Background report on resource efficiency indicators

Draft Report for EEA

Version: 3
Date: 09/06//2011
EEA activity: 1.4.3b Activity 1 and 2
ETC/ICM task, milestone: Task 1.4.3.b, Key Deliverable 1 of milestone 1 and 2
Background document on water resource efficiency

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Version History

Version	Date	Author	Status and description	Distribution
0.1	13/01/2010	MLO, JMG, MK, PR	Pre-draft for ETC Contributions from ECOLOGIC, NTUA, CENIA	To partners, CIRCA
0.2	26/01/2011	MLO, JMG, PR, MN	Comments from partners: Petra Ronen (CENIA) and Michael Nagy (AT UBA)	circa
2.0	05/05/2011	MLO, JMG, PR, MN	Comments and contributions by Michael Nagy and Petra Ronen	Partners
3.0	09/06/2011	MLO, JMG, PR, MN, MK	Comments and contributions by Rob Collins, Bo Jacobsen (EEA)	REI expert workshop participants

Executive Summary

As an introduction to task 1.4.2.b of ETC-ICM 2011 on the development of water related resource efficiency indicators, this report outlines the background to resource efficiency indicators, picks up recent policy and research developments and introduces the term 'resource efficiency indicator'. Further, this report presents already existing resource (water) efficiency indicators on a national level and proposes a selection of resource (water) efficiency indicators to be developed on an EU-wide level.

The report further discusses the possible contribution of water accounting activities at EEA and Eurostat to a regular production of water resource efficiency indicators and shows the potential and limitations of using SEEA-Water as a core concept to link water-related data from different data sources.

Thus this report is key deliverable 1 of milestone 1-2 and will be used as a basis for the development of new indicators under task 1.4.2b.

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Description of assignment

The ETC-ICM task 1.4.2.b focuses on the development of resource efficiency indicators for water use across all sectors, including water quantity and water quality aspects. Where appropriate, components relating to water economics will be considered. The information resulting from the task will be used to feed into assessments related to water scarcity and drought as well as resource efficiency (see 1.4.3)' (IP 2011 ETC-ICM).

Abbreviations used

BOD	Biological Oxygen Demand
CSI	Core Set of Indicators
EEA	European Environment Agency
EU	European Union
ETC	European Topic Center
MFA	Material Flow Analysis
NAMEA	National Accounting Matrix with Environmental Accounting
OECD	Organisation for Economic Co-operation and Development
SCP	Sustainable Consumption and Production
SEEA-W	System of Environmental Economic Accounting for Water
SETAC	Society of Environmental Toxicology and Chemistry
SNA	System of National Accounts
UNEP	United Nations – Environment Programme
UWWTP	Urban Wastewater Treatment Plant
WFD	Water Framework Directive
WWF	World Wide Fund for Nature
WISE-SoE	Water Information System for Europe – State of the Environment

1. Introduction

As an introduction to task 1.4.2.b, this report sets the scene with exploring the background as well as recent policy and research developments related to resource efficiency. Next, the concept of resource efficiency indicators is introduced and available indicators in the topic are presented. In the final part, this report proposes a selection of resource (water) efficiency indicators for further indicator development on a EU-wide level. This report concludes with the next steps needed in task 1.4.2.b.

1.1. Background

The global ecosystem's capacity to provide resource inputs and assimilate emissions and waste is a crucial precondition for the functioning of our world economy. Once resources are used and/or pollutants emitted beyond the sustainable limit of ecosystems, the damage caused to the latter further deteriorates their services. Resource efficiency (decoupling) is required to maintain economic growth in the long run.

The fourth Environment State and Outlook report (SOER 2010) released by the European Environment Agency in 2010, comprehensively assesses how and why Europe's environment is changing. Currently, Europe and the planet as a whole, are consuming more natural resources than is ecologically stable, with resource use increasing in the EU-12 by 34% between 2000 and 2007. SOER 2010 concludes that the transformation of Europe to a resource-efficient green economy can result in a healthy environment and simultaneously increase prosperity and social cohesion.

As a central point in the EU strategy for sustainable development, decoupling the linkage between economic growth and resource use is a central objective of the 6th EU Environmental action program. In March 2010, the European Strategy for smart, sustainable and inclusive growth 'Europe 2020' was released by the European Commission, which highlights – among others - the need of a *more resource efficient* economy. Particularly for water, the European Commission is expected to publish a 'Blueprint for Safeguarding Europe's Water' by 2012 to focus on water-savings, which builds upon a number of in-depth assessments of water scarcity and drought in the European Union[1]

The system of national accounts, which was established in 1952 and underpins the GDP calculations, does not consider environmental or social dimensions. Reflecting the growing recognition that conventional economic performance benchmarks, such as GDP and its growth rate are poor measures of human well-being and the health of nature and society, the European Union, in partnership with the European Parliament, the Club of Rome, the Organisation for Economic Co-operation and Development (OECD), the Ecologic Institute and the WWF hosted an expert workshop followed by the high level conference 'Beyond GDP'[2]. The purpose was to clarify which indicators are best suited to measure progress, human well-being and the sustainability of economic, environmental and societal systems. Recognizing its unique position and responsibility as one of the leading economic and political groups in the world, the European Commission released on 20 August 2009 its Communication "GDP and beyond: Measuring progress in a changing world" (COM/2009/0433) justifying its quest to reform reporting on social, economic and environmental progress using indicators.

