *resource efficiency* indicators. *Top sectors* are responsible for more than 70 percent of all energy, biomass use and metal use. Also water use is rather high. *Top sectors* consist mainly of businesses that are active in manufacturing, energy, agriculture and transportation. These are all sectors in which the production processes are characterised by relatively high environmental and resource intensities. Only the use of minerals is relatively low, primarily because construction and manufacturing of building materials (sectors which use relatively much in minerals) are not part of *top sectors*.

Top sectors have an above average share in the environmental goods and services sector (EGSS)[2] compared to the rest of the Dutch economy. Therefore the contribution of *top sectors* in the transition to a green economy in terms of economic opportunities is above average. However, *top sectors* pay almost 35 percent of all environmental taxes paid by industries, so their financial burden is relatively low despite the relatively high level of environmental pollution. This indicates that most polluters are not paying the costs, that is, the costs are not effectively internalised via taxes.

3.3.1 Green growth indicators: share of top sectors in the total economy in the Netherlands



[2] The Environmental goods and services sector is 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.

Evaluation of the trend over time shows that the *top sectors* score positive on all green growth indicators, see table 3.3.2. That is, for the short time series investigated, top sectors have become more efficient with regard to emissions and waste, more resource efficient, and score better with regard to green policy instruments and creating (green) economic opportunities. In general, the score of green growth indicators in *top sectors* was comparable with the trends in the total economy.

However there are some discrepancies. Concerning environmental efficiency, the total waste generated over the investigated period did show relative decoupling in the whole economy, but for *top sectors* absolute decoupling is observed. Also the improvement in environmental efficiency was higher in *top sectors* with respect to emissions of greenhouse gases and heavy metals. Only in resource efficiency were the scores similar to the total economy. Finally, environmental taxes decreased for the total economy, but increased for *top sectors*.[3)] This is a positive development as the environmental pressure is relatively large in *top sectors*, compared to the rest of the economy. So the price for pollution became more internalised. Nevertheless in absolute terms *top sectors* still pay considerably less in environmental taxes than the total economy. The environmental efficiency improved in *top sectors*, while environmental taxes decreased. Possibly, its high emissions and resource use by itself was an incentive to improve the environmental efficiency in *top sectors* regardless of the environmental tax burden.

3.3.2 Green growth indicators: trend in scores for top sectors and the Dutch economy

	Trend Total Netherlands	Trend Total *top sectors*
	%	
Environmental efficiency		
Production-based GHG emissions	–7	–8
Emissions of PM_{10}	–12	–9
Emissions heavy metals to water	–5	–6
Emissions of nutrients	–5	–1
Total waste	1	–2
Resource efficiency		
Net domestic energy use	–6	–6
Water use	–6	–6
Domestic use of biomass		
Domestic use of metals		
Domestic use of minerals		
Green policy instruments and economic opportunities		
Share of environmental taxes	–7	1
Implicit tax rate for energy	13	43
Value added (EGSS)	3	0
Employment (EGSS)	3	7

Source: Statistics Netherlands.

Note: The shown percentage is the change in intensity (measured as environmental pressure/euro value added) from 2010 to the most recent year. A lower percentage means a higher environmental efficiency improvement.

3) In this chapter the indicator for environmental taxes is defined as total environmental taxes divided by value added.

Green growth by top sector

How did the individual top sectors perform in the short time period from 2010 onwards? The overview of the scores of the indicators is shown in Figure 3.3.1. Some of the indicators could not be scored over time and have been coloured grey. Figure 3.3.3 shows the share of each individual top sector in the total of top sectors. A description by *top sector* is given below.

3.3.3 Green growth indicators: trend in green growth by top sector, from 2010 to most recent year

Source: Statistics Netherlands.

Top sector Agri&Food

The *top sector Agri&Food*, which includes much of the agricultural sector and manufacturing of food products, has a very strong impact on the environment in absolute terms. It has the highest share of all *top sectors* in nutrient emissions, waste generation, particulate emissions, and heavy metal emissions (see figure 3.3.4). In addition, this sector ranks third of all top sectors in greenhouse gas emissions. The value added of Agri&Food increased from 2010 to 2013, whereas employment decreased slightly. The environmental efficiency indicators for this *top sector* show a mixed picture. Absolute decoupling takes place in greenhouse gas emissions, heavy metal and nutrient emissions. However, no decoupling is observed for particulate emissions and waste production. For resource efficiency, the sector ranks highest of all top sectors in water and biomass use. The trends in time are comparable with the rest of the economy regarding absolute decoupling for all resource efficiency indicators.

The share of Agri&Food in environmental taxes in the total Dutch economy has decreased. This was mainly because the tax on packaging, was abolished, which was largely paid by the manufacturing of beverages that is part of this top sector. Hence the pollution and resource use becomes less internalized in the prices. Nevertheless the environmental efficiency of Agri&Food has improved, which might be interpreted that its high emissions and resource use was an economic incentive to become more environmental and resource efficient. Employment in the EGSS sector is increasing primarily because of the increase of organic farming.

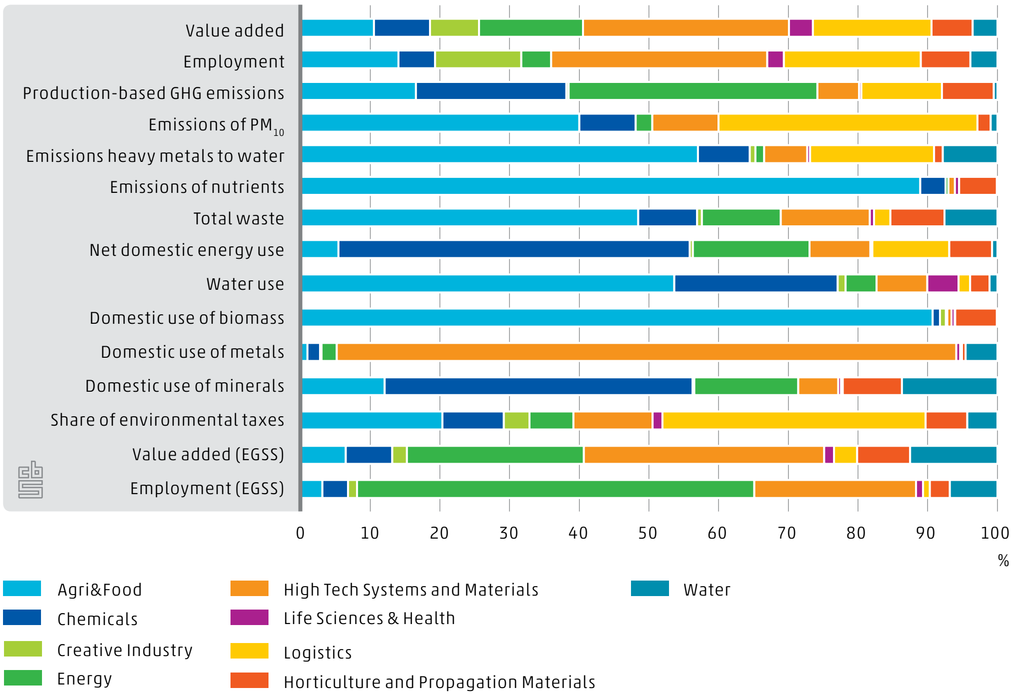
Top sector Chemicals

The *top sector Chemicals* has the highest net energy use of all *top sectors*, with more than 10 times the national average. Energy in the chemical industry is used for endotherm processes and fossil fuels are also a source material for the production of plastics for instance. This sector also contributes greatly to heavy metal and greenhouse gas emissions, water and mineral use. Chemicals is the only top sector that scores 'green' on all indicators: we observed decoupling with respect to emissions and waste production and with respect to the use of water, energy and materials. This is accompanied by an increase in environment related taxes paid. So this environmental and resource intensive sector is apparently making progress with regard to green growth.

Top sector Creative Industry

The *top sector Creative Industry* is a small sector in terms of value added, employment, environmental pollution and use of materials. Businesses within the *top sector Creative Industry* are responsible for less than half a percent of the total air and water emissions and waste production. In economic terms, the emission and material intensities are also relatively low; few companies in the *top sector Creative Industry* are active in manufacturing. On the whole, this sector has the highest implicit tax rate for energy, but does not pollute much. Only a few green growth indicators could be evaluated, and show a mixed picture of positive and negative development.

3.3.4 Relative share of top sectors for each investigated green growth indicator[1)]



1) Some top sectors overlap with respect to certain activities. This could not be taken into account in this graph as no data for this overlap with regard to the green growth indicators is available.

Top sector Energy

The *top sector Energy* is characterised by high levels of energy use and greenhouse gas emissions. The sector uses 11 percent of all the energy used by the Dutch economy and emits 25 percent of all greenhouse gases emitted by Dutch producers. Electricity producers in the *top sector Energy* are the main contributors to the high energy use and greenhouse gas emissions. The sector showed absolute decoupling for both indicators between 2010 and 2013. Also the implicit tax rate on energy increased, indicating that the price for pollution is becoming more internalised in this *top sector*. Emissions of particulate matter and emissions to water are low. The subsector 'Sustainable energy: pre-exploitation phase' is characterised by products and services that contribute to a cleaner environment. In 2013 this subsector comprised 42 thousand full-time jobs, approximately 63 percent of the total in the *top sector Energy*.

Top sector High Tech Systems and Materials

Although the *top sector High Tech Systems and Materials* is the largest *top sector* within the economy, the level of environmental pollution associated with it is relatively low. The contribution to greenhouse gases, particulate matter and heavy metals, as well as waste production are between 10 and 15 percent of all *top sectors*. Nonetheless, this *top sector* consumes roughly 90 percent of all metals used in the Netherlands, far more than any other *top sector*. This sector shows absolute decoupling for all efficiency indicators except waste production. Environmental taxes paid by the sector have increased. The *top sector* encompasses 15 percent of the employment in environment-related goods and services industry. This proportion is only slightly below the proportion in the *top sector* Energy. Environment related employment in this sector is increasing.

Top sector Life Sciences & Health

The *top sector Life Sciences & Health* is a small sector within the economy. Its share in emissions, waste and resource use is even smaller, reflecting that this is an emission and resource extensive sector. Noteworthy are only the relatively high levels of ground and drinking water use. The subsector pharmaceutical industry is primarily responsible for this. Water use has decreased in recent years. The sector also shows absolute decoupling with regard to greenhouse gas and particulate emissions, but no decoupling with respect to waste production.

Top sector Logistics

The *top sector Logistics* contributes significantly to the emissions of heavy metals to water and particulates to air. This *top sector* pays 14 percent of all environmental taxes levied on companies and organisations, which is more than any other *top sector*. This is due to the excises on petrol and motor vehicle tax paid by road transport. Environmental taxes in this top sector are low despite relatively high use, greenhouse gas emissions fell only slightly, and emissions of heavy metals went up. The value added in the sector decreased from 2010 to 2013. So according to these indicators no green growth was realised in the *top sector Logistics*. A positive note is that the particulate emissions decreased at a faster pace than the economic downturn.

Top sector Horticulture and Propagation Materials

The *top sector Horticulture and Propagation Materials* has the second largest impact on nutrient emissions and biomass use of all top sectors. This *top sector* scores positive for most green growth indicators. Emissions of greenhouse gases and nutrients fell more than value added. Also energy and water use showed a sharp decrease. This is accompanied by a decrease in environmental taxes and an increase in the implicit tax rate for energy. Possibly, its high nutrient emissions and biomass resource use by themselves were an incentive to improve environmental efficiency.

Top sector Water

The *top sector Water* is relatively small with regard to employment and total value added. Also its contribution to emissions and resource use is small. Exceptions are the high heavy metal emission to water and the relatively high usage of metals and minerals, mainly through ship-building and related (metal construction) industries. It was impossible to score the trend for many of the green growth indicators. This *top sector* scored negatively for waste production and the emissions of nutrient to water. The findings of the *top sector Water* are not all easy to interpret since the sector is relatively small.

3.4 Conclusions

The share *top sectors* have in total pollution and resource use is high, and therefore cause much pressure on the environment. Their contribution to employment and value added in the economy is much lower, indicating that *top sectors* on average have environmental and resource intensive activities. Environmental taxation for *Top sectors* is relatively low. This is contrary to the polluter pays principle. On average, *top sectors* show the same green growth trends as the economy as a whole. However, the environmental efficiency and resource efficiency improved more than in the rest of the economy. The enhanced improvement of the green growth indicators may be due to the relatively high emissions and resource use in *top sectors*. Any efficiency improvement could be a direct financial incentive to do so. *Top sectors* also contribute significantly to the employment of the environmental goods and services sector (EGSS).

Only short time series were available for this analysis, making a good evaluation on the progress in green growth difficult. This is particularly true for *top sectors* that have a low environmental impact. In the future, longer time series will make a better assessment of the performance of *top sectors* possible.

4.

Dutch Urban Mining of Waste of Electrical and Electronic Equipment

We can all relate to how electronic and electrical equipment (EEE) takes up more and more room in our homes and work places. And as the lifespan of EEE such as computers, smartphones, routers, and monitors shortens, unsightly piles of barely used, broken or obsolete equipment are mounting. This chapter contributes data on the quantities, the potential as a secondary resource, and the fate of the waste of electronic and electrical equipment in the Netherlands: the so-called Dutch urban mine.

4.1 Introduction

The technological inventions of the last decades have led to a continuously increasing amount of electric and electronic equipment (EEE). Technological advancement quickly makes old models obsolete. As these are discarded by their owners they turn into electronic waste (e-waste) or waste of electric and electronic equipment (WEEE). WEEE contains toxic materials that should be treated in environmentally sustainable ways. According to the waste framework directive, prevention (reuse) and recycling are favoured ways to treat waste. This creates jobs, minimizes pollution, and turns waste into secondary resources. However, collection rates in the Netherlands, Europe and the rest of the world are currently low. The global environmental issues currently associated with WEEE arise from the low collection rates (Baldé, 2015a).

There are many reasons why collection rates are low: the final owner can either store the equipment in cupboards, cellars, attics etc. or dispose of it in bins after which it ends up in incineration or landfills. Another dimension of improper disposal is trading WEEE so that it ends up in undesirable destinations, such as substandard treatment in developed or developing countries. In an ideal case, resource efficiency and low environmental impact can be optimised when WEEE is collected and treated in state-of-the-art facilities. However, imperfect disposal scenarios do and did exist, causing the current WEEE problems.

The imperfect disposal scenarios also impact on whether WEEE is recycled and turned into raw materials. WEEE contains valuable materials that may be scarce and could be reused or recycled. This chapter focusses on quantifying the most common raw materials in WEEE: silver, aluminium, gold, batteries, chlorofluorocarbons (CFCs), copper, iron, lead-glass, palladium and plastics. It will be a first step in quantifying those amounts in WEEE and in qualitatively analysing the supply of raw materials to recycling.

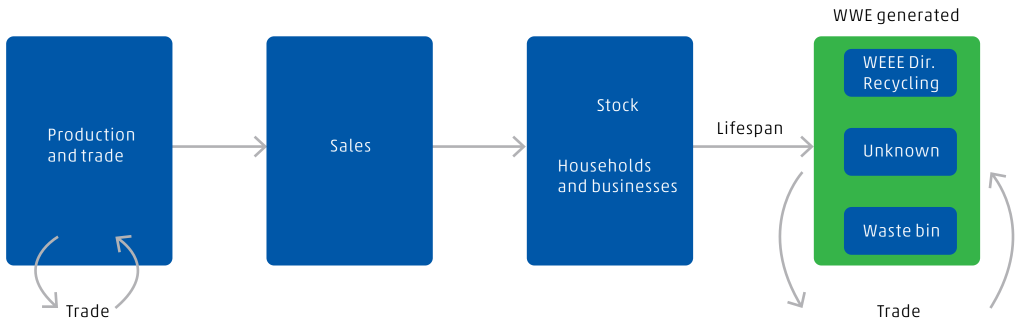
4.2 Methodology

E-waste or WEEE is a term used to cover all items of EEE and parts that have been discarded by their owners as waste without any intention of re-use (Step Initiative, 2014). WEEE includes a wide range of products – almost any household or business item with circuitry or electrical components with a power or battery supply.

The WEEE statistics in this report have been compiled using the methodology developed by the Partnership on Measuring ICT for Development (Baldé, 2015b). In this methodology, the sales of EEE are first estimated using the 'Apparent Consumption' approach. This formula is: Domestic sales = Domestic production + Imports – Exports. Prodcom statistics were used to calculate domestic production. Trade statistics have been used for the calculation of the imports and exports.

EEE products have been classified using the UNU keys, which are 54 product groups. This classification groups similar products with identical functionality and/or same return stream characteristics. A lifespan profile has been made for every UNU key (Magalini et al., 2015). These lifespan profiles may differ between countries and also change in time. By combining the EEE sales of historic years and the lifespan profiles we calculated the WEEE generated. WEEE generated corresponds to the total weight of discarded products (waste) as a result of consumption within the territory of that member state, prior to any activity (collection, preparation for reuse, treatment, recovery (including recycling) or export after discarding. The flows of products to waste are shown in Figure 4.2.1.