1 For example: Communication from the Commission to the European Parliament and the Council - Addressing the challenge of water scarcity and droughts in the European Union {SEC(2007) 993} {SEC(2007) 996}; (EC (2008) REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT - Follow up Report to the Communication on water scarcity and droughts in the European Union COM(2007) 414 final

2 See: www.beyond-gdp.eu

Decision-makers which seek to promote resource efficiency will need to draw upon a wide scope of information which falls into two wide categories: knowledge about the sources and amounts of resources that are used and their impact; and knowledge about policies and approaches to enhance resource efficiency (EEA, 2010: Knowledge Base).

One means of assessing the environmental pressure or impact in relation to the driving economic force (e.g. GDP), is using decoupling, , including resource efficiency, indicators[3]. These illustrate whether resources are used efficiently in terms of both, the economy and the environment. In 2011 resource efficiency indicators shall be fully embedded in the Sustainable Consumption and Production (SCP) indicators framework[4].

1.2. Recent policy developments on this topic

While not directly and solely focussing on water resource efficiency indicators, a number of similar EU research projects are currently being executed.

In a working paper (February 2010), the EEA introduced its ideas on the fast track implementation of simplified **ecosystem capital accounts** for Europe. With the emphasis on the production of physical accounts for a number of feasible elements of ecosystem capital accounting, the final draft of terrestrial and marine accounts shall be completed in 2012, while the first draft of terrestrial ecosystem capital accounts shall be available in 2010. This project will result in an indicator 'Total Ecosystem Potential' which is computed on the basis of six indices, among which a Water Index[5]. The Water Index reflects the available water resources, i.e. water quantity and quality, river basins and ecological status[6]. The accounting table for the water index is combined in an ecosystem asset table and sector table, which are connected by flow accounts which balance withdrawals and returns, allowing for integration to the SEEA-W framework. Indicators in the flow accounts include e.g. withdrawals by activities, returns from water systems from activities, storage in the user system, and consumption/evaporation in the use system.

The **National Accounting Matrix with Environmental Accounting (NAMEA),** developed in collaboration between United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development and the World Bank, is a statistical information system which combines the national accounts with the environmental accounts in a single matrix to a hybrid accounting system.

The **System of Environmental Economic Accounting for Water (SEEA-Water)** has been prepared by the UN Statistics Division in collaboration with the London Group on Environment Accounting. SEEA-Water, by using concepts, definitions and classifications consistent to those used in the System of National Accounts 1993 (1993 SNA), it is a framework for the organisation of physical and economic information related to water. It provides a conceptual framework for organizing the hydrological and economic information in a coherent and consistent manner to then assess the contribution of

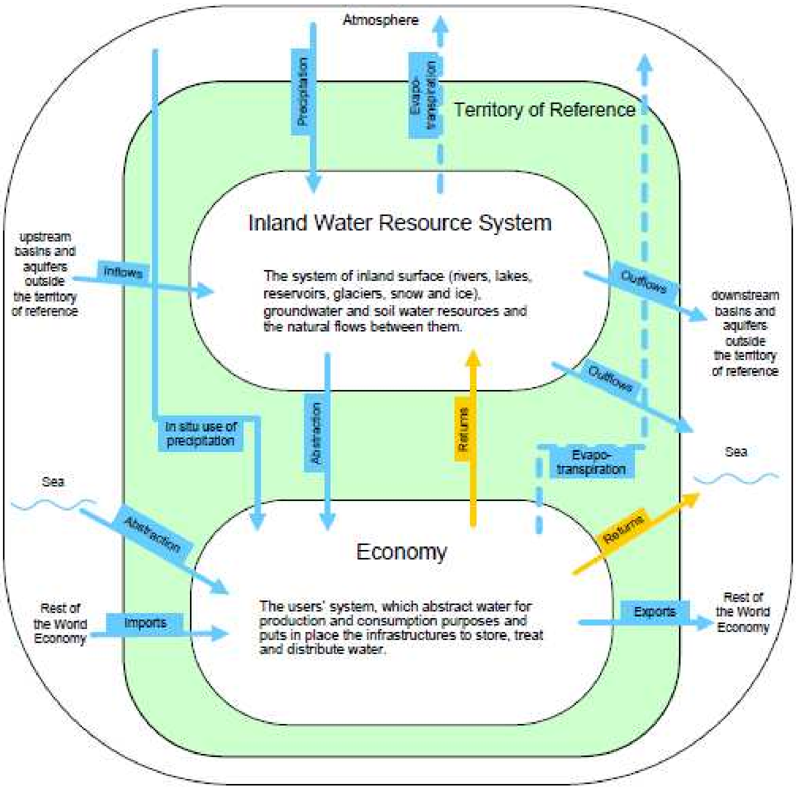
[3] These indicators illustrate whether economic growth is achieved on account of growing resource use and associated impact or together with a reduced resources use and impact. Simple decoupling decouples resource use from economic growth, while 'double decoupling' further seeks to decouple GDP from environmental impacts.

[4] The full report on the SCP indicator framework is available for download under: http://scp.eionet.europa.eu/publications/SCP_Indicator_frame

[5] The remaining indices are: Biodiversity Index, Carbon/Biomass Index, Landscape Index, Health Index, Dependency Index

[6] More specifically: Water protection and management; water resource, supply and use; water functions & ecosystem services; water bodies resource & abstraction; water quality and quantity.

the environment to the economy and the impact of the economy on the environment[7]. The conceptual framework of the flows between the economy and the environment can be seen in Graph 1.



Graph 1 Conceptual Framework SEEA-W; Source: United Nations Statistics Division (Final Draft) System of Environmental-Economic Accounting for Water

The **United Nations Environment Program (UNEP)** works to promote resource efficiency and sustainable production and production in developing and developed countries. UNEP seeks to support and facilitate global efforts to decouple economic growth from resource use and environmental degradation, for example in the area of enhancing resource efficiency. UNEP's work focuses on knowledge dissemination on resource efficiency and sustainable consumption and production, building governmental capacity, consolidating or extending partnerships with business and industry and influencing consumer choice[8]. In addition, UNEP's Green Economy Initiative (GEI) focuses on sectoral efficiency. 'The Green Economy Report', published in 2010 by the GEI, elaborates on opportunities, challenges and enabling conditions required in 11 distinct sectors[9]. UNEP's International Panel for Sustainable Resource Management (short: International Resource Panel, IRP) was launched in November 2007 and shall provide scientific impetus for decoupling economic growth and resource use from environmental degradation[10]. In 2011, the IRP published a report on decoupling natural resource use and environmental impacts from economic growth, which illustrated that decoupling has occurred in the past. Between 1990 and 2011 the same was produced while using 10% less resources. The IRP further plans to carry out a series of investigations relating to decoupling in different sectors, including the water sector (UNEP, 2011). The Water Footprint, Neutrality and Efficiency (WaFNE) Umbrella Network from UNEP seeks the collaboration between UNEP and the public and private sectors in the area of water use efficiency. The specific objectives include refining methods and management tools for

[7] For more information on SEEAW: http://unstats.un.org/unsd/envaccounting/seeaw.asp

[8] More information on UNEP's resource efficiency initiative can be found under: http://www.unep.org/resourceefficiency/Home/tabid/214/Default.aspx

[9] More information on the GEI and the Green Economy Report can be found under: http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/1375/Default.aspx

[10] More information on the resource panel can be found under: http://www.uneptie.org/scp/rpanel/

the water footprint and water neutrality concepts, building capacity among private and public sectors to apply water footprint and neutrality concepts and to demonstrate the applicability of harmonized concepts in enhancing water efficiency and improving water quality in high water impact and water dependent industries and in water stressed regions[11].

The Green Growth Strategy was launched in June 2009 by the **OECD**, following the adoption of the 'Declaration of Green Growth' by the Ministers during the OECD Ministerial Council Meeting. The Interim Report published in 2010 highlights preliminary findings on issues policy makers face in transitioning to greener economies. The Green Growth Strategy Synthesis Report, which shall be presented to the Ministerial Council Meeting in 2011, will focus, among other themes, on green indicators[12].

In the 'Vision 2050' Report, the World **Business Council on Sustainable Development (WBCSD)** outlines key targets for resource efficiency.

The **CEO Water Mandate**, a collaboration between the United Nations Global Compact, the Government of Sweden and a group of companies and organizations, seeks to encourage the development and use of new technologies, including technologies for irrigation efficiency and water efficiency[13].

The Economics of Ecosystems and Biodiversity (TEEB) attempts to show the accumulated policy experience in efforts to achieve a more resource efficient economy. The idea to make ecosystem values visible through well-designed policies shall empower consumers and business to make more informed choices and thus contribute to the transition of a more resource efficient economy.