4.2.1 Flow diagram of EEE and WEEE in a territory



The WEEE directive (Council Directive EC, 2003) requires producers and importers of EEE by law to take care of separate collection and recycling of WEEE. It is also specific in the recycling methods. All WEEE quantities have to be registered in 10 categories and made publicly available. Collection takes place through municipal waste collection facilities, shops and some other collection points. The waste collected in this way is referred to as official collection. People also discard WEEE in waste bins, together with the residual waste. This waste never gets fully recycled.

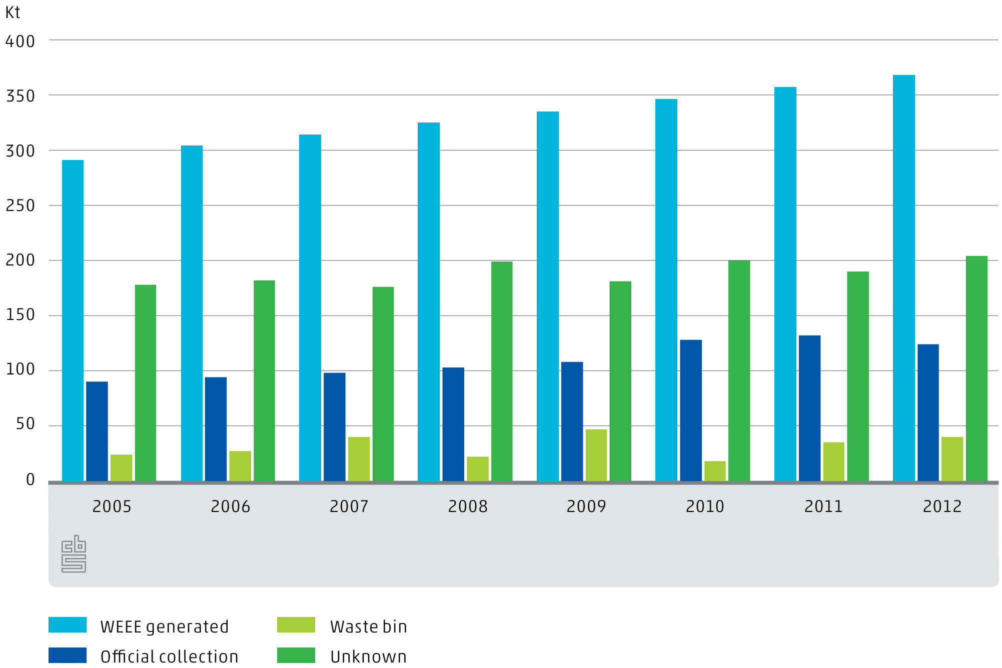
Apart from this, EEE can also be traded as a product, it can be scrapped, or stripped and partly sold (for instance hard discs) domestically or abroad. It can be exported as waste, or treated domestically in a metal or plastic scrap recycling. In the figures and tables they are grouped under Unknown. They are calculated as WEEE generated minus official collection and waste bin.

To identify the material composition of EEE, a representative product has been chosen for every UNU-KEY. Its composition has been taken from the literature (Wang, 2014). No composition data were available in our databases for medical devices, monitoring and control instruments and automatic dispensers. The prices of the raw materials were obtained from market values in 2013 of the commodities gathered from the literature (Wang, 2014).

4.3 Results

Fate of WEEE in the Netherlands

4.3.1 Weight of WEEE generated by collection method



Source: Statistics Netherlands, Eurostat.

Figure 4.3.1 shows that the amount of WEEE generated has grown steadily from 291 kt in 2006 to 368 kt in 2012. The steady growth can be due to the calculation method used, as the WEEE generated was calculated using lifetimes of preceding sales. Any effects of the economic crisis, for instance that people postpone buying new products and keep their old ones a bit longer, are not reflected in the data. This could result in WEEE generated being slightly overestimated after 2008 when the economy was in a crisis, and probably slightly underestimated after 2012 when the economy recovered.

The official collection and treatment of WEEE is the most regulated way to treat WEEE. This official collection had increased from 2005 to 2011, but decreased in 2012. For all years, less than half of all WEEE is collected through the official channels. About 20 to 40 kt of EEE is thrown in waste bins every year. This amount seems to be growing over time, and is related to bad disposal behaviour.

Table 4.3.2 shows the amounts of WEEE generated and the collection method for all 10 categories of the WEEE directive for 2012. How the waste bin and other collection totals are divided over these 10 categories is based on data in *The Dutch WEEE Flows* (Huisman, 2012). This report shows that there are hardly any large household appliances (cat. 01) and automatic dispensers (cat. 10) disposed in waste bins whereas medical products (cat. 08) have a 60 percent chance of being binned.

However, current registrations provide no insight in the fate of the remaining WEEE. More than 50 percent of most categories is unknown and undocumented (table 4.3.2). For monitoring equipment, this is even 86 percent. Only the data for automatic dispensers (cat. 10) seem to indicate that this waste is treated mainly in the official way. Research of the WEEE flows in the Netherlands suggests that of the 200 kt of undocumented WEEE around 44 kt of used EEE is exported and 110 kt is recycled but not registered as WEEE (Huisman, 2012). The exported quantities certainly happen in practice, however are often not visible in international trade statistics. This is mostly caused by the absence of a commodity code for WEEE trade nomenclature. In practice, when WEEE is exported it is registered under the same commodity code as the new products, unless it is scrapped because then it can be reported with the metal scrap or plastic scrap code. This part of WEEE is invisible in both cases. Exporters may also perceive functioning equipment not as waste, but as a second hand commodity, which does not have to be declared as hazardous waste for the Basel Convention.

WEEE is also illegally traded and exported, ending up in waste dumping sites in the third world. Official data on this do not exist, although research suggests that the amounts of illegally traded Dutch WEEE are modest, between 8 and 14 kt in 2012 (Huisman, 2012).

4.3.2 Weight of WEEE divided by collection method and product group in kilotonnes, 2012

Waste categories	WEEE generated	Official collection	Waste bin	Unknown	% official collection	% waste bin	% unknown
Total	368	124	40	204	34	11	55
01 Large household appliances	138	60	1	78	43	0.5	56
02 Small household appliances	49	7	10	32	14	20	66
03 IT and telecom equipment	69	18	9	43	26	13	62
04 Consumer equipment	61	30	8	24	49	13	39
05 Lamps	28	3	9	15	12	32	55
06 Tools	7	2	2	3	33	23	44
07 Toys, leisure and sports equipment	6	1	1	4	12	24	64
08 Medical devices	1	0.2	1	0.3	16	60	24
09 Monitoring instruments	5	0.03	1	4	1	14	86
10 Automatic dispensers	3	3	0	0.2	93	0	7

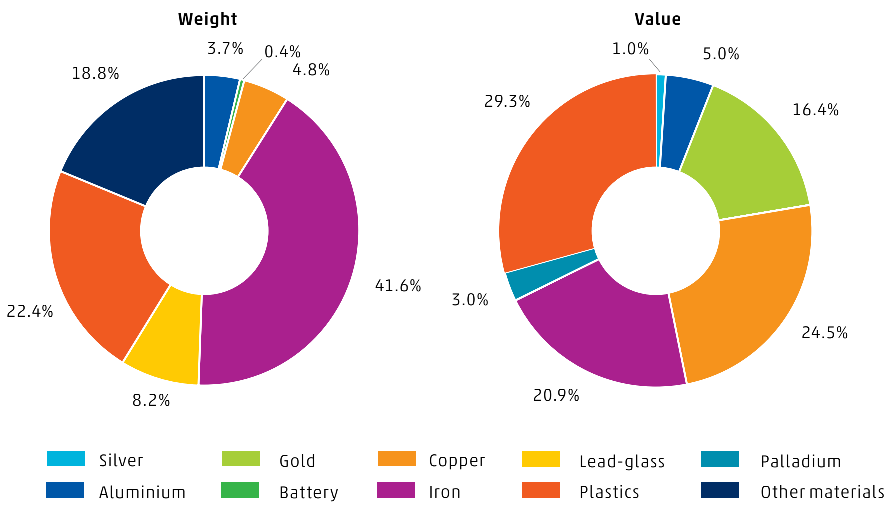
Source: Statistics Netherlands.

The Annex includes a similar table for each year between 2005 and 2012.

Raw materials in WEEE

There are many raw materials in WEEE. Those materials can be valuable, or scarce, toxic, and recyclable. The following graphs show the shares for some relevant raw materials in terms of weight and value in the total WEEE generated. Although batteries are no raw materials by themselves, they are also included in the analysis.

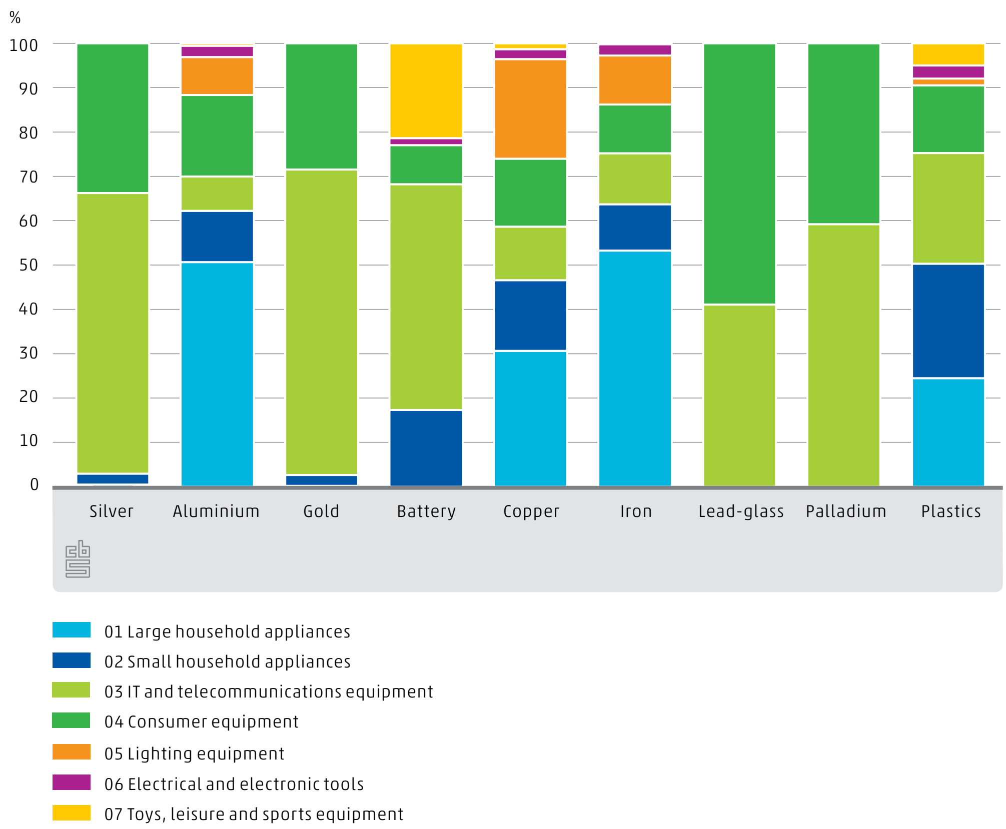
4.3.3 Share of raw materials and batteries in total WEEE, 2012



Source: Statistics Netherlands; Wang (2014).

Iron and the plastics combined already take up over 60 percent of WEEE weight. With the current data, only 19 percent of WEEE consist of unspecified materials. Considering the value of the raw materials in WEEE, the shares are notably different. This is firstly because the toxins are priced as zero in WEEE, such as lead glass and CFCs. But it is also because of the unknown prices of unspecified materials. Plastics have the highest share, around one third of the total value. Copper accounts for almost a quarter as does iron. Gold also has a major share with 16 percent while palladium accounts for 3 percent.

4.3.4 Raw materials and batteries per product group, 2012



Raw materials are often linked to product types. Figure 4.3.4 shows in which waste groups from the WEEE directive the raw materials can be found. Groups 08 Medical devices, 09 Monitoring instruments and 10 Automatic Dispensers are not presented in this figure because there are no data on the composition of the products in those categories. This figure shows that the precious metals silver, gold and palladium are mainly found in IT and in telecommunications and consumer equipment. This is to be expected as these metals are often found in circuit boards, chips and connectors. Iron and aluminium are mainly found in large household appliances. Copper is more broadly applied and is present in a large range of product types.

Although 71 percent of the weight of the materials in toys, leisure and sports equipment consist of plastics, this table shows that only 5 percent of the weight of all plastics used in EEE are used in this group.

To get an idea of how many materials will potentially be available in future waste, the stock of products still in use can be examined. This is the amount of previously sold EEE that has not yet become waste. Table 4.3.5 shows the stock per household for a selection of products for the years 2005, 2010 and 2012. To get an idea of the amount of products in the stock, a selection has been indirectly modelled using average weights, time series of sales (in which the years prior 1995 are extrapolated) and lifetime profiles. The data is per household, but it also includes devices used in offices, schools and other buildings.

4.3.5 Modelled number of products in stock per household[1)]

	2005	2010	2012
Product			
Dishwashers	0.5	0.6	0.5
Washing machines	0.9	1.0	1.0
Dryers	0.3	0.3	0.2
Fridges (incl, combi fridges)	1.3	1.7	1.7
Freezers	0.6	0.6	0.6
Microwaves	0.8	0.7	0.7
Kitchen appliances	5.3	7.4	8.1
Coffee makers, kettles	1.8	4.2	5.1
Vacuum cleaners	1.9	2.0	2.0
Personal care (tooth brushes, hair, razors)	5.0	5.0	4.9
Desktop computers	1.3	1.3	1.2
Laptops/Tablets	0.5	1.0	1.1
Printers	2.1	2.0	2.2
Landline telephones	5.9	4.4	3.3
Mobile phones	4.7	7.3	7.9
CRT monitors	1.5	1.2	1.0
Flat panel monitors	0.1	0.6	0.7
Video (VCR,DVD, Blu-ray)	2.1	2.6	2.9
Cameras	1.8	1.8	1.5
CRT TVs	1.7	0.9	0.6
Flat panel TVs	0.0	0.9	1.3
Tools	3.8	5.8	5.9
Alarms (fire/burglary)	9.5	13.2	13.0

Source: Statistics Netherlands.

1) The data is normalized per household, but the data includes also stocks in businesses, it also includes dormant items that have not become waste yet.

Modelled stock data is in the right order of magnitude of what is generally expected. Every household has a washing machine, but not all households own a dishwasher. This is also confirmed by data for 2004 (Statistics Netherlands, 2015b). According to these data 96 percent of the households owned a washing machine and 47 percent a dishwasher, 59 percent had a wash dryer in 2004 while there are only 0.3 per household in the modelled stock data of 2005. The stock of freezers, fridges, and combined fridges amounts to 2.3 per household. One would expect this number to be slightly lower than 2, as most household are expected to have one fridge and one freezer, or one combined fridge freezer. This may seem a slight overestimate, but some households have two fridges or an obsolete fridge in storage. The data also comprises equipment in use in businesses, so the cooling and freezing equipment in use there is also included. More laptops and tablets are used while the stock of desktop computers has declined, but not as fast as the growth of laptops. This is tentatively explained by the behaviour that people store their old computers for a while before discarding them. The stocks of old CRT monitors and TVs decrease as flat panel stocks increase. In 2012 the average household kitchen had 3 more devices than in 2005. The decline in cameras can be attributed to mobile phone developments. The data shows that on average 8 mobile phones are present per household. This includes mobile phones in drawers, and not in use.

All this EEE in stock contains raw materials as described in Figure 4.3.4. Table 4.3.6 shows the weight and market value of all specified raw materials in EEE in the stock of 2012 (excluding the minor amounts present in Medical devices (cat. 08), Monitoring instruments (cat. 09) and Automatic Dispensers (cat. 10).

4.3.6 Amount and value of materials in stock in the Netherlands, 2012

	Weight in kt	Price per kg (euros)	Value in million euros
Silver	0.06	583	33
Aluminium	164	1.45	238
Gold	0.02	35,020	555
Battery	11	0	0
CFCs	3	0	0
Copper	225	5.55	1,250
Iron	2,158	0.55	1,179
Mercury	0	70	0
Lead-glass	192	0	0
Palladium	0.01	17,614	112
Plastics	866	1.42	1,232
Unquantified	736	0	0
Total	**4,355**		**4,600**

Source: Statistics Netherlands; Wang (2014).

There are still chlorofluorocarbons (CFCs) present in the current stock of EEE, while the use of CFCs in cooling and freezing equipment has been banned since 1995 in the Netherlands. This indicates that there are still some very old fridges in households. When the entire stock of EEE in 2012 becomes waste, the value of its raw materials will be over 4.6 billion euros in market prices of 2013. Of this, the value of the theoretical supply of WEEE is approximately 0.4 billion euros annually.

Having a look at the annual global production for the materials is one way of putting the amount of the materials in Dutch WEEE in perspective. Table 4.3.7 shows the amount calculated to be present in Dutch WEEE and stock in 2012 and the annual global production of the materials. This gives an indication of the importance of the recovery of the materials. The amount of Palladium in Dutch WEEE was enough to cover 0.53 percent of the use of this material in global production in the year 2014.