1.3. Recent research developments – ongoing EU

The **IN-STREAM** project led by the Ecologic Institute aims to develop new recommendation for indicators that measure progress in economic success, human well-being, environmental protection, and long-term sustainability through both qualitative and quantitative analyses. The project provides needed insight into the synergies and trade-offs implicit in Europe's simultaneous pursuit of economic growth and environmental sustainability.

The goal of the **OPEN:EU** project is to develop an academically robust "footprint family" of sustainable development indicators and introduce them into discussions and decision-making of different stakeholders to help the EU transformation to a One Planet Economy by 2050[14].

The objective of the **'Environmental Pressure Index'** project is to measure environmental pressures, "reflecting the pollution and other harm to the environment caused physically within the territory of the EU to assess the results of environmental protection" (COM/2009/0433).15 It should therefore include the major anthropogenic stressors on the environment and aggregate them in a comprehensive way[16].

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[11] More information on WaFNE can be found under: http://www.uneptie.org/scp/water/wafne.htm

[12] More information on the OECD Green Growth Strategy can be found under: http://www.oecd.org/document/10/0,3746,en_2649_37465_44076170_1_1_1_37465,00.html

[13] More information on CEO Water Mandate can be found under: http://www.unglobalcompact.org/issues/Environment/CEO_Water_Mandate/

[14] Institutions involved: Ecologic Institute, WWF-UK; Global Footprint Network (GFN); Stockholm Environment Institute (SEI); University of Twente; NTNU (University of Trondheim); Sustainable Europe Research Institute (SERI); Institute for European Environmental Policy (IEEP)

15 http://eur-lex.europa.eu/Notice.do?checktexts=checkbox&val=499855

[16] The Ecologic Institute is involved in a contract on data services for the composite index on environmental pressures.

Eurostat developed material flow analysis (MFA) based indicators, of which the most frequently used ones are Domestic Extraction Used (DEU) and Domestic Material Consumption (DMC). When expressed as GDP per unit of (DMC), the efficiency of how an economy uses its resources is measured. However, water is not included in the MFA, as it would dwarf all other resources combined.

1.4. EEA needs

The EEA approaches the need for resource efficiency indicators in the water sector in a twofold manner via the ETC-ICM tasks 1.4.2.b and 1.4.3.b and via the Framework Contract Ref No. EEA/IEA/09/002-Lot 3, namely on Water Economics and Ecosystem Accounts.

To enable a declining or stable resource use, information not just on the quantity of resources used, but also on the impacts on the environment and the sustainable resource capacity must be available. Care needs to be taken to not understand resource efficiency too narrowly as merely the ratio of resource inputs to economic output, as this enhanced resource efficiency will not necessarily lead to declining or stable resource use.

Besides enhancing knowledge on options for technological efficiency increases, the understanding of natural capital stocks that drive the economies and their monetary measures to convey their value to the public need consideration.

The EEA is seeking for operational and policy-relevant resource efficiency indicators. As such, emphasis should be put on resource efficiency indicators which incorporate real numbers affected by the real operation/performance of economical activities rather than numbers for nominal capacities
and can realistically be made operational and therefore policy relevant, i.e. overly theoretical approaches should be avoided. The efficiencies should be expressed as functional relationships between object (product) and resource used. Further, these indicators should be available at an aggregation level corresponding the target group(s) of stakeholders of key importance for the outcome of the indicator. Whenever adequate, existing resource efficiency indicators can be borrowed if they can help illustrate a point.

As so far no REI have been included into the EEA indicator set, it needs to be assessed whether efficiency elements can be incorporated into existing CSI and other EEA indicators[17] (disaggregated level) or whether new efficiency indicators addressing main economic drivers/ or impacts can be designed[18].

Where ever possible, production and consumption indicators shall be developed and assessed to reflect both sides where relevant.

[17] The core set of indicators developed by the EEA and other EEA indicators can be found here: http://www.eea.europa.eu/data-and-maps/indicators#c7=all&c5=&c0=10

[18] Dissagregated efficiency indicators can complement the overall eco-efficiency indicators as they describe particular elements of the composite indicator, shedding light on particular cause-effect relationships.

2. Resource efficiency indicators

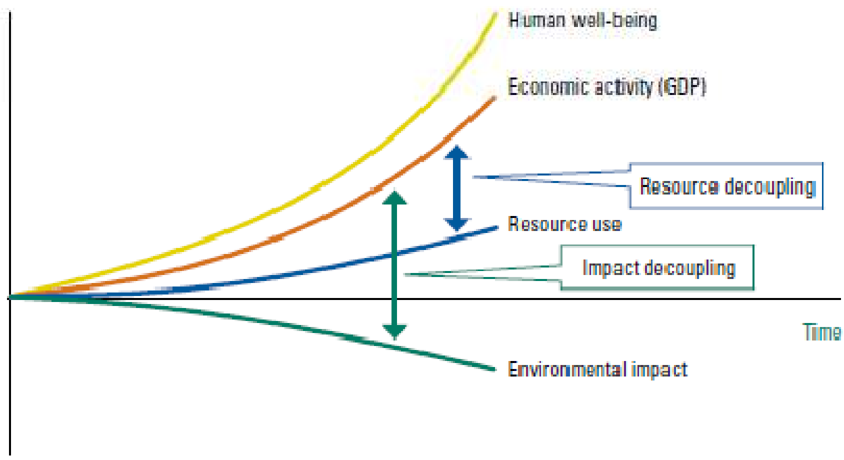
Resource efficiency and decoupling: concepts

Resource efficiency describes the use of less overall resource inputs to produce the same amount of economic output, i.e. value of products or services, while decoupling takes this definition a step further and is described by UNEP (2011:4) as "reducing the amount of resources […] used to produce economic growth and delinking economic development from environmental deterioration".

UNEP (2011) describes the two key aspects of decoupling as resource and impact decoupling (Graph 2) Resource decoupling means "using less resources per unit of economic output" while impact decoupling shall "reduce the environmental impact of any resources that are used or economic activities that are undertaken" (UNEP, 2011:8).

Decoupling can be absolute ("reduction of per capita resource consumption") or relative ("reduction of growth rates of resource consumption"). Eurostat, for example, measures resource productivity as GDP/DMC, where DMC stands for domestic material consumption. In EU-27 this ratio has increased, which suggest that a decoupling took place. However, at the same time the DMC has also increased, indicating that only relative decoupling, rather than absolute has taken place. This distinction is particularly relevant when allocating global responsibilities for environmental impact and its reduction between "developed" and "developing" countries which can be referred to "common, but differentiated responsibilities". (Hennicke and Sewerin, 2009)

Graph 2 Two aspects of decoupling



Source: UNEP, 2011:8

Following the various research and policy streams related to resource efficiency, different definitions have been employed. The European Commission defines resource efficiency as "producing more value using less material and consuming differently" (European Commission, 2010c) and as "using the Earth's limited resources in a sustainable manner" (European Commission, 2011). Further,, the Life Cycle Initiative (UNEP and SETAC) define resource efficiency as a 'concept that has the overarching aim of decoupling economic growth from resource use and environmental degradation'. UNEP defines resource efficiency from a life cycle and value chain perspective. This means reducing the total environmental impact of the production and consumption of goods and services, from raw material extraction to final use and disposal[19].

However, it needs to be considered that the gains made from increased resource efficiency can be marginalized by counteracting social and economic reactions, which include direct and indirect rebound effects, growth, structural and quantity effects (Hennicke and Sewerin, 2009). As such, Hennicke and Sewerin (2009) stress that it is crucial to base resource policies on the triangle of sufficiency ("less can be more"), consistency ("better for more") and efficiency ("more for less") to ensure a decoupling of the quality of life and use of natural resources, in other words a sustainable economy. The following, however, will focus on the efficiency aspect, i.e. "producing more for less" of the triangle for decoupling.

The following three elements to resource efficiency can be measured:

1. **Physical efficiency indicator**: measures the resource use productivity and is expressed as the ratio between a measure of economic activity (e.g. unit of produced good) and resource used. *It indicates whether resource use is decoupled from economic growth*.
   Example: Agricultural Water Use Efficiency Index
2. **Environmental efficiency indicator**: measures the resource impact and is expressed as the ratio between the impact of the resource used and the amount of the resource used. *It indicates whether resource use is decoupled from its impact*.
   Example: Environmental Impact Intensity

3. **(Composite) Eco-efficiency indicator**: expressed as the relation of overall economic performance (e.g. GDP) to overall environmental impact associated with domestic consumption and weighted use of natural resources, i.e. combination of weighted pressures *It indicates whether economic performance is decoupled from environmental impacts.*
   Example: Environmental Impact weighted against unit of economic performance per sector; Gross Value Added, JRC decoupling and basket-of-product indicators, ecological footprint measures etc.
   Note: This element can be used to assess the overall impact relating to freshwater resources, or, once the results of all ETC work groups are available as an aggregate for all environmental impacts cause in relation to economic performance.

Resource efficiency indicators can focus on macro- or microeconomic scales. Baskets of indicators can be used to understand the aggregate impact of the economy on the ecosystem. As such, a recent study proposed to measure Europe's resource use with four indicators, namely water use, land use, material use and carbon emissions[20]. On the other hand, resource efficiency on microeconomic scales can focus on the efficiency of sectors and individual firms, such as the Water Footprint. Considering Europe's engagement in global trade, and the consequent partial shift of environmental burden abroad, resource efficiency indicators can further link trade and resource use as e.g. the life cycle assessment does.