4.3.7 Dutch amount in WEEE in relation with annual global production

Raw material	In Dutch WEEE 2012 (kt)	Dutch stock 2012 (kt)	Annual global production in 2014 (kt)	Raw material in Dutch WEEE compared to global production (%)
Silver	0.007	0.06	26	0.03
Aluminium	14	164	49,300	0.03
Gold	0.002	0.02	2.86	0.07
Copper	18	225	18,700	0.10
Palladium	0.001	0.01	0.19	0.53

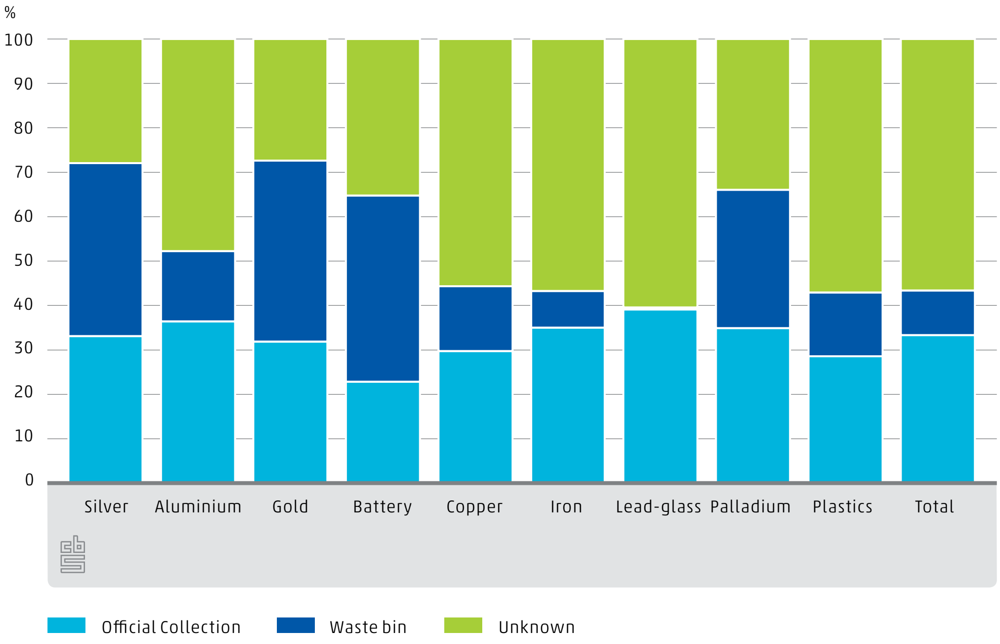
Source: Statistics Netherlands; http://minerals,usgs,gov and Critical Rare Earths, Global supply & demand projections.

The lost gold

As Figure 4.3.1 shows, only a part of Dutch WEEE is collected through those official flows that will ensure the best possible recycling technology. However, even state-of-the-art recycling technology cannot recover the whole amount present in waste. Furthermore, the whereabouts of most of the WEEE is unknown, making it even more uncertain whether all potential raw materials can be recovered. Also, a significant part of the WEEE ends up in waste bins, so it is probably incinerated. Figure 4.3.8 shows the collection method in percentages of the total amount of each specified raw material in the WEEE generated. Base metals, such as iron, copper and aluminium, will probably be recovered even if the destination is unknown. However, the probability of recovering other raw materials is much smaller when they are collected and recycled through the official channels.

Yet even with official recycling it is impossible to achieve 100 percent material recovery due to the intrinsic properties of the separation processes, imperfect liberation from pre-processing, loss of materials in end-processing and the degradation of recyclables in different recycling stages. So this figure gives a general impression on the possibility of recovery of the raw materials.

4.3.8 Collection methods per raw material, 2012



Large quantities of valuable materials in EEE end up in waste bins. About 40 percent of all silver and 30 percent of the gold and palladium are chucked in the bin because they are part of relatively small ICT products.
Most of these materials are then burned and lost. Recovery from the ashes is not efficient and too expensive. When looking at the raw materials in the WEEE generated in 2012 the amount and value of those are as shown in Figure 4.3.9.

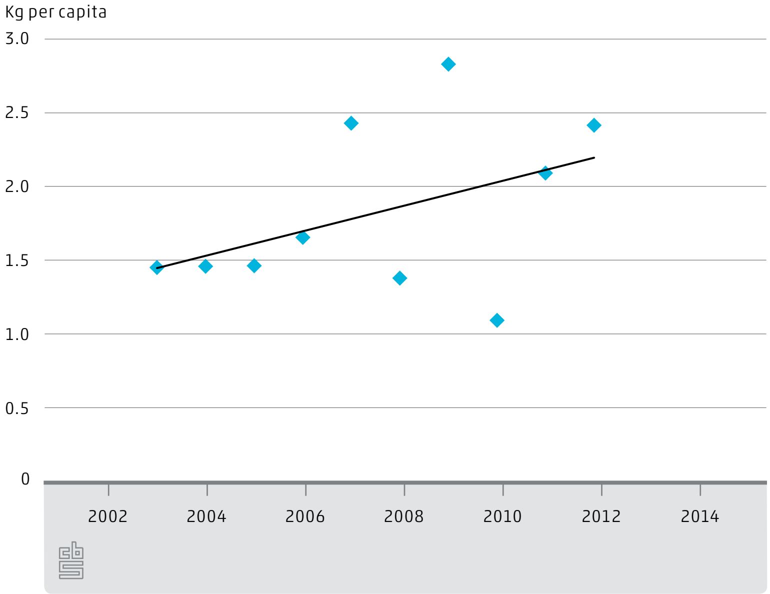
4.3.9 Lost raw materials from WEEE in the waste bin (not separately collected), 2012

	Weight in kt	Price per kg (euros)	Value in million euros
Silver	0.003	583	2
Aluminium	2	1.45	3
Gold	0.001	35,020	27
Battery	1	0	0
Copper	3	5.55	14
Iron	13	0.55	7
Lead-glass	0.14	0	0
Palladium	0.0002	17,614	4
Plastics	12	1.42	17
Unquantified	10	0	0
Total	**40**		**73**

Source: Statistics Netherlands; Wang (2014).

So in the WEEE generated in 2012 more than 73 million euros in raw materials is lost because of equipment being thrown in the waste bin. Furthermore, the amount of waste that is binned is increasing.

4.3.10 WEEE ending up in waste bins



Source: Statistics Netherlands, Rijkswaterstaat (2013).

4.4 Conclusions

Roughly 368 kt of WEEE was generated in 2012. Around 30 to 40 percent is officially collected and recycled in the Netherlands. Around 10 percent ends up in waste bins. The flows and treatment of the remaining WEEE are not known from registrations, but it is partly exported and partly recycled without being registered as WEEE. Another part is completely unaccounted for. The electrical and electronic devices in the country's stock represent 4,400 kt with an indicative value of 4.6 billion euros in raw materials. This is the WEEE of the future. With the current low collection rates and disposal behaviour, the raw materials are not fully recovered and value could be lost in the future. For instance, around 40 kt of mainly small WEEE, representing 73 million euros of raw materials, were disposed in the waste bin each year.

Annex – WEEE generated by collection method and waste group

A.1 Weight of WEEE generated by collection method and waste group in kilotonnes, 2005–2012

	2005	2006	2007	2008	2009	2010	2011	2012
Total								
WEEE generated	291	304	314	325	335	346	357	368
Official collection	90	94	98	103	108	128	132	124
Waste bin	24	27	40	22	47	18	35	40
Unknown	178	182	176	199	181	200	190	204
01 Large household appliances								
WEEE generated	103	108	113	118	123	128	133	138
Official collection	42	40	39	39	48	64	63	60
Waste bin	0	0	1	0	1	0	1	1
Unknown	60	67	74	79	74	64	70	78
02 Small household appliances								
WEEE generated	34	36	37	39	41	44	47	49
Official collection	9	9	10	9	6	7	9	7
Waste bin	6	7	10	6	11	4	9	10
Unknown	20	20	18	24	24	32	30	32
03 IT and telecom equipment								
WEEE generated	56	60	62	63	64	66	67	69
Official collection	17	18	21	23	23	21	19	18
Waste bin	5	6	9	5	10	4	7	9
Unknown	35	36	32	35	32	41	40	43
04 Consumer equipment								
WEEE generated	62	63	64	64	64	63	63	61
Official collection	19	20	21	24	25	28	32	30
Waste bin	5	5	8	4	9	3	7	8
Unknown	38	38	35	36	29	32	24	24
05 Lamps								
WEEE generated	21	22	23	24	24	25	26	28
Official collection	1	4	4	4	2	3	3	3
Waste bin	5	6	9	5	10	4	8	9
Unknown	16	13	10	15	12	19	15	15
06 Tools								
WEEE generated	3.8	4.1	4.5	5.0	5.5	6.1	6.6	7.2
Official collection	1.1	1.3	1.7	1.9	1.5	1.8	2.3	2.4
Waste bin	1.0	1.1	1.6	0.9	1.9	0.7	1.4	1.7
Unknown	1.7	1.8	1.2	2.2	2.1	3.5	2.9	3.2
07 Toys, Leisure and Sports equipment								
WEEE generated	3.4	3.5	3.6	4.3	4.9	5.4	5.8	5.8
Official collection	0.5	0.3	0.4	0.4	0.1	0.5	0.8	0.7
Waste bin	0.8	0.9	1.4	0.8	1.6	0.6	1.2	1.4
Unknown	2.0	2.2	1.9	3.1	3.3	4.3	3.7	3.7

A.1 Weight of WEEE generated by collection method and waste group in kilotonnes, 2005-2012 (end)

	2005	2006	2007	2008	2009	2010	2011	2012
08 Medical devices								
WEEE generated	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.2
Official collection	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2
Waste bin	0.4	0.5	0.7	0.4	0.8	0.3	0.6	0.7
Unknown	0.8	0.7	0.4	0.6	0.2	0.6	0.4	0.3
09 Monitoring instruments								
WEEE generated	3.7	3.6	3.6	3.8	4.1	4.5	4.8	5.0
Official collection	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0
Waste bin	0.4	0.5	0.7	0.4	0.8	0.3	0.6	0.7
Unknown	3.3	3.1	2.9	3.4	3.2	4.1	4.2	4.3
10 Automatic Dispensers								
WEEE generated	2.5	2.5	2.5	2.5	2.6	2.7	2.9	3.0
Official collection	0.9	1.4	1.7	1.9	3.0	2.8	3.1	2.8
Waste bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	1.6	1.1	0.8	0.6	-0.4	-0.1	-0.2	0.2

Source: Statistics Netherlands; Eurostat (2015).

The total WEEE generated is calculated on the based of data on sales combined with life-span profiles of groups of products, where the official collection is actual data from the recycling facilities. In group 10 this difference in calculation method even leads to a higher official collection than WEEE generated for some years.
Because of the economic crisis, people and companies tend to postpone buying new products and keep their old ones a bit longer. This could result in a slight overestimation of WEEE after 2008 when the economy was in a crisis and probably a slight underestimation after 2012 when the economy recovered.

5. Ecosystem Accounting – a case study for Limburg Province

Worldwide, ecosystems and their biodiversity are under severe environmental pressure. Consequently, valuable services provided by these ecosystems, such as the provisioning of timber, water regulation, air filtration or recreation, may be reduced or lost. Ecosystem accounting aims to quantify and monitor the interdependence between ecosystems (and their services) and economic activities, in an internationally consistent manner. The accounting system is based on tracking changes in the supply and economic use of ecosystem services. It also aims to monitor the extent and condition of ecosystems and to identify the underlying causes for change. Below we describe the results of a pilot study on ecosystem accounting in Limburg Province, the Netherlands.

5.1 Introduction

Ecosystems provide services, known as ecosystem services, that contribute to national economies and human welfare. For example, soils and vegetation form sinks for carbon dioxide, the air is filtered by vegetation and dunes protect against coastal floods and provide space for recreation and education. The supply and sustainability of such services depend on ecosystem condition and extent. Ecosystem accounting was developed in recognition of the vital importance of these ecosystem services and provides a tool for consistent monitoring and quantifying the supply and use of ecosystem services. This is highly relevant because ecosystems and their biodiversity are subjected to increasing environmental pressures worldwide, a trend that was already signalled and described in the Brundtland Report in 1987 (WCED, 1987). These environmental pressures are in part related to expanding human populations and increased economic activities. The increased demand for food and materials, fuel and living space lead to pollution, severe land degradation, the transition of natural areas to cultivated land and to the loss of biodiversity (for example Butchart et al., 2010). In addition, climate change may severely impact ecosystems (IPCC, 2014). In time, these pressures may lead to a reduction of the supply of ecosystem services, which could have dire consequences for human welfare and the economy (see box 1).

Many nations now recognise the vulnerability and value of their ecosystems and have applied conservation and protection measures (for example WAVES, 2012). Currently, however, neither the ecosystem contributions to economies, nor the losses or increases of services are accounted for in national and international statistics. To fill this gap, the United Nations Statistics Department launched the System of Environmental Economic Accounts – Experimental Ecosystem Accounting in 2014 (SEEA-EEA, UN et al., 2014). This publication provides provisional guidelines and encourages nations to experiment with Ecosystem Accounting using methods that are consistent with the System of National Accounts (SNA). It is a novel approach to measure the contribution of ecosystem services to national economies. The SEEA-EEA were developed with the purpose to *'better inform individual and social decisions concerning the use of the environment by developing information in a structured and internationally consistent manner, based on recognition of the relationship between ecosystems and economies and other human activity' (UN et al., 2014).* The ecosystem accounting system is further explained in section 2.

In the current study we describe the outcomes of a pilot study carried out by Statistics Netherlands in collaboration with Wageningen University. This project was financed by the Dutch Ministries of Economic Affairs and Infrastructure and the Environment. For this pilot project, Limburg Province was selected because within the Netherlands it is known for its attractive countryside and relative naturalness. Eight different ecosystem services were selected, based on data availability and feasibility. For these the physical and monetary flows were modelled. In addition, an Ecosystem Unit map was developed for the Netherlands. This chapter first provides a brief overview of the most important concepts of the SEEA-EEA guidelines. Next, we present the methods and results for the pilot project carried out for ecosystem services in Limburg. Finally we discuss the implications of the findings and provide recommendations for future work.

Examples of consequences of pressures

The combined pressures of human population growth and climate change have been related to the worldwide, rapid loss of biodiversity. In recognition of this threat, world leaders committed to the reduction of biodiversity loss by ratifying the Convention on Biological Diversity (Secretariat on the Convention of Biodiversity, 2005). However, a study aimed at assessing the state of biodiversity several years after CBD was ratified found that nearly all indicators of biodiversity showed a continuous decline, and only few signs for a slowing down of those declines (Butchart et al., 2010). Deforestation was recognized as the major cause for the loss of biodiversity worldwide (Strassburg et al., 2012). Deforestation also influences another important ecosystem service, carbon sequestration. The loss of forests worldwide is the cause of major greenhouse gas emissions due to the loss of the carbon sink function (IPCC, 2014).

Air pollution has serious consequences; a recent study (Lelieveld et al., 2015) estimates that worldwide, 3.3 million premature deaths (among the population younger than 5 years and older than 30 years) were attributable to air pollution (by fine dust particles ($PM_{2.5}$) and ozone) in the year 2010 alone. According to Lelieveld et al. (2015) emissions from agriculture form the largest source of pollution in Europe. Entrapment of fine dust particles by vegetation is therefore a highly relevant ecosystem service, in particular in areas with intense agricultural activities. In the Netherlands, pollution by PM_{10} has decreased steadily over the past 30 years. However, current values are still associated with a decreased life expectancy of ca. 12 months (National Institute for Public Health and the Environment, 2013).

5.2 Ecosystem Accounting: the SEEA EEA approach

The 'System of Environmental Economic Accounts – Experimental Ecosystem Accounting (SEEA-EEA)' was developed and published under the auspices of the UN Statistics Division (UN et al., 2014). It was based on the inputs of professionals from multiple disciplines such as economists, biologists, modellers and statisticians. International organisations such as the UNSD, World bank, UNEP (United Nations Environmental programme), Eurostat, EEA (European Environmental Agency) and NGO's were also involved. Ecosystem accounting aims to identify changes in the condition and extent of ecosystem units and the resulting changes in the quantity and – where possible – monetary value of the supplied ecosystem services. Consequently, Ecosystem Accounting provides a powerful tool to monitor the economic impacts of pressures as well as protection measures on ecosystems and the subsequent changes in ecosystem services.

The SEEA –EEA is based on the concept of ecosystem services, which are explained in section 5.3. The accounting logic is as follows: extent and condition of ecosystem units determine the possible supply of ecosystem services to the economy (Capacity), whereas the actual supply also depends on the demand for services (Use). Thus, following the SNA rules, supply equals use. Accounting tables are then developed for ecosystem condition (including extent), and for the supply and use of ecosystem services (for example $kg \cdot ha^{-1} \cdot yr^{-1}$), in physical terms. In addition, the monetary supply of ecosystem services ($€ \cdot ha^{-1} \cdot yr^{-1}$) can be analysed. In the current study, the physical supply and use tables and the condition table were developed and populated where possible. In addition, monetary supply and use tables were developed by Wageningen University.

The SEEA-EEA also provides information on the concepts of monetary asset and capacity accounts. These potentially provide insight into the balance of ecosystem services and in the sustainability of their use. In addition, a set of supporting accounts (biodiversity, carbon, land, water) was envisaged in the guidelines. For example, biodiversity has been recognised as a key ecosystem property and therefore a separate account for biodiversity was proposed to enable the monitoring of biodiversity over time in a consistent manner. Key indicators from this account form input for the condition account (UNEP-WCMC, 2015). However, these accounts were outside the scope of the current pilot project.