A number of (water) resource efficiency indicators have already been developed in some EU member economies and are further discussed in the inventory under 2.1. . Resource efficiency indicators can relate resource use to the economy (e.g. GDP/m³) or to certain metrics (e.g. l/cap/day or l/end use product).

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19 Source: UNEP:http://www.unep.org/resourceefficiency

20 Friends of the Earth and SERI (2010) Measuring our resource use.

Linking Resource Efficiency Indicators to Existing European Indicator Sets

As so far no REI have been included into the EEA indicator set, it needs to be assessed whether efficiency elements can be incorporated into existing CSI and other EEA indicators[21] (disaggregated level) or whether new efficiency indicators addressing main economic drivers/ or impacts can be designed[22].

SEEA-Water and NAMEA accounts, as well as SoE-WISE can be drawn upon as potential starting points to incorporate efficiency indicators and collate information from – however, other sources must be considered in addition.

Strong communication with the EEA fast track Ecosystem Capital Accounts (particular water accounts) shall be maintained and outputs should be used where possible to develop and strengthen resource efficiency indicators. However, as most work on the Resource Efficiency Indicators will be done in the first half of 2011, it remains uncertain in how far work on the Fast Track Ecosystem Capital Accounts can be fed in. Therefore, all alternative relevant information sources will need to be explored.

Linking Resource Efficiency Indicators to the EU Water Framework Directive (2000)

The implementation of the Water Framework Directive (WFD) in 2000 was a crucial development for European water management. Under a unified water body protection framework, the WFD stipulates that 'good status' is to be achieved for all European water bodies by 2015. Given the availability of information provided via the River Basin Management Plans (2009) and the prior published environmental and economic characterization reports (2004), potential links to the development of resource efficiency indicators should be exploited. As such, data on the chemical and ecological status, as well as data on the number and impact of environmental pressures per river basin can be considered important data input to the development of indicators. For example, in the Netherlands, indicators on the emission intensity (water emissions per euro value added) have been calculated on the river basin level as well as on national level. Thus the possibility to combine resource efficiency indicators and WFD reporting should be considered.

2.1. Inventory of existing water resource efficiency indicators

As part of task 1.4.3.b, an inventory of the available material on water resource efficiency has been undertaken. Besides providing an interesting overview on the past activities of European Member States to assess water resource efficiency, this inventory shall provide insights for the subsequent development of EU-wide water resource efficiency indicator (links with TASK 1.4.2b).

This following section shall provide a brief analysis of the inventory and shall highlight the most interesting and insightful resource efficiency indicators.

Table 1 offers a brief overview of the resource efficiency indicators which are covered in the inventory and subsequent analysis. Detailed factsheets for each individual indicator can be found in Annex 1

[21] The core set of indicators developed by the EEA and other EEA indicators can be found here: http://www.eea.europa.eu/data-and-maps/indicators#c7=all&c5=&c0=10

[22] Dissagregated efficiency indicators can complement the overall eco-efficiency indicators as they describe particular elements of the composite indicator, shedding light on particular cause-effect relationships.

Table 1 Overview of resource efficiency indicators covered in the inventory

#	**Name**	**Description**	**Country**
1	Water consumption and value added	This indicator brings the value added in relation to the water consumption per sector	Australia
2	Water use and payments for water	This indicator brings the water price in relation to the use of distributed water per sector.	Australia
3	Water use intensity	This indicator describes the trend in water consumed (m³) per of value added (DKK million) over time and per industrial sector	Denmark
4	Economic growth and emissions to water (nu-trients, heavy metals) – “Emissions intensity”	This indicator assesses whether economic growth and emissions to water have been decoupled. This is done by several means: • Trend analysis of the development of economic growth and emissions to water, starting from a com-mon point in 1995 (=100) to 2008 • Identification of the emission intensity, i.e. the emis-sions to water per mil € value added, for key indus-tries and for river basins. • Comparison the trend of economic growth and emis-sions to water between 1995 and 2005. • Identification of emission intensity in relation to value added from agriculture and manufacturing in-dustry calculated for RBD	Netherlands
5	Population growth and tap water usage	This indicator assesses the relation of per capita water use, household water use between 1990 (=100) and 2009 to illuminate a potential decoupling between population growth and tap water usage.	Netherlands
6	Industrial water use, GDP growth and employment	This indicator assesses the relationship between GDP, employment and tap water use in industries over the period 1990-2009. Further, the water use intensities of tap water, i.e. the water used (l) per € value added are determined for selected industries and compared between the years 2003 and 2008.	Netherlands
7	Value added and crop pro-duction from irrigated agriculture	This indicator presents water productivity as gross value added per cubic meter of water consumed for irrigation of particular crops (also over time).	Spain (Cordoba Prov-ince)
8	Water abstractions, value added, employment and environmental costs in water intensive industries	This indicator analyses the evolution (between 2000 and 2004) of water abstractions, value added, employment and environmental costs in the five Swedish river basin districts. For the individual river basin districts, these factors are analyzed per water intensive industry.	Sweden
9	Water use intensity in man-ufacturing industries	This indicator describes the water use in manufacturing industries in relation to the production value (l/SEK). Further, this indicator offers economic profiles of each analyzed manufacturing industry, including production value, value added, hours worked, energy used etc.	Sweden
10	Total abstraction from non-tidal surface and groundwa-ter, leakage losses and GDP	This indicator shows the development of GDP in compar-ison to total water abstraction and leakage losses	UK
11	Population growth, connec-tion to WWPTs and N & P discharges	This indicator first illustrates the relationship between population growth and the number of inhabitants not connected to wastewater treatment plants. Further, it illustrates the amount of N and P per capita that is dis-charged without treatment into the, as a factor of popula-tion growth.	OECD countries