5.3 Ecosystem services

Types of ecosystem services

Ecosystem services represent the flow of material and immaterial services through human and economic activities that provide benefits to the economy (UN et al., 2014). These contributions are manifold and are subdivided into three types of services. Provisioning services reflect material and energy contributions of the ecosystems (for example timber, ground water). Regulating services result from the capacity of ecosystems to regulate climate, hydrological and bio-geochemical cycles and a broad variety of biological processes. For example, air filtration by trees contributes to clean air, which is important for public health. Similarly, natural flood protection, for example by dune areas, contributes to public safety and the protection of property. Cultural services are generated from the physical settings, locations or situations giving rise to recreational, intellectual or symbolic benefit. For example, the possibility for recreation in nature or the enjoyment of a 'green' living environment contributes to wellbeing and health.

The supply of ecosystem services

The character of supplied ecosystem services varies between ecosystem units. For example, in the Netherlands, crop production primarily takes place on agricultural land and timber is mainly produced in forest, whereas recreation by bike is a service that is provided by both ecosystem types. The supply and use of a service also depend on ecosystem condition and on economic demand. For example, an extensive forest with a high biodiversity will provide a different quantity and set of services than a monoculture production forest: timber production will be highest in the latter, and bike recreation will likely be higher in the former type of forest, as long as it can be reached by bike in a feasible amount of time by a significant number of people.

This example illustrates the interdependence of ecosystem services within one ecosystem type, as well as the influence of factors that determine use. The current supply of ecosystem services per ecosystem unit depends on the extent and condition of that unit with regard to the ecosystem service under consideration, and taking into account parameters that influence the economic use of that service. These parameters are geographically highly variable, therefore an Ecosystem Unit map was needed.

5.4 Methods

Ecosystem Unit Map and Economic Users (ISIC-registry) map

Ecosystem accounting was designed to be spatially explicit: ecosystem services and conditions are spatially modelled or mapped, or otherwise attributed to spatial units. This implies that both the physical and monetary supply tables are based on mapped ecosystem services as much as possible. An Ecosystem Unit map was developed for the Netherlands. The map is essential to model and quantify ecosystem services and to assign supplied services spatially to a set of ecosystem units. Therefore, the Ecosystem Unit map reflects a division into ecosystem units that was practical for the purpose of modelling ecosystem services. The map needs to provide full spatial coverage, implying that all built up terrain is also assigned to a set of ecosystem units. The aim was to provide a detailed map that reflects land use and vegetation properties at a high level of detail. On top of that, essential location features were mapped for two natural assets: coastal dune areas and river floodplains. For the Netherlands, both assets are of critical importance in the protection against coastal and river floods, on local, regional and national scales. Information on all ecosystem units within these regional scale features is also available at a lower legend level.

The Ecosystem Unit map was based on a strategic combination of a number of maps and datasets covering the Netherlands: the cadastral map, agricultural crops grown, address based business register, addresses of buildings, the basic topographical registry and land use statistics for the Netherlands. Maps were combined following a strict hierarchical approach. First all water was assigned. Once a unit is assigned, it can no longer be changed. Next, on land, the agricultural crops grown in 2013 were defined.

In a series of following steps, the different units for built up areas (residential areas, business areas etc.) were assigned, followed by roads and other paved surfaces. Finally, all unpaved surfaces without agricultural activities remained. These were assigned using the basic topographical registry for remaining types of land cover and a number of other delineations of policy-based locations (Natura 2000, National Ecological Network (EHS) map, delineation of riverbeds). For built up areas, the cadastral unit was taken as the base unit. However, where cadastral parcels were dissected by roads, water or railways, the smaller parcels were taken as the initial unit. The resulting map is a highly detailed polygon map that also contains fine line elements (for example gravel paths, hedgerows wider than 6m). It contains all available information on agricultural land use and detailed information on natural and semi-natural areas.

To identify the users of ecosystem services, two approaches were applied:1) conceptual selection of users, and 2) geographical allocation of users, with the help of an Economic Users map. The Economic Users map was based on the same data and delineations as the Ecosystem Units map (see Fig. 5.5.4). The legend for the economic users map was based on the ISIC registry for businesses (NL: SBI 66), which has 21 sections (A-U). In addition to these ISIC units, four non-economic land use types were distinguished to ensure full map coverage: roads, households, water and (semi) natural areas. Using this map, it is possible to identify the users of ecosystem services that are spatially explicit, such as flood protection or noise reduction.

Physical supply of ecosystem services

Remme et al. (2014) provide a detailed description of the modelling approaches used to estimate the physical supply of the selected ecosystem services. For the current study, the approach was updated by using the newly developed Ecosystem Unit map as a basis. In summary (all based on Remme et al., 2014), the provisioning of crops was modelled for the most common crop types in the base registry for crops grown (> 10 crop types for human consumption). Fodder was modelled using data on yields of two main sources of fodder: maize and pasture. Groundwater provisioning was modelled for eleven (shallow) groundwater extraction wells and surrounding protected areas, where groundwater is extracted to supply drinking water. Meat obtained by hunting was modelled for 43 hunting districts in Limburg for wild boar (*Sus scrofa*) and European roe deer (*Capreolus capreolus*).

The regulating service capture of PM_{10} reflects the filtering of particulate matter from the air (see box 1). It was modelled using published values for PM_{10} capture by different types of land cover, combined with ambient PM_{10} concentration maps. Terrestrial carbon sequestration is the storage of carbon in vegetation and soils. It was mapped using published data on carbon storage in different land cover types. The cultural service recreation by bike was modelled using the national cycle path network, a map of attractiveness of the landscape and population density. The total number of recreational biking trips (excluding race biking and mountain biking) was known from previous publications. Nature tourism was modelled using data on accommodation capacity and visiting statistics for three regions in Limburg.

Monetary supply of ecosystem services

The monetary valuation of ecosystem services was carried out by the Environmental Systems Analysis group, Wageningen University. All methods are described in detail in Remme et al. (2015). The SEEA-EEA guidelines describe a number of valuation methods, including the resource rent method, avoided damage costs, and replacement costs. Using these methods, consumer surplus ('willingness to pay') is excluded from the monetary valuations.

According to the resource rent method, ecosystem services can be calculated as the residual of the total revenue, after all costs for capital and labour have been subtracted. This method was applied to calculate the monetary value of crop production, fodder production and nature tourism. Meat from hunting was considered primarily a recreational activity. Its value was modelled using the price paid to land owners for hunting rights, which is a slightly adapted form of the resource rent method. The value of carbon sequestration and PM_{10} capture were assessed using the avoided damage costs approach. PM_{10} capture was based on avoided air pollution-related health costs. Carbon sequestration was valued using the social cost of carbon, which is an estimate for the damage costs of climate change. The value of groundwater supply was based on the replacement cost method. This calculates the costs for the cheapest available substitute, in this case the use of surface water to provide drinking water.

An experimental approach to hedonic pricing was also carried out within this project. Aim of this experiment was to test whether it was possible to detect the influence of 'green' areas on house prices (WOZ values were used as a proxy) and to gain insight into the methodology. The used dataset included house properties for all houses with gardens (WOZ value, living space, type of house and year of construction). Apartments were excluded due to data difficulties, whereas combined uses such as a doctors' practice at home or an active farm were also excluded because the value of these is likely to be influenced by factors very different from 'regular' houses. In addition, the average distances to facilities for each neighbourhood were used (for example supermarkets, schools, train stations) and to 'green' areas (public parks, forests, open natural areas) (Statistics Netherlands, 2008; 2012). First, to reduce multi-collinear effects, highly correlated variables and variables with a strongly similar signal in a principal component analysis were removed or replaced by a surrogate. Next, multiple linear regression approach was used on this subset. The method was strictly experimental, and mostly used to gain insight in the strengths and weaknesses of the hedonic pricing method.

Development of accounting tables

All tables were designed according to SEEA-EEA guidelines. Ecosystem extents for Limburg Province were calculated based on the Ecosystem Unit map. Ecosystem supply was provided for each ecosystem unit (columns) and for all ecosystem services (rows) that were included in this study. The physical and monetary quantities of services supply were based directly on the modelled ecosystem services maps. So, to determine the monetary supply of ecosystem services per ecosystem unit, for example the monetary supply of the service nature tourism, the monetary supply map for nature tourism was overlain with the Ecosystem Units map.

The Use table was constructed differently. Although a detailed economic users map (based on the ISIC registry) was developed within this project, none of the ecosystem services that were included in this study had spatially explicit economic users, as would have been the case for for example flood protection and noise reduction. Therefore, users were defined depending on the physical and monetary model characteristics, following the ISIC classification as much as possible.

5.5 Results and interpretation

Ecosystem Unit map

The Ecosystem Unit map was constructed for the Netherlands. The figures below provide examples of the many different units that are discerned and the high level of detail. Figure 5.5.2 shows a part of the map for the municipality of Roerdalen in the central part of Limburg. National Park 'de Meinweg' is located at the border with Germany and is characterized by deciduous, mixed and coniferous forest types and heathland. The city of Roermond (to the West) shows up as a mixture of all built up ecosystem unit types. It lies directly along the river Maas. The streambed of the river Maas and adjacent artificial lakes (from gravel extractions, all in light blue) and the entire floodplain (the area where flooding may occur during runoff peaks, shown in dark blue) are shown in detail. In Limburg a number of villages were built within the floodplain of the river as can also be seen in this figure. Parts of these villages are situated on naturally higher ground, whereas other parts and villages in Limburg are situated at lower elevations and were flooded in 1993 and 1995.

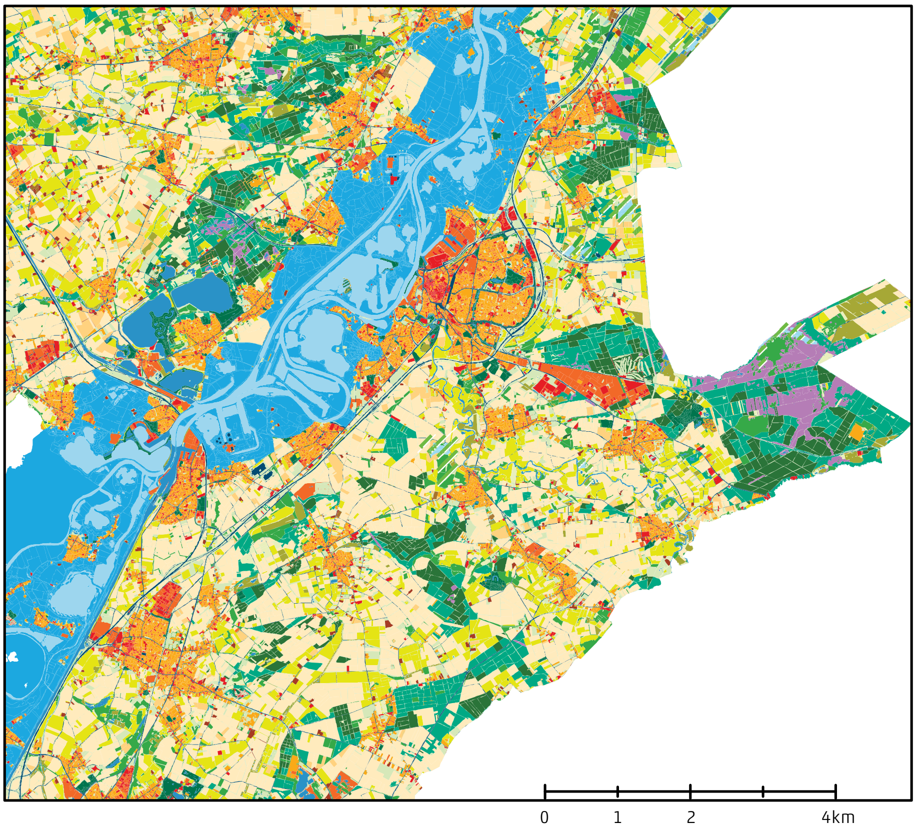
Figure 5.5.3 provides an example of the high level of detail by showing a part of the small river Roer. The Roer has several meander cut-offs (oxbow lakes) that are overgrown with deciduous trees, and small sandy islands within the streambed. Gravel roads in this rural area also show up clearly (light green lines).

5.5.1 Ecosystem Units map for Limburg

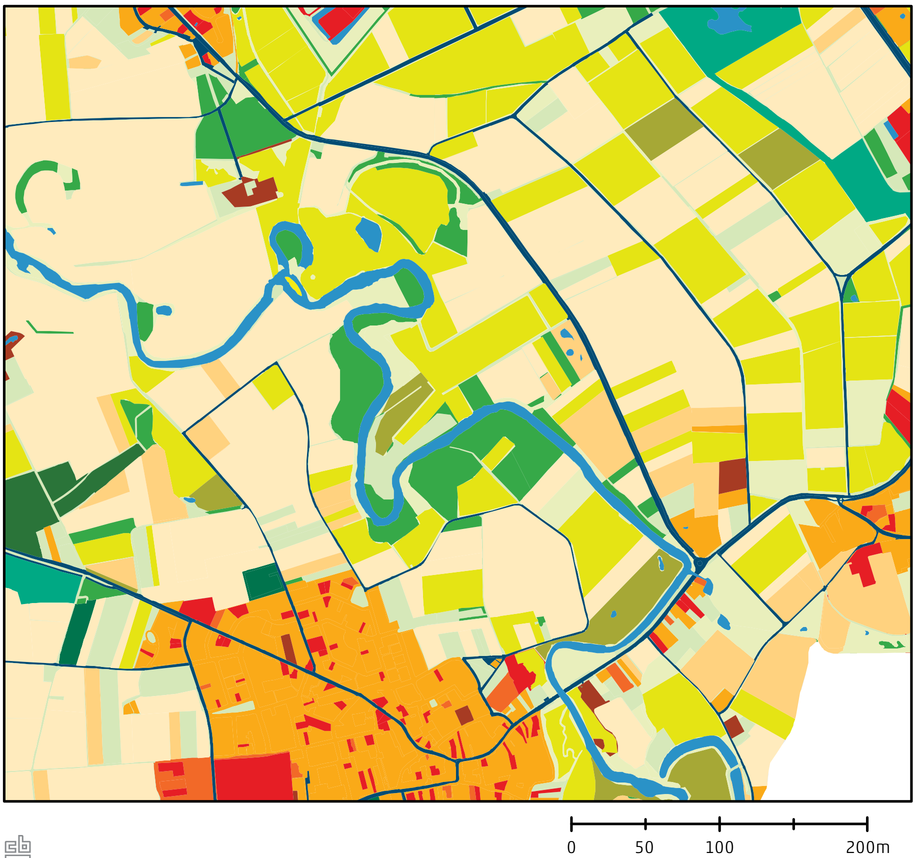
This legend corresponds with figures 5.5.1, 5.5.2 and 5.5.3.

- Non-perennial plants
- Perennial plants
- Greenhouses
- Meadows (grazing)
- Hedgerows
- Farmyards and barns
- Dunes with permanent vegetation
- Active coastal dunes
- Beach
- Deciduous forest
- Coniferous forest
- Mixed forest
- Heath land
- Inland dunes
- Fresh water wetland
- (semi) Natural grassland
- Public green space
- Other unpaved terrain
- Riverflood basin
- Salt marsh
- Residential area
- Industry: offices and businesses
- Services: offices and businesses
- Public administration: offices and businesses
- Roads, parking lots, runway, other
- Forestry: offices and businesses
- Fishery: offices and businesses
- Non-commercial services: offices and businesses
- Sea
- Lakes and ponds
- Rivers and streams
- Other

5.5.2 Ecosystem Units map, showing Roermond and Roerdalen



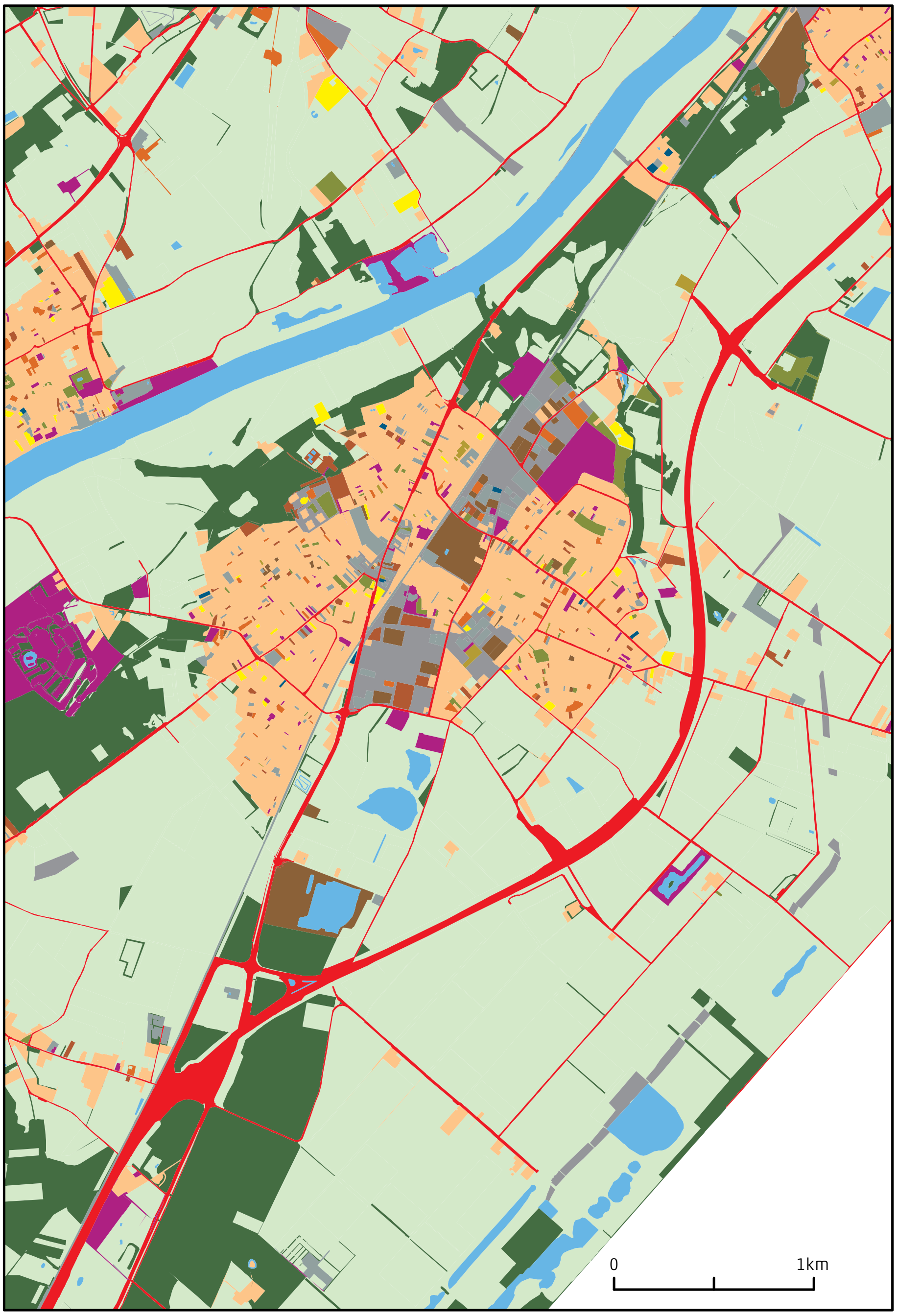
5.5.3 Ecosystem Units map, detail for the Roer south of Herkenbosch



Economic Users (ISIC) map

Figure 5.5.4 shows the Economic Users (ISIC) map for a village in central Limburg. This map is an aggregated version of the original, highly detailed map. The Economic Users map allows for the identification of economic land use by ISIC section, where relevant. For example, the industrial area in the central part of the village (dark brown, legend unit B-E) represents a clay extraction site with associated industries. Purple areas represent activities in the recreation services sector, such as a marina (central area north of the river), a campground (left, north of river), holiday homes (far left) and a football field (northwestern edge of the village).

5.5.4 Economic Users map



This legend corresponds with figure 5.5.4.

- A Agriculture, forestry and fishing
- B - E Mining, manufacturing, energy and water supply
- F Construction
- G - I Retail, transport, accomodation and food service activities
- J Information and communication
- K Financial and insurance activities
- L Real estate activities
- M - N Professional, scientific, technical, administrative and support service activities
- O - Q Public administration, education, human health and social work activities
- R - U Arts, entertainment, recreational and other service activities
- Residential
- Nature
- Water
- Roads
- Other

Physical and Monetary Supply Tables

Tables 5.5.5 and 5.5.6 show the physical supply tables for the included ecosystem services in this study, as total values per ecosystem unit and as values per ecosystem unit per hectare. The monetary supply of ecosystem services is depicted in Table 5.5.7. For recreation by bike monetary values could not be calculated yet.

Both the physical and monetary supply tables show the supply of ecosystem services per ecosystem unit. The total extent of each ecosystem unit in Limburg (total of all land parcels assigned to the same Ecosystem Unit) is also provided. This information was used to calculate the physical supply of ecosystem services per hectare in Table 5.5.6. Some interesting results can be obtained from these tables. For example, the largest amount of fodder is produced mainly on meadows used for grazing, giving a yield of 328.800 tonnes in 2013 (Table 5.5.5). This represents a monetary ecosystem contribution of over €4.8 million (experimental results, according to the resource rent approach) as shown in table 5.5.7. Carbon sequestration primarily takes place in forests, which represent 10–15 thousand tonnes of carbon per year and an experimental equivalent value of € 350.300 – 562.500, depending on the forest type.

The most valuable of the ecosystem services included in this study (according to the valuation methods applied in Remme et al (2015) and in this project) is nature tourism. This ecosystem service is provided by multiple ecosystem units. Table 5.5.6 shows the relative value of each ecosystem types for this service. Although the total number of visitors to forests nearly equals the total for non-perennial plants (94.000), the values per hectare clearly indicate the importance of forests and of hedgerows in particular. The high score for hedgerows may seem spurious. However, in South Limburg, where the supply of the ecosystem service nature tourism is relatively highest (see Remme et al., 2015), hedgerows are an important part of the attraction of the landscape. Many of them are located alongside so-called hollow roads, which are part of very old cultural landscapes. Many of these are part of, or situated in the vicinity of nature reserves.

5.5.5 Physical supply of ecosystem services – Limburg province

Ecosystem	Units	1 Non-perennial plants	2 Perennial plants	4 Meadows (for grazing)	5 Hedgerows	6 Farmyards and barns	21 Deciduous forest	22 Coniferous forest	23 Mixed forest
Ecosystem services									
Extent (ha)		53,600	8,100	27,100	2,900	2,100	11,400	7,100	10,400
Provisioning									
Crops	tonnes/yr	1,427,300	65,000	-	-	-	-	-	-
Fodder	tonnes/yr	140,800	4,700	328,700	-	-	-	-	-
Meat (from game)	kg/yr	11,500	1,500	5,900	800	400	2,500	1,700	2,900
Ground water (drinking water only)	in 1,000 m³/yr	9,000	1,400	4,200	500	100	1,900	100	500
Regulating									
Capture of PM_{10}	tonnes/yr	400	100	200	-	-	300	400	500
Carbon sequestration	tonnes C/yr	-	2,400	4,900	500	-	16,500	10,300	15,100
Cultural									
Recreation (cycling)	1,000 bike trips/yr	1,800	300	1,000	100	100	600	200	400
Nature tourism	# tourists/yr	94,000	22,000	136,800	57,000	-	160,300	93,800	147,400

5.5.6 Physical supply per hectare

Ecosystem	Units	Non-perennial plants	Perennial plants	Meadows (for grazing)	Hedgerows	Farmyards and barns	Deciduous forest	Coniferous forest	Mixed forest
Ecosystem services									
Provisioning									
Crops	tonnes/ha/yr	26.63	8.02	-	-	-	-	-	-
Fodder	tonnes/ha/yr	2.63	0.58	12.13	-	-	-	-	-
Meat (from game)	kg/ha/yr	0.21	0.19	0.22	0.28	0.19	0.22	0.24	0.28
Ground water (drinking water only)	1,000m³/ha/yr	0.17	0.17	0.15	0.17	0.05	0.17	0.01	0.05
Regulating									
Capture of PM_{10}	tonnes/ha/yr	0.01	0.01	0.01	-	-	0.03	0.06	0.05
Carbon sequestration	tonnes C/ha/yr	-	0.30	0.18	0.17	-	1.45	1.45	1.45
Cultural									
Recreation (cycling)	1,000s bike trips/ha/yr	0.03	0.04	0.04	0.03	0.05	0.05	0.03	0.04
Nature tourism	#tourists/ha/yr	1.75	2.72	5.05	19.66	-	14.06	13.21	14.17

24	25	26	27	28	29	31	41–48	52	53	
Heath land	Inland dunes	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	River flood basin	Paved surfaces	Lakes and ponds	Rivers and streams	**Totals**
2,100	100	900	3,100	4,800	22,600	14,100	42,300	3,100	3,800	220,900
-	-	-	-	-	-	-	-	-	-	1,492,400
-	-	-	-	-	-	66,900	-	-	-	541,100
600	-	200	800	900	4,700	2,400	-	-	-	36,800
100	-	-	700	400	2,400	1,300	3,800	500	-	27,000
-	-	-	-	100	200	100	-	-	-	2,300
400	-	200	600	1,200	4,100	2,800	-	-	-	59,000
-	-	-	100	200	1,300	600	2,100	100	-	9,100
22,700	1,000	11,600	55,400	11,800	65,900	94,500	-	100	-	974,300

Heath land	Inland dunes	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	River flood basin	Paved surfaces	Lakes and ponds	Rivers and streams
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	4.74	-	-	-
0.29	-	0.22	0.26	0.19	0.21	0.17	-	-	-
0.05	-	-	0.23	0.08	0.11	0.09	0.09	0.16	-
-	-	-	-	0.02	0.01	0.01	-	-	-
0.19	-	0.22	0.19	0.25	0.18	0.20	-	-	-
-	-	-0	0.03	0.04	0.06	0.04	0.05	0.03	-
10.81	10.00	12.89	17.87	2.46	2.92	6.70	-	0.03	-

5.5.7 Monetary supply

		1	2	4	5	6	21	22	23
		Non-perennial plants	Perennial plants	Meadows (for grazing)	Hedgerows	Farmyards and barns	Deciduous forest	Coniferous forest	Mixed forest
LIMBURG									
Extent	ha	53,629	8,133	27,066	2,940	2,142	11,414	7,091	10,437
Provisioning									
Crops	€	35,303,100	2,605,287	-	-	-	-	-	-
Fodder	€	1,960,900	66,000	4,587,100	-	-	-	-	-
Meat (from game)	€	817,700	112,900	223,400	-	9,600	186,800	192,700	261,100
Ground water	€	3,861,200	607,200	1,802,300	193,900	61,800	824,200	63,500	218,700
Regulating									
Capture of PM_{10}	€	301,200	54,300	173,700	30,400	11,700	200,200	185,700	200,700
Carbon sequestration	€	300	80,200	165,700	18,000	100	562,500	350,300	515,000
Cultural									
Nature tourism	€	4,410,000	1,042,600	6,349,100	2,357,700	-	6,930,100	3,162,500	5,443,100
Recreation (cycling)	€	NA							
Totals	**€**	**46,654,400**	**4,568,500**	**13,301,400**	**2,600,000**	**83,200**	**8,703,800**	**3,954,700**	**6,638,800**
Value per ha (excl. Amenity service)	**€/ha**	**870**	**562**	**491**	**884**	**39**	**763**	**558**	**636**
Value per ha (incl. Amenity service)*	**€/ha**	**870**	**562**	**491**	**884**	**39**	**1,193**	**988**	**1,066**

5.5.8 Monetary use of ecosystem services - Limburg province

		Economic Users (ISIC Sections)				
	Ecosystem Units	A	B–D	E	F–H	I,R
Ecosystem services						
Provisioning						
Crops	tonnes/yr	37,908,400				
Fodder	tonnes/yr	7,556,200				
Meat (from game)	kg/yr					
Ground water (drinking water only)	in 1,000 m^3/yr			11,602,800		
Regulating						
Capture of PM_{10}	tonnes/yr					
Carbon sequestration	tonnes C/yr					
Cultural						
Recreation (cycling)	1,000 bike trips/yr					
Nature tourism	# tourists/yr					41,816,200

	24	25	26	27	28	29	31	41–48	52	53	
	Heath land	Inland dunes	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	River flood basin	Paved areas	Lakes and ponds	Rivers and streams	**Totals**
	2,149	114	936	3,121	4,761	22,591	14,126	42,349	3,122	3,807	**220,922**
	-	-	-	-	-	-	-	-	-	-	**37,908,400**
	-	-	-	-	-	-	942,300	-	-	-	**7,556,200**
	35,600	2,000	12,700	32,900	14,700	211,200	136,000	-	-	-	**2,249,400**
	57,300	300	11,200	295,700	192,600	1,041,100	545,700	1,620,500	200,800	4,800	**11,602,800**
	27,200	2,200	2,400	46,700	78,100	258,200	85,900	574,500	27,300	15,400	**2,275,900**
	13,200	-	6,400	19,300	40,500	139,000	95,600	-	-	-	**2,006,100**
	917,000	41,600	392,800	2,488,900	625,900	2,870,600	3,162,100	-	719,600	902,400	**41,816,200**
											NA
	1,050,400	**46,100**	**425,400**	**2,883,500**	**951,700**	**4,520,200**	**4,967,500**	**2,195,000**	**947,700**	**922,600**	**105,415,000**
	489	**403**	**454**	**924**	**200**	**200**	**352**	**52**	**304**	**242**	**477**
	489	**403**	**454**	**924**	**688**	**220**	**352**	**52**	**768**	**242**	**553**

	Rest	Exports	Household cons	Government cons.	Investments	Inventories	Env (global goods)
			2,249,400				
			2,275,900				
							2,006,100
			na				

Monetary Use Table

Table 5.5.8 shows the monetary use table.[1] Following standard SNA accounting rules, total supply must equal total use, hence total sums are the same. The tables shows who benefits from the different ecosystem services that are provided in Limburg.

Logically, the ecosystem contribution to the production of crops and fodder is used by the agricultural section (A). The users of the service provisioning of meat (from hunting game) are defined as households; hunting in the Netherlands is primarily a recreational activity and the monetary value of this service was calculated as such (based on hunting rights paid, not on the market price of meat). The use of fine dust air filtration (PM_{10}) was also tentatively assigned to households. Although for example governments, companies and health insurers also benefit indirectly from this service, for the moment households were assigned as the primary user. More research is needed to determine whether this is the best solution. The provisioning of ground water for drinking water purposes was assigned entirely to water companies (section E). The reason for this is that in the model, only water extraction for drinking water was included, whereas groundwater extraction for for example irrigation was disregarded in the current model. For the moment, carbon sequestration was attributed to Global Goods, because in essence carbon sequestration (like carbon emissions) has a global impact rather than a national or regional one. This attribution may change depending on the further development of the guidelines for ecosystem accounting. Finally, the benefits of the ecosystem contribution to nature tourism were attributed to those economic activities that provide tourist accommodation; hotels, holiday houses and campgrounds (ISIC sections I and R).

5.6 Discussion and further recommendations

This pilot project has explored the possibilities of ecosystem accounting for a selected set of ecosystem services in Limburg Province. The study illustrates the strong potential of the data that are made available with the ecosystem accounting approach, following the SEEA – EEA guidelines. However, the study also illustrates that a lot of work remains to be done; for Limburg several economically and socially important ecosystem services were not yet included in the current pilot project. In addition, the monetary accounts are strictly experimental. As mentioned previously, the monetary values in part depend on the chosen methodology. Further research is needed to gain experience with monetary valuation, so that 'best practice' advice can be shared with the international community.

Finally, it is important to keep in mind that monetary values are partly calculated for goods and services that do not have a market price. The omission of consumer surplus implies that values for such services may seem low. It should be kept in mind that the main strength and aim of ecosystem accounting is to provide an internationally consistent framework to track changes in ecosystem condition and the supply and use

[1] The physical use table was also compiled but is not shown here.

of services over time. Such developments can be compared with economic data from the national accounts, between regions and between countries and over time.

Once completed for the Netherlands and for a broad set of ecosystem services, the supply accounts provide information on the amount and location of supplied ecosystem services. This gives insight in the wide range of services that are offered primarily by natural and semi-natural vegetation. This information is vital to monitor the progress towards the goals set by the Dutch Government: to achieve a sustainable use of ecosystem services and prevent further loss of biodiversity (Min. Economic Affairs, 2013, 2013; Min. Economic Affairs et al., 2015). Moreover, ecosystem accounting provides a clear overview of the many services (other than intrinsic values) that are provided by ecosystems in the Netherlands. Defining and quantifying these services and the factors that support or undermine them (condition indicators) is needed to highlight the importance of all types of ecosystems in the Netherlands. Protection of the natural environment is highly important not just because of its (potentially incalculable) intrinsic value, but also because of the services that provide clear economic benefits to businesses, governments and households.

To explore the full potential of ecosystem accounting, it is necessary to set up physical and monetary supply (and use) accounts at regular temporal intervals, based on detailed Ecosystem Unit maps (also updated at the same temporal interval). The condition account is essential to interpret spatial and temporal changes in the supply tables. In addition to these accounts, the SEEA-EEA guidelines propose the development of a number of additional accounts (described briefly section 5.2), which would provide information on the sustainability of ecosystem services supply and the monetary balance of ecosystems. Ideally, such accounts would be developed at the national and provincial scale, whereas ecosystem service supply maps and condition indicators should provide meaningful information on smaller scales as well.

6.

Measuring energy efficiency in services and economic opportunities from energy saving activities

Efficient use of energy has been gaining attention from policymakers because energy consumption of fossil fuels is a major factor in global warming. Another concern is the dependency on fossil fuels, as fossil fuel sources are being depleted and they are extracted in only a few countries. Measuring energy saving requires the development of robust indicators. This chapter describes the development of energy efficiency indicators through microdata for the services sector, as well as indicators to measure the economic opportunities created by energy saving activities.