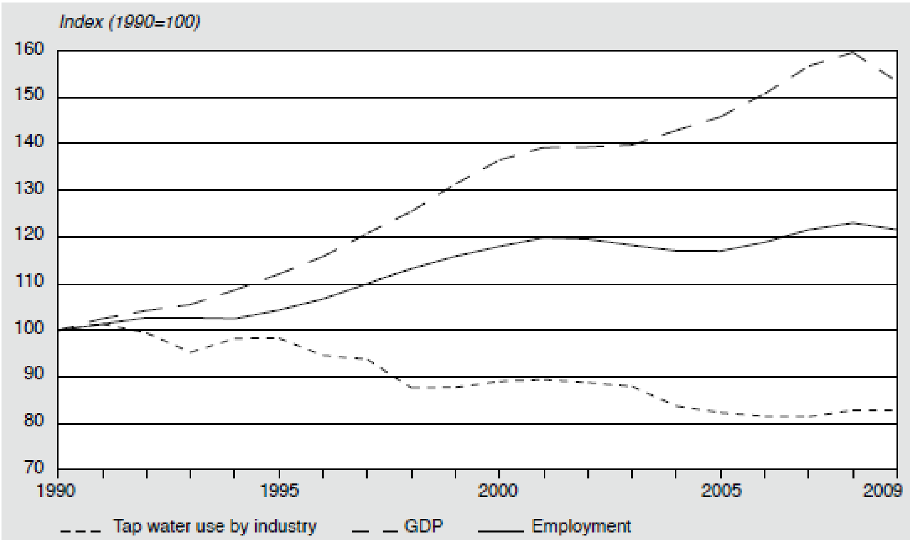
Analysis
(The numbers of the indicators relate to those introduced in Table 1)

Almost three quarters of the identified indicators, relate the use and pollution of water to economic development. Economic development is depicted by overall GPD or by the value added as a result of the water use.

Indicator #6, e.g. provides an overall picture of the development of industrial tap water use, GDP and employment between the years 1990 and 2009 (Graph 3). By indexing the baseline to the year 1990 (=100), the trends of changes can be illustrated clearly. Industries have used progressively less tap water since 1990, despite GDP growth. This can indicate a decoupling between GDP growth and tap water usage. [23]

Graph 3 Industrial tap water use, GDP growth and employment in the Nether-lands,1990-2009

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



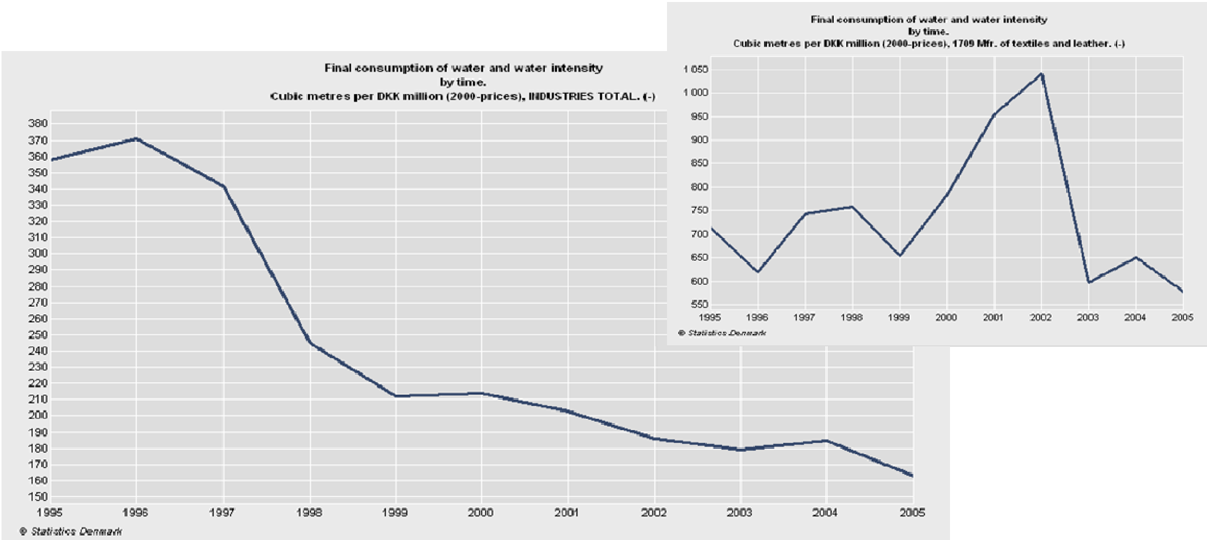
Source: VEWIN, 2010A, 2010B, CBS 2010.