6.1 Introduction

A range of policies and programmes stimulate energy efficiency and energy saving behaviour, such as the energy investment allowance (EIA), national and local subsidy schemes and tax reductions. One such policy is 'the European Commission Directive on energy end-use efficiency and energy services (ESD)'. This policy requires member states to establish action plans to save energy by increasing energy efficiency. The first action plan covered the period 2008 – 2016. A target was set to reduce energy end use by 2 percent in 2010 and 9 percent by 2016, compared to the average energy consumption between 2001 and 2005. These targets were again included in the second national action plan.

Measures include requirements for energy performance in new buildings (as of 2015) and Ecodesign guidelines for lighting and economical pumps. The use of high frequency lighting has been compulsory in new buildings since 2012 and will be compulsory in existing buildings from 2017 onwards. All government buildings larger than 500 m^2 accessible to the public have been provided with a visible energy label since 2013. As of 2015 the label is mandatory in all buildings larger than 250 m^2. For new buildings, the Government Buildings Agency remains one phase ahead in tightening the energy performance coefficient (EPC) to achieve zero energy buildings. This will start by the end of 2018.[1)]

Monitoring the progress in energy saving requires efficiency indicators. This article describes two types of indicators. The first one delineates the possibilities and limitations of energy efficiency for the services sector. In this pilot project a methodology was developed to establish the indicator energy consumption per m^2 floor area for different building types. The second one describes the economic opportunities created by energy saving activities. The latter is part of the Sustainable Energy Sector, which is described in more detail in the National Energy Outlook 2015 (ECN et al., 2015b).

1) Second National Energy Action Plan Netherlands (2011).

6.2 Methodology

Methodology of energy efficiency indicators

The objective of the study on the first set of indicators is to present the possibilities and limitations of energy efficiency indicators for the services sector in line with the International Energy Agency (IEA) Handbook, built on data from the client registers.

The IEA describes various indicators which can be established to monitor energy efficiency. In this article we present the following energy efficiency indicators, ascending in level of detail:

Indicator A: Share of the services sector in final energy consumption of all companies;
Indicator B: Share of economic sectors in final energy consumption of total services;
Indicator C: Energy consumption per gross value added (GVA) for each sector;
Indicator D: Energy consumption per unit of activity[2)] for each (sub)sector;
Indicator E: Energy consumption per m^2 floor area for different building types, building sizes, and construction period.

The indicators A-C could be established with existing data. The main focus of the pilot study therefore was the development of indicator E. With the methodology to develop indicator E established, indicator D can be developed for some subsectors depending on data availability of activities at the micro level.[3)]

Statistics Netherlands receives annual microdata from the energy network companies on all gas and electricity deliveries from public gas and electricity networks: the client registers. In order to derive gas and electricity consumption by sector, the client registers are matched with several registers on buildings and companies. Data on the consumption of gas and electricity by sector have been published on StatLine[4)] since 2010.

Consistency of data 2010-2013

From 2012 onwards, the client registers have been matched to the national buildings register (BAG). This is a comprehensive register with the addresses of all dwellings and companies. BAG has been available from 2012 onwards and allows a more precise determination of building types than the registers available in previous years. This change in data sources has had a significant impact on the assignment of gas and electricity deliveries to economic sectors.

Furthermore, in the last two years some other methodological refinements have been made in the procedures for the assignment of economic sectors. The impact on these changes are most significant for the sectors O (Public administration), J (Information and

2) For example, measured in terms of number of students (education), number of occupied beds (hospitals) or full-time employment (retail and offices).
3) Data on *activities* (primary education, hospitals etc.) at the micro level are needed as data on total energy consumption by activity are not available from the client registers (due to incomplete coupling of registers). Though the total energy consumption by activity cannot be derived from the client registers, there is a lot of data available at the micro level on energy consumption by activity. This allows us to make reliable estimation of average energy consumption by activity for some activities, depending on data availability on activities at the micro level.
4) StatLine is the electronic databank of Statistics Netherlands. See table electricity and gas deliveries for different economic sectors.

Communication) and L (Renting, buying, selling real estate) and to a lesser extent for the sectors P (Education), Q (Health), I (Accommodation and food services), R (Culture and Recreation) and S (Other services).

Data on energy consumption by economic sector from 2012 onwards are therefore not directly comparable to data before 2012.

Temperature correction for gas

Gas is mainly used to heat buildings in the services sector and is therefore affected by annual temperature variations. To be able to compare trends in gas consumption across years independent of temperature changes, the IEA Handbook gives the advice to correct gas consumption used for space heating for annual temperature variations with the heating degree days method. Hence, data on gas deliveries have been corrected for annual temperature variations with the advised method by IEA. However the temperature correction with the heating days method is rather crude and some effects of annual temperature variations on gas consumption are still evident in the results.

Development of Indicator E

For the residential sector,[5)] energy consumption has been linked at the micro level to addresses of residential buildings, allowing analysis of energy consumption by building type, size and construction period. For the services sector, energy consumption statistics were only available by economic sector. The pilot study took the statistics on energy consumption in the services sector one step further by assigning gas and electricity consumption of services to buildings, allowing the analysis of gas and electricity consumption per m^2 floor area by economic (sub)sector and by building type, size and construction period.

Matching data of gas and electricity deliveries in the services sector to buildings and subsequent floor areas is complicated. Companies often do not occupy just a single address and they often have more than one gas and/or electricity connection. The term ‘building complex’ has therefore been introduced to define one or more than one unique address occupied by a single company served by one or more than one gas and electricity connection. Examples of building complexes are described below:

- A company occupying a single building consisting of one unique address (for example a grocery store). This is the simplest case for which linking the energy consumption to floor area is rather straightforward.
- A company occupying a whole building consisting of multiple addresses (for example an apartment hotel). In such cases matching the energy consumption to floor area depends on the identification of which addresses belong together. Such information is available for most buildings.
- A company occupying only part of a building (for example a single shop in a shopping mall). In such cases other companies may occupy other parts of the building, complicating identification of the floor area occupied by the company and the gas and electricity connections belonging to it.

5) Living quarters for private households

– A company occupying several buildings that belong together (for example a university or a hospital). In such a case matching the energy consumption to floor area depends on the identification of which buildings belong together. This information is not always available.

In the pilot study a methodology has been developed to assign gas and electricity deliveries to 'building complexes'. Due to the complications discussed above, sometimes only a part of a building complex can be identified. In such cases the energy efficiency indicator is overestimated. In other cases none or not all energy connections belonging to a building complex can be defined. In those cases the energy efficiency indicator is underestimated. To exclude such cases in the analysis we developed a set of validation rules and plausibility checks at the micro level.

The methodology developed in the pilot study has been applied to data of the client registers matched to building registers of the year 2013. Building complexes were identified, including the energy connections belonging to the building complex. These connections have unique identification numbers. Data on gas and electricity deliveries of other years can be matched on the basis of these energy connection identification numbers. In the pilot study we developed a methodology to determine whether the building complex was still occupied by the same economic activity in different years, taking into account the effect of methodological improvements on assigning economic activities. Indicator E is only calculated for building complexes with the same economic activity across the years and with validated gas and electricity rates per m^2 across all years. Contrary to indicators B-D, the methodological improvements discussed earlier have only a limited effect on the consistency of trends between 2010–2013 for indicator E.

However, the results are only representative for building complexes in the services sector throughout 2010–2013. The indicator does not take the effects of new buildings constructed after 2010 into account nor the effects of demolitions before 2014. The indicator is also not representative for companies housed in buildings with energy connections that are shared by different companies. One example is an office building that houses several companies with different economic activities. These companies rent the office space from a real estate company which manages the building infrastructure including energy. In such cases it is impossible to determine the share of gas and electricity consumed by the different companies.

In general the quality of the indicator is considered high for simple building complexes, i.e. building complexes occupied by one company consisting of a single address (for example primary schools and shops). The quality of the indicator decreases for building complexes that are part of a larger building (offices) and building complexes consisting of several distinct buildings (for example universities and hospitals).

Building types (for example primary schools, secondary schools, supermarkets, shops, etc.) have been developed together with energy institutes in the Netherlands (ECN and EIB). The building types are often an aggregation of more detailed classes in the economic activities classification (SIC 2008). The indicators (average temperature corrected gas consumption in m^3 per m^2 floor area and average electricity consumption in kWh per m^2 floor area) are therefore available at a more detailed level than economic sectors. For instance for sector P (SIC 2008), the indicator is estimated for the building types primary education, secondary education and tertiary education. Like for indicator D, it is impossible to estimate the total energy consumption at disaggregated level.[6)]

Methodology of the economic indicators for companies and institutions dealing with energy saving

The supply of goods and services related to energy saving is part of the 16 activities of the environmental goods and services sector (EGSS). Hence, the economic indicators 'employment' and 'gross valued added' of energy saving activities are based on the SNA and SEEA definitions and comprise both goods and services sector. Moreover, they only include energy efficiency measures taken in addition to 'common practice'. For example, insulation activities in new building are the rule rather than the exception and can therefore not be seen as a characteristic activity of the environmental goods and services sector.
The economic indicators of energy saving activities are based on a micro- database of companies (active in the field of assemblage/construction, installation, consultancy, research and development) and the output value of insulation activities. The results are part of the sustainable energy sector and they are published in the National Energy Outlook (Schoots and Hammingh, 2015). We refer to this publication and the Economic Radar of the Sustainable Energy Sector (Statistics Netherlands, 2014b) for more information on the methodology and output of the economic indicators of the Sustainable Energy Sector.
For the purpose of the NEV, Statistics Netherlands also assigned employment and value added of electric transport and smart grids to the energy saving activities. In this article, the same definition is used in order to retain consistency with the NEV publication.

6.3 Results of energy efficiency indicators

Indicator A: Share of the services sector in the final energy consumption of all companies

The share of gas consumption by the services sector in the total final gas consumption of all companies excluding sector D, decreased from 23 percent in 2010 to 22 percent in 2013. The share of electricity consumption decreased from 48 percent in 2010 to 47 percent in 2013.
Energy efficiency could be defined as producing the same amount by using less energy. The indicator on its own therefore does not provide information on trends in energy efficiency. For example, energy reductions because companies cease to exist or produce

[6)] Due to incomplete coupling of registers it is not possible to identify total energy consumption and floor area at the disaggregated economic sector level. There is however a lot of data available at the micro level on energy consumption and floor area by economic sector at the disaggregated level. This allows reliable estimation of average energy consumption by m^2 floor area by economic sector at the disaggregated level for some economic sectors.

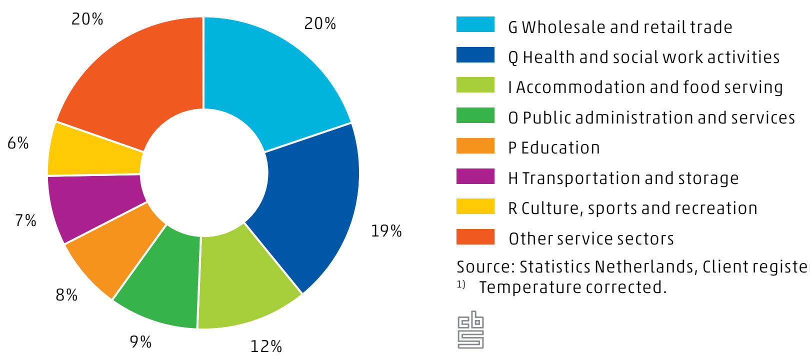
less, do not signify an increase in energy efficiency. Indicator C 'energy consumption per 1,000 euros gross value added' is a much better measure for interpreting whether or not the decrease in the share of services in total energy consumption is a relative increase in energy efficiency in the services sector compared to other sectors (see discussion below).

Indicator B: Share of economic sectors in the final energy consumption of total services

Sector G (Wholesale and retail trade) is the largest consumer of gas and electricity in the services sector, accounting for 20 percent of its total gas consumption (see Figure 6.3.1) and 25 percent of its total electricity consumption (see Figure 5.3.2). Sector Q (Health), with a 19 percent share, is the second largest consumer of gas and the fourth largest consumer of electricity within services. Sector H (Transportation and storage) with a share of 13 percent is the second largest consumer of electricity but only the sixth largest consumer of gas within services.

Sector Q saw the largest share increase in gas consumption between 2010 and 2013 (+2 percent) and sector G the largest decrease (-2 percent). The share of electricity consumption increased most in sector O (+1 percent) and decreased most in sector L (-1 percent).[7)] Like the previous indicator, the indicator on its own does not measure improvements in energy efficiency. Energy efficiency of economic sectors within services can be measured better by indicators D and E.

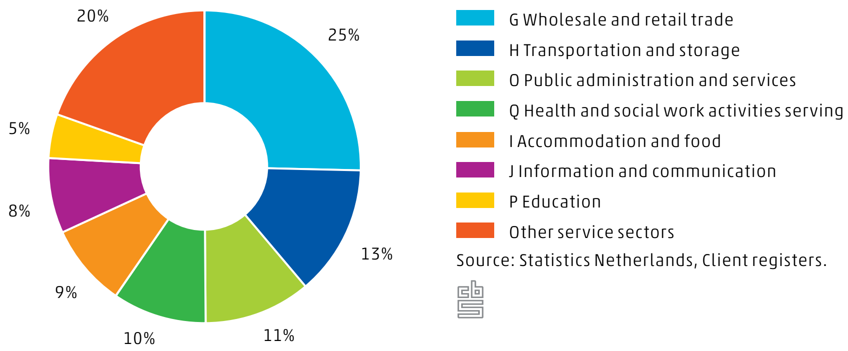
6.3.1 Share of economic sectors in gas consumption of total services[1)], 2013



Source: Statistics Netherlands, Client registers.
1) Temperature corrected.

7) This indicator is affected by the methodological improvements made between 2010 and 2013, see the section on methodology (chapter 5.2). Results should therefore be interpreted with care.

6.3.2 Share of economic sectors in the electricity consumption of total services, 2013



Source: Statistics Netherlands, Client registers.

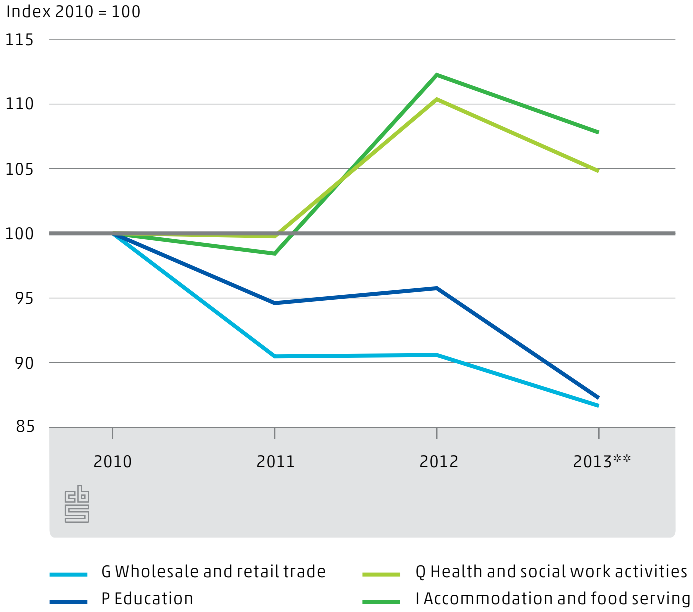
Indicator C: Energy consumption per unit of gross value added (GVA)

It is difficult to compare energy efficiency related to production across different economic sectors. Therefore, energy efficiency is often measured in terms of gross value added (GVA) as a proxy indicator of production. GVA is output minus the value of intermediate consumption expressed in euros.

The data show that gas consumption in the services sector decreased from 11 m^3 per 1,000 euros GVA (at 2010 constant prices) in 2010 to 10 m^3 in 2013, while it increased from 121 to 126 m^3 per 1,000 euros GVA (at 2010 constant prices) for the other economic sectors (excluding sector D). Electricity consumption in the services sector decreased from 84 to 81 Kwh per 1,000 euros GVA (at 2010 constant prices) and increased from 293 to 304 Kwh per 1,000 euros GVA (at 2010 constant prices) in the other economic sectors. This suggests an efficiency increase in services compared to the other economic sectors.[8)] Figure 6.3.3 shows trends in gas efficiency. It is measured as the amount of temperature corrected gas consumption in m^3 per 1,000 euros GVA with 2010 constant prices for selected economic sectors within services (2010 = 100). Figure 6.3.4 shows the trend in electricity efficiency measured as the amount of electricity consumption in kWh per 1,000 euros GVA for these sectors. Due to methodological improvements the data of 2010–2011 are not fully comparable with the data of 2012–2013. Looking only at the trend between 2012 and 2013, the data suggest an improvement in gas efficiency for these sectors since gas consumption per GVA decreased by 4 percent for sectors G and I (Accommodation and food serving), in sector Q it was by 6 percent and in sector P by 8 percent. Electricity efficiency deteriorated as consumption per GVA increased in sectors G, I and Q by 2 percent and remained stable in sector P.
The relative large fluctuations in gas consumption per GVA are partly caused by the effect of annual temperature variations, which are not completely removed by the applied correction for temperature variations (see 6.2).

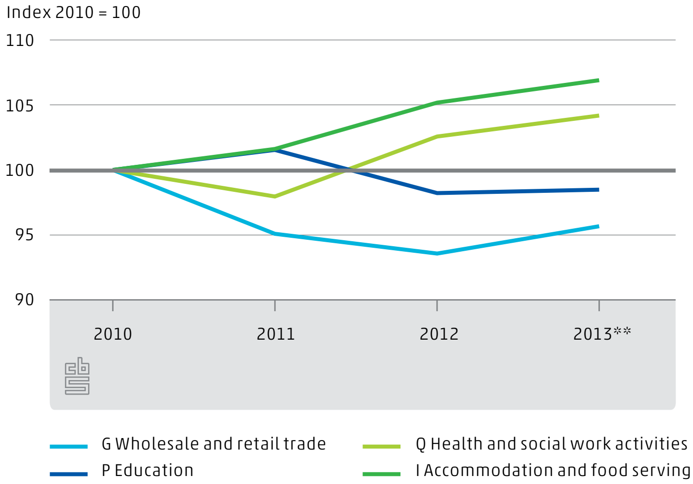
[8)] This indicator is affected by the methodological improvements made between 2010 and 2013, see the section on methodology (chapter 5.2).

6.3.3 Development of gas efficiency between 2010 and 2013[1)]



Source: Statistics Netherlands, Client registers, National Accounts.
[1)] Electricity efficiency is measured as Kwh electricity consumption per 1,000 euros GVA at 2010 constant prices.

6.3.4 Development of electricity efficiency between 2010 and 2013[1)]



Source: Statistics Netherlands, Client registers, National Accounts.
[1)] Electricity efficiency is measured as Kwh electricity consumption per 1,000 euros GVA at 2010 constant prices.

As noted in the IEA Handbook, the definition of boundaries for gross value added in the services sector must match the corresponding energy consumption data. Data on GVA are derived from the national accounts. The classification into economic sectors in the client registers is based on several sources. Therefore it is not entirely coherent with the classification of economic activities in national accounts. Trends on energy efficiency between 2010 and 2013 are also affected by the methodological improvements discussed in the Methodology section. Results should therefore be interpreted with care.

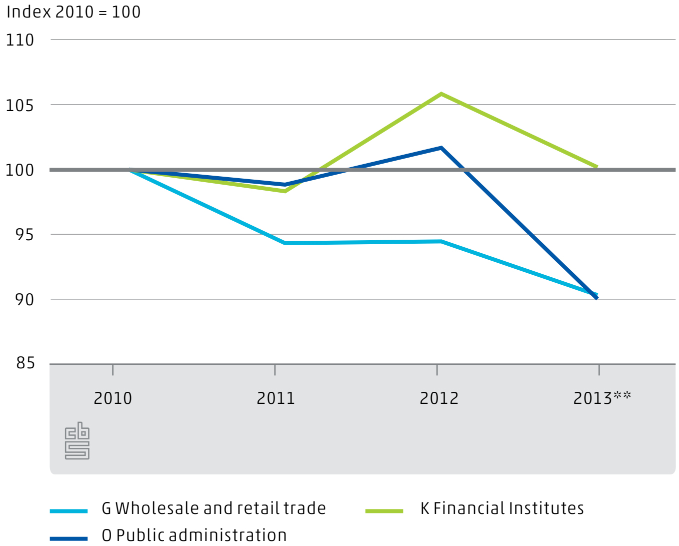
Indicator D: Energy consumption per unit of activity

Indicator C is perhaps difficult to interpret. The IEA Handbook therefore discusses an alternative indicator for the services sector: energy consumption per activity. This indicator is not very adequate when established at a highly aggregated level (economic sector), as the activities differ per economic sector and even within economic sectors. The IEA recommendation is to develop these indicators for meaningful activities at disaggregated levels. Examples given are the number of pupils in primary education, the number of occupied beds in hospitals and the number of employees in retail establishments and offices.

The trend for temperature corrected gas efficiency is shown in Figure 6.3.5. Figure 6.3.6. illustrates the trend for electricity efficiency per full-time equivalent (FTE) for the economic sectors O, K and G. The economic sectors O (public administration) and K (financial institutions) are typical office sectors. Here too the data of 2010–2011 are not fully comparable with the data of 2012–2013 due to the methodological improvements. Looking only at the trend between 2012 and 2013, the data suggest an improvement in gas efficiency, but a slight deterioration in electricity efficiency for these sectors. Between 2012 and 2013 temperature corrected gas consumption in m^3 per FTE decreased by 4 percent in sector G (similar to the trend of indicator C), 6 percent in sector K and 12 percent in Sector O. These rather large fluctuations are influenced by the correction for temperature variation. Without correction, gas consumption in m^3/FTE between 2012 and 2013 would have increased by 2 percent for sector G, 1 percent for sector K and decreased by 5 percent for sector O. Trends in gas efficiency must be interpreted over longer periods to reduce the effect of annual temperature variations on the results. The electricity consumption in Kwh per FTE employee increased by 2 percent in sector G (similar to indicator C), 2 percent in sector K and 0 percent in sector O.

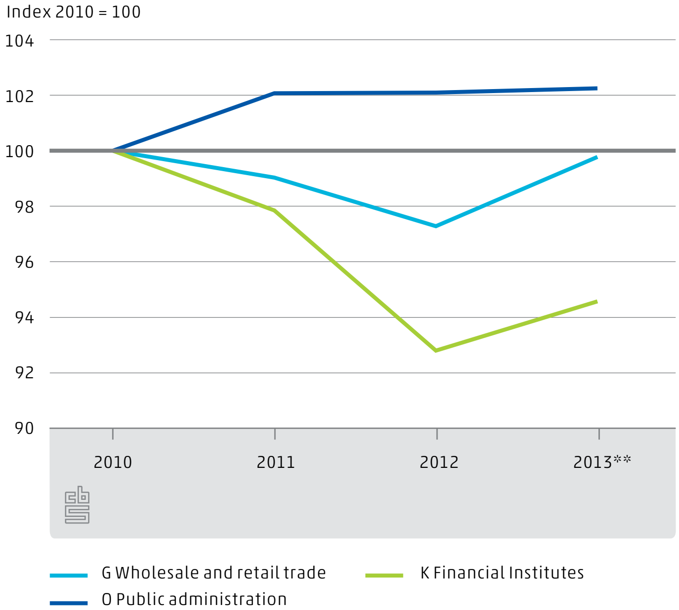
For other sectors the data are more meaningful at a lower level. The methodology developed for indicator E links energy deliveries to building complexes occupied by one company for different building types. In most cases building types follow the classification of SIC 2008 at a disaggregated level. It may be possible to define meaningful activities at this disaggregated level. At the level of building types, the total energy consumption is unknown (see footnote 3). Indicator D can however still be established at this level by linking data on activities (FTE, students, hospital beds etc.) to building complexes at the micro level. In that way trends in the average energy consumption per activity can be monitored for different economic activity classes (building types). To do so, data on activities would be needed at micro level (see chapter 6.2).

6.3.5 Development of gas efficiency between 2010 and 2013[1)]



Source: Statistics Netherlands, Client registers, National Accounts.
[1)] Gas efficiency is measured as temperature corrected gas consumption in m³ per fte.

6.3.6 Development of electricity efficiency between 2010 and 2013[1)]



Source: Statistics Netherlands, Client registers, National Accounts.
[1)] Electricity efficiency is measured as electricity consumption in kWh per fte.

Indicator E: Energy consumption per floor area for building types, building size and construction period

The pilot study focused on developing indicator E (energy efficiency in relation to building characteristics). This is considered the most appropriate indicator for measuring gas efficiency in the services sector, as gas is often used to heat buildings. Policy measures to reduce gas consumption are therefore directed at building characteristics (for example insulation of walls). Building regulations affecting energy use were introduced as early as 1920 and were updated in 1975, 1988, 1992 and 2015. Gas consumption in m^3 per m^2 floor area is expected to decrease with increasing floor size (due to economies of scale) and decreasing age of the building (due to stricter insulation regulations etc.).

This indicator may not be adequate for monitoring electricity efficiency in the services sector, as electricity consumption is only partly related to buildings (lighting, cooling etc.) and a significant part of electricity consumption is determined by the use of electronic devices. For instance, savings on electricity by applying energy saving measures for lighting and cooling may be offset by an increasing use of electronic devices. The indicator would be more effective if the end use of electricity (lighting, space cooling, electronic devices etc.) could be determined. However, the available data from the client registers cannot specify that. To monitor electricity efficiency in services with the currently available data, our recommendation is to develop indicator D for specified building types and to monitor electricity efficiency by using both indicators D and E.

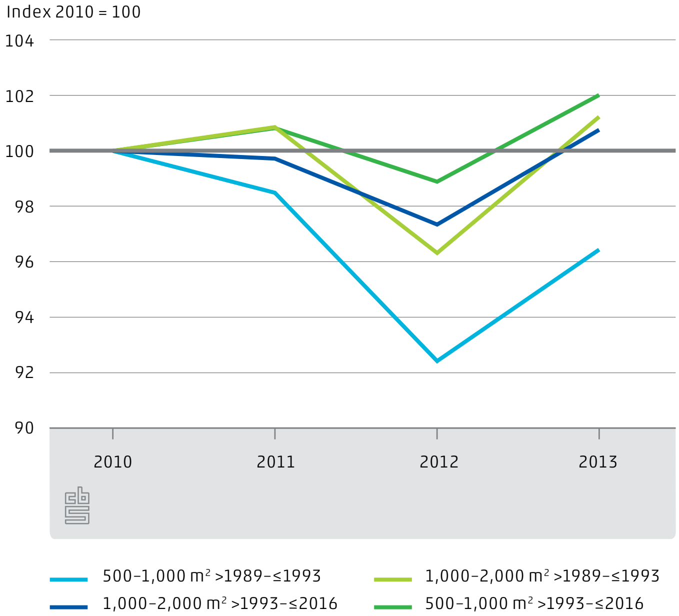
The pilot study showed that matching the client registers with building registers provides a wealth of data at the micro level. Hence, indicator E can be established per sector, per building type, per m^2 floor area and per construction period. In this paragraph we only show the results for primary schools to illustrate what can be obtained from indicator E. Results of other building types will soon be available on StatLine.
Figure 6.3.7 shows as expected that the average gas consumption (corrected for annual temperature variations) per m^2 floor area declines with increasing building sizes for primary schools. In general, the average gas consumption per m^2 floor area also declines with the decreasing age of the building.

6.3.7 Gas efficiency in primary schools in 2013, by building size and construction period[1)]

Source: Statistics Netherlands, Client registers.
1) Temperature corrected.

Figure 6.3.8 shows the trend in gas efficiency between 2010 and 2013, (2010 = 100) for primary schools of a certain size class and construction period. The methodological improvements have had little impact on the trends noted for this indicator. The temperature corrected gas consumption per m^2 floor area has fluctuated between 2010 and 2013. Even with the correction for temperature, temperature variations affect the indicator. To minimise their effects on the estimation of trends in gas efficiency, the recommendation is to monitor trends over much longer periods of time (for example 5–10 years).

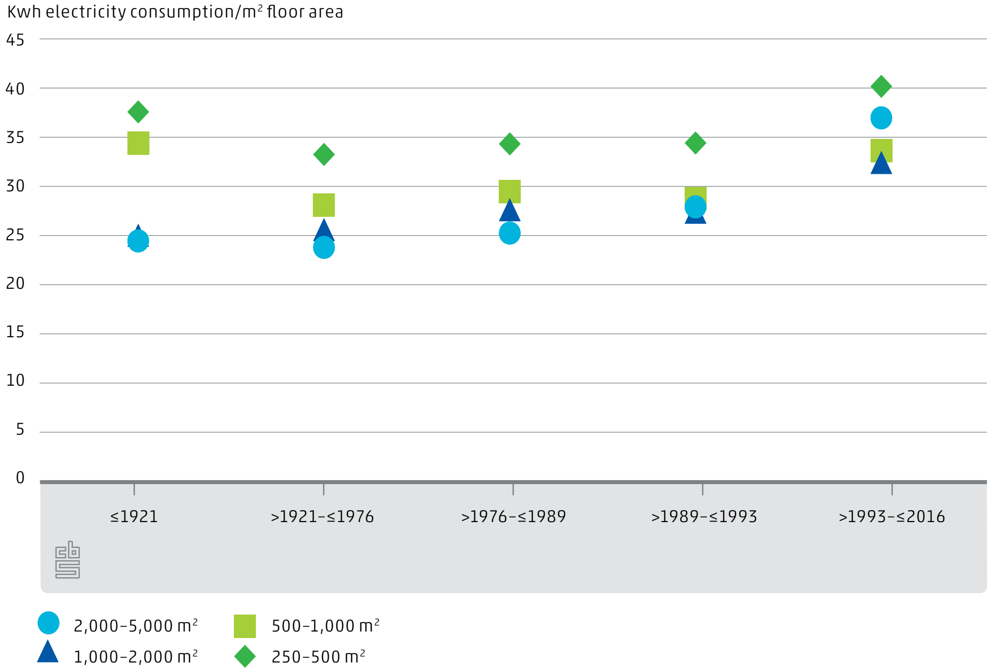
6.3.8 Development of gas efficiency in primary schools, by building size and construction period[1)]



Source: Statistics Netherlands, Client registers.
[1)] Temperature corrected.

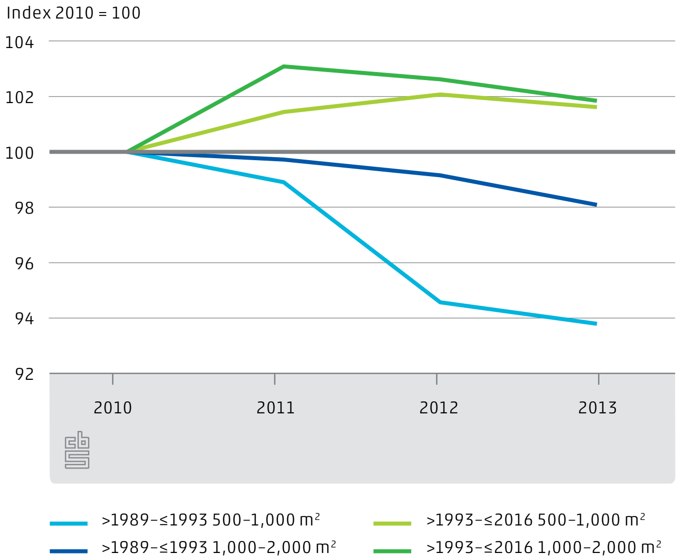
The general trend is that the average electricity consumption per m^2 floor area decreases as the size of primary school buildings increases (see Figure 6.3.9). Electricity consumption is higher per m^2 floor area in more recently constructed buildings than in older buildings. As explained earlier, the relationship between building characteristics and electricity consumption is not as strong as for gas since a significant part of electricity consumption in services is related to non-building uses such as electronic devices. Measures to improve energy efficiency based on building characteristics may therefore be offset by increases in non-building related electricity use. The integration of new electronic education tools may also vary among schools. New school buildings may have better integrated electronic education tools than older school buildings or make use of heat pumps and air-conditioning systems. To analyse such effects, data are required on the end use of electricity or on the use of electronic devices at the micro level.
The development of electricity efficiency in primary education is diffuse. It improved between 2010 and 2013 for buildings constructed between 1989 and 1993, but deteriorated in buildings constructed after 1993 (See Figure 6.3.10). Again, efficiency improvements made in building-related electricity consumption may be offset by increasing use of non-building-related electricity consumption. To analyse such effects data are required on the use of electronic devices at the micro level.

6.3.9 Electricity efficiency in primary schools in 2013, by building size and construction period



Source: Statistics Netherlands, Client registers.

6.3.10 Development of electricity efficiency in primary schools, by building size and construction period



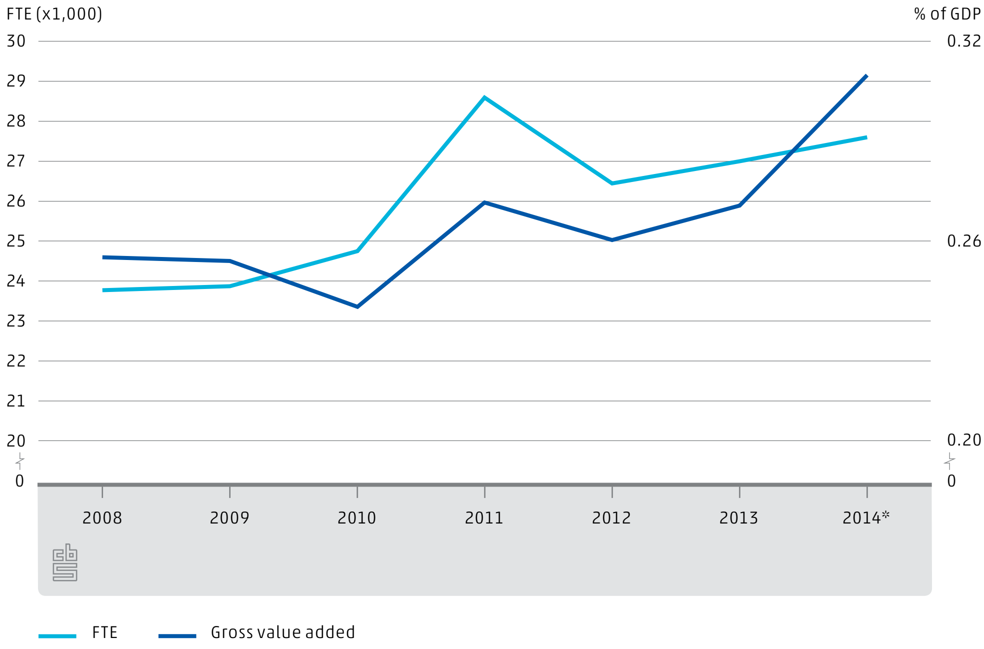
Source: Statistics Netherlands, Client registers, National Accounts.

6.4 Results of economic growth opportunities from energy saving activities

Applying energy saving measures costs money. However, these measures may also create new economic opportunities for all kinds of companies active in this field. As investments in energy saving measures are increasing, employment in these activities will increase as well. Employment grew from 23,8 thousand FTE in 2008 to 27,6 thousand FTE in 2014 (see Figure 6.4.1). This increase is most evident in the insulation installation sector (glazing and insulation material) of existing constructions, see also *Economic Radar of the Sustainable Energy Sector in the Netherlands* (Statistics Netherlands, 2014b). Another fast growing sector is electric transport, where employment has doubled between 2012 and 2014 to more than 3 thousand FTE.

The share of gross value added of the energy saving sector in the Dutch economy also increased, from 0.26 percent in 2008 to 0.31 percent in 2014 (see Figure 6.4.1, please note the two y-axes). Value added and employment tend to follow the same trend. The energy saving sector is expected to grow. More on the monitoring of the energy transition in the Netherlands and forecasts can be found in the National Energy Outlook (Schoots and Hammingh, 2015).

6.4.1 Employment and gross value added of energy saving activities



Source: Statistics Netherlands.

6.5 Conclusions

The main objective of this study was to present the possibilities that microdata from the client registers offer for establishing energy efficiency indicators on gas and electricity for the services sector. We have assessed five energy efficiency indicators for the services sector proposed internationally by the IEA within the Dutch context.

Methodological improvements discussed in the Methodology section affect trends between 2010–2013 for the indicators B–D. Trends for indicator E are not significantly affected as the methodological changes were taken into account in the methodology developed to establish indicator E for 2010–2013. Results presented in this article for indicators B–D should be interpreted with care. The methodology was stabilised in 2014, allowing the consistent analysis of trends from 2012 onwards.
All of the efficiency indicators for gas are affected by annual temperature variations. Although gas consumption has been adjusted for variations, they still affect the indicators. The recommendation is to analyse trends in energy efficiency over a decade or so.

Indicator D (energy efficiency per unit of activity), if developed at a sufficiently disaggregated level and with suitable measures for activities, and indicator E (energy efficiency per m^2 floor area) are considered to be the most useful indicators for analysing energy efficiency in the services sector. At the moment indicator D cannot be developed due to lack of microdata on activities. Indicator E is currently the most detailed indicator, allowing analysis of energy efficiency by (sub)sector, building type, building size and construction period.

The results show that the available microdata offer a huge potential for analysis of energy savings in the services sector. The results in this article are provisional and are only presented as an illustration of possibilities and to discuss potentials and pitfalls. Despite the provisional character, some conclusions can be drawn. Indicators C and D show an improvement in gas efficiency for sector G, while electricity efficiency deteriorated. Results from indicator E for primary education show that trends may vary even within economic sectors at the disaggregated level. Electricity efficiency in primary schools improved more in buildings constructed between 1989 and 1993 than in schools constructed after 1993. In the near future this method will be refined and more data will be analysed and published on StatLine.

Economic opportunities created by energy saving are evident. Energy saving activities have become increasingly important as the share of gross value added of the energy saving sector in the Dutch economy increased from 0.26 percent in 2008 to 0.31 percent in 2014. Employment grew from 24 thousand FTE in 2008 to 28 thousand FTE in 2014, whereas employment in most other economic activities did not increase during this period.

References

Adriaanse, A. (1993), Environmental Policy performance Indicators, SDU Publishers, The Hague.

Baldé, C.P. et al. (2015a), *The global e-waste monitor – 2014*, United Nations University, IAS – SCYCLE, Bonn.

Baldé, C. P. et al. (2015b), *E-waste statistics: Guidelines on classifications, reporting and indicators*, United Nations University, IAS – SCYCLE, Bonn.

Council Directive EC (2003), Council Directive (EC) 2002/96/EC of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Dijk A.J. van and A. Boele (2011), *Handleiding SOVON Broedvogelonderzoek*. SOVON Vogelonderzoek Nederland, Nijmegen.

ECN, PBL, CBS and RvO (2015a), *Nationale Energieverkenning 2015*. ECN-O--15-033. Petten: Energieonderzoek Centrum Nederland.

ECN, PBL, CBS and RvO (2015b), Netherlands National Energy Outlook 2015.

European Commission (2014), *Common Fisheries Policy (CFP).* http://ec.europa.eu/fisheries/cfp/index_en.htm

Eurostat (2015), http://ec.europa.eu/eurostat/web/waste/key-waste-streams/weee

Green Growth Knowledge Platform (2013), Moving towards a common approach on *green growth indicators*.

Gregory, R.D., A. van Strien, P. Vorisek et al. (2005), *Developing indicators for European birds*. Phil. Trans. R. Soc. 360: 269-288.

Huisman, J. et al. (2012), *The Dutch WEEE Flows*, United Nations University, ISP – SCYCLE, Bonn.

IEA (2014), Energy Efficiency Indicators: Fundamentals on Statistics.

IPCC (2013), *Climate Change 2013, the Physical science basis*. Fifth Assessment Report, Cambridge, Cambridge University Press.

IPCC (2014). *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)). IPCC, Geneva, Switzerland, 151 pp.

Lelieveld J., J.S. Evans,M. Fnais et al. (2015), *The contribution of outdoor air pollution sources to premature mortality on a global scale*. Nature 525, 367 – 371. DOI: 10.1038/nature15371.

Magalini, F. et al. (2015), *Study on collection rates of waste electrical and electronic equipment (WEEE)*, Preliminary version, subject to final verification, United Nations University, Bonn.

Ministry of Economic Affairs and Ministry of Infrastructure and Environment, on behalf of Ministry of foreign Affairs and Ministry of Interior and Kingdom Relations (2015), *Tussenbalans Groene Groei, 2015*. Pp. 44

Ministry of Economic Affairs (2013), *Uitvoeringsagenda Natuurlijk Kapitaal*. http://www.noordzeeloket.nl/images/kamerbrief-over-uitvoeringsagenda-natuurlijk-kapitaal_2695.pdf

National Institute for Public Health and the Environment (2013), *Dossier Fijn Stof*, 212 p.

OECD (2008), The Global Project on "Measuring the Progress of Societies", Paris.

OECD (2011a), Green Growth Strategy, Paris.

OECD (2011b), *Towards green: growth: Monitoring progress: OECD indicators*, OECD Green growth Studies, OECD Publishing, Paris.

OECD (2014), *Greening Household Behaviour Overview from the 2011 Survey* - Revised edition. Paris. http://dx.doi.org/10.1787/9789264214651-en

OECD (2015), *Towards Green growth: Tracking progress, OECD indicators*, OECD Green growth Studies, OECD Publishing, Paris.

PBL (2013), Nederland voldoet aan de Kyoto-verplichting uitstoot broeikasgassen. Persbericht 09-09-2013, The Hague.

Remme, R., B. Edens, M. Schröter et al. (2015), *Monetary accounting of ecosystem services: A test case for Limburg province, the Netherlands.* Ecological Economics 112 (2015), p. 116–128.

Rijksoverheid (2011), Tweede Nationale Energie Efficiëntie Actie Plan voor Nederland.

Remme, R., M. Schröter en L. Hein (2014), *Developing spatial biophysical accounting for multiple ecosystem services*. Ecosystem Services 10, p. 6 – 18.

Rijksoverheid (2011), Tweede Nationale Energie Efficiëntie Actie Plan voor Nederland.

Rijkswaterstaat (2013a), http://www.lap2.nl/publish/library/190/2014-02-10_ontwikkelingenstorten_dec2013_bijlage.pdf

Rijkswaterstaat (2013b), Samenstelling van het huishoudelijk afval, resultaten sorteeranalyses 2012, Rijkswaterstaat, Utrecht.

RIVM (2012), *Agricultural practice and Water Quality in the Netherlands*, period 1992-2010.

Rockström, J. et al. (2009), *A safe operating space for humanity*. Nature, 461 (7263), pp. 472–475.

Secretariat of the Convention on Biological Diversity (2005), *Handbook of the Convention on Biological Diversity Including its Cartagena Protocol on Biosafety*, 3rd edition, (Montreal, Canada).

Statistics Netherlands (2008), *Kerncijfers wijken en buurten*.

Statistics Netherlands (2011), *Green growth in the Netherlands*, Heerlen/The Hague.

Statistics Netherlands (2012a), *Kerncijfers wijken en buurten*.

Statistics Netherlands (2012b), *Monitor topsectoren. Uitkomsten eerste meting*, Den Haag/Heerlen.

Statistics Netherlands (CBS) (2013a), *Environmental accounts of the Netherlands 2012*, Heerlen/The Hague.

Statistics Netherlands (2013b), Nulmeting groene groei in topsectoren, Heerlen/The Hague.

Statistics Netherlands (2014a), Compiling the EPE module for the Netherlands: short time series and improvements, Eurostat Grant project.

Statistics Netherlands (2014b), Economic Radar of the Sustainable Energy Sector in the Netherlands, Edition 2014, Heerlen/The Hague.

Statistics Netherlands (2014c), Environmental accounts of the Netherlands 2013, Heerlen/The Hague.

Statistics Netherlands (2015a), Sustainability Monitor of the Netherlands: Indicator report, Heerlen/The Hague.

Statistics Netherlands (2015b), http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37926&D1=0-40&D2=0,8-14,30-31,34-36&D3=l&VW=T

Statistics Netherlands, (2015c). *Monitor topsectoren 2015 Methodebeschrijving en tabellenset*. Den Haag/Heerlen/Bonaire, 2015.

Statistics Netherlands, PBL, Wageningen University and Research Centre (UR), *Compendium voor de leefomgeving*, http://www.compendiumvoordeleefomgeving.nl/

Statistics Netherlands, PBL, Wageningen University and Research Centre (UR) (2012), *Nitraat in het bovenste grondwater in landbouwgebieden, 1992–2010 (indicator 0271, versie 09)*, CBS, Heerlen/The Hague; PBL, Den Haag/Bilthoven and Wageningen UR, Wageningen.

Statistics Netherlands, PBL, Wageningen University and Research Centre (UR) (2014), *Kwaliteit oppervlaktewater, 2013* (indicator 1438, versie 06, 9 september 2014). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

Step Initiative (2014), One global definition of E-waste, Solving the E-Waste Problem (Step) White Paper, The StEP Initiative/United Nations University.

Strassburg B.N., A.S.L. Rodrigues, M. Gusti et al. (2012), *Impacts of incentives to reduce emissions from deforestation on global species extinctions*. Nature Climate Change 2, 350-355. DOI: 10.1038/nclimate1375.

Strien, A. van, J. Pannekoek, W. Hagemeijer et al. (2004), *A loglinear Poisson regression method to analyse bird monitoring data*. In: Anselin, A. (ed.) Bird Numbers 1995, Proceedings of the International Conference and 13th Meeting of the European Bird Census Council, Pärnu, Estonia. Bird Census News 13 (2000): 33-39.

Tweede Kamer (2013), Brief '*Groene Groei: voor een sterke, duurzame economie*' van 28 maart 2013 (Tweede Kamer, 33043 nr. 14)

UN (United Nations) (2012a), *The future we want*, Outcome document.

UN (United Nations) (2012b), Realizing the Future We Want for All, Report to the Secretary-General, New York June 2012.

UN, EC, FAO, IMF, OECD and World Bank (2012), *System of Environmental-Economic Accounting*, Central Framework, New York.

UN, EC, FAO, OECD, World Bank (2014), System of Environmental-Economic Accounting 2012. Experimental Ecosystem Accounting, United Nations, New York, USA.

UNEP (2009), Global Green New Deal Policy Brief.

UNEP (2011), Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication.

UNEP-WCMC, (2015), Experimental Biodiversity Accounting as a component of the System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA-EEA). Supporting document to the Advancing the SEEA Experimental Ecosystem Accounting project. United Nations.

Wang, F. (2014), E-waste: collect more, treat better; Tracking take-back system performance, Doctoral dissertation, Delft University of Technology.

WAVES (2012), Moving Beyond GDP - How to factor natural capital into economic decision making. World Bank.

WCED (1987), *Our Common Future*: Report of the World Commission On Environment and Development. Oxford University, 1987.

Wilting, H.C. et al. (2015), Trends in Nederlandse voetafdrukken, Den Haag: PBL.

WWF (2012), Living Planet Report 2012, Biodiversity, biocapacity and better choices; WWF International, Gland, Switzerland.

Abbreviations

BAG	National Buildings Register (Basisregistraties Adressen en Gebouwen)
CBS	Statistics Netherlands (Centraal Bureau voor de Statistiek)
CBD	Convention on Biological Diversity
CCS	Carbon Capture and Storage
CFC	chlorofluorocarbon
CFP	Common Fisheries Policy
CRT	Cathode Ray Tube (computer monitor)
DCMR	Environmental protection agency of local and regional authorities in the Rijnmond region
DMC	Domestic Material Consumption
DVD	Digital Versatile Disc
EBCC	European Bird Census Council
EC	European Commission
ECN	Energy research Centre of the Netherlands (Energieonderzoek Centrum Nederland)
EEA	European Environmental Agency
EEE	Electric and Electronic Equipment
EGSS	Environmental Goods and Services Sector
EHS	National Ecological Network
EIA	Energy Investment Allowance
EIB	Economisch Instituut voor de Bouw
EPC	Energy Performance Coefficient
EPO	European Patent Office
ESD	European Commission Directive on energy end-use efficiency and energy services
EU	European Union
EU-28	European Union, 28 countries
Eurostat	The European Statistical Bureau
EZ	Dutch ministry of Economic Affairs
FBI	Farmland Bird Indicator
FTE	Full-time equivalents (jobs)
GDP	Gross Domestic Product
CFCs	Chlorofluorocarbons
GGD	Gemeentelijke Gezondheidszorg
GGE	Greenhouse Gas Emissions
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GJ	Gigajoule
GVA	Gross Value Added
ICES	International Council for the Exploration of the Sea
ICT	Information and Communication Technology
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification of All Economic Activities
IT	Information Technology
IUCN	International Union for the Conservation of Nature
KRW	Kader Richtlijn Water (Water Framework Directive)
Kt	kiloton

kWh	kilowatt-hour
MDG	Millennium Development Goals
MEP	Milieukwaliteit elektriciteitsproductie scheme to stimulate the production of renewable energy
MRIO	Multi-regional Input Output table
MSA	Mean Species Abundance
MSY	Maximum Sustainable Yield
NACE	Nomenclature statistique des Activités économiques dans la Communauté Européenne
NEM	Network Ecological Monitoring
NEV	National Energy Outlook
OECD	Organisation for Economic Co-operation and Development
PAH	Polyaromatic Hydrocarbons
PBL	Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving)
PC	Personal Computer
PDBE	Polybrominated Diphenyl Ethers
PGO’s	Particuliere gegevensbeherende organisaties
Probos	Non-profit institute for forestry, forest products and services
Prodcom	PRODuction COMmunautaire Product classification for the sections mining, quarrying and manufacturing of the Statistical Classification of Economy Activity in the European Union
Rio+20	International sustainability Summit
RIVM	National Institute for Public Health and the Environment
RLI	Red List Indicator
RMC	Raw Material Consumption
RME	Raw Material Equivalents
RvO	Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland)
SDE	The main renewable energy subsidy in the Netherlands
SDG	Sustainable Development Goals
SEEA	System of Environmental-Economic Accounting
SER	The Social and Economic Council of the Netherlands (Sociaal-Economische Raad)
SIC	Standard Industrial Classification
SME	Small and Medium sized Enterprises
SNA	System of National Accounts
SOVON	Dutch centre for field ornithology
TV	Television set
UN	United Nations
UNEP	United Nations Environment Program
UNU	United Nations University
UNU-Keys	UN classification for E-waste
UWWTP	Urban Waste Water Treatment Plants
VCR	Video Cassette Recorder
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WB	World Bank
WCED	World Commission on Environment and Development
WCMC	World Conservation Monitoring Centre
WEEE	Waste of Electric and Electronic Equipment
WFD	Water Framework Directive
WOZ	(Waardering Onroerende Zaken) Appraisal value of dwellings
WWF	World Wildlife Fund

Acknowledgements

Authors

Kees Baas
Kees Baldé
Roel Delahaye
Arthur Denneman
Cor Graveland
Rixt de Jong
Krista Keller
Paul Klein
Anne Miek Kremer
Wai King Meijer-Cheung
Martin Poot
Sjoerd Schenau
Niels Schoenaker
Marcel van Velzen
Karin van der Ven
Richard Verweij
Jurriën Vroom

Contributors

Ellen Brinksma
Hendrik Dijkerman
Bram Edens
Bas van den Elshout
Marleen Geerdinck
Remco Kaashoek
John Klein
Irene van Ligten-Velt
Marieke Rensman
Reinoud Segers
Jan-Pieter Smits
Vincent van Straalen
Marjan Verberk-de Kruik

Lars Hein (Wageningen University)
Roy Remme (Wageningen University)

Editors

Kees Baldé
Rita Gircour
Sjoerd Schenau
Anna Tanzer-Kulig
Karin van der Ven