To gain a more detailed insight into the water usage of industrial sectors and its relation to economic development, four identified indicators (#3, #6, #7, #9) analyse the water intensity of key sectors, i.e. how much water is used in relation to its production value.

One example to analyse this relationship is to assess the trend of water consumed in the national in-dustry per value added of the production over time (Indicator #3). Graph 4 shows clearly that there has been a steep drop in water consumed per unit of production in Danish industry since late 90ies, where the amount of water used to produce 1 million DKK of added value decreased from 370m³ to 165 m³ between 1996 and 2005 (55 % decrease, left graph). With water use information available, this analy-sis can also be done for specific sectors, e.g. for the textile and leather industry (right graph). The latter graph nicely illustrates that the concept of water use intensity can also be used to detect irregularities, such as the steep increase in water use in between 1999 and 2002.

[23] As other water sources are not included in this indicator, the conclusion that overall GDP growth has been decoupled from overall industrial water usage cannot be made.

Graph 4 Final consumption of water and water intensity by industry in Denmark, 1995-2005

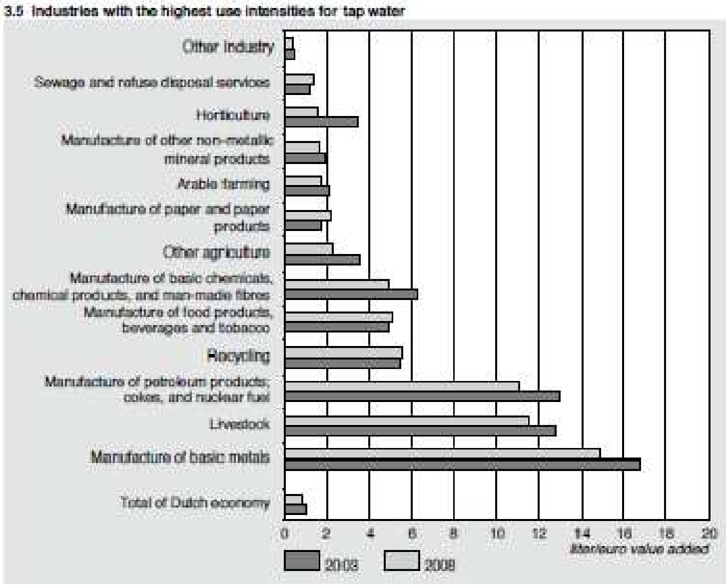


Source: Statistics Denmark

Note: the left graph illustrates the entire industry, while the upper left graph focuses on the textiles and leather industry.

To gain a comparative overview over the water use intensity between sectors over time, bar charts offer graphical insights into the current and past situation. Graph 5 shows the water use intensities of tap water for selected industries for the years 2003 and 2008 in the Netherlands (Indicator #6). Water use intensity for an industry is defined here as the use of tap water (l) per Euro value added in the respective industrial sector. On average, 0.85 litres were used for every euro of value added generated by the Dutch economy in 2008. This is an improvement when realizing that 1.04 litres were used for every euro value added in 2003. High water use intensive industries, such as “manufacture of basic metals” can be distinguished from low water use intensive industries, such as “sewage and refuse disposal services”. The comparison of water use intensity in industries in 2003 and 2008 gives insights into the development of water use intensity over the past years and sheds light on the trends of water use for the main industrial water users. For example, this graph shows that some water intensive industries, such as “manufacture of basic metals”, “livestock” and “manufacture of petroleum products” significantly reduced their tap water use intensity rates by 12%, 10% and 15% respectively. On the other hand, sectors such as the “manufacture of paper and paper products” and “sewage and refuse disposal services” increased their tap water intensity rates by 22% and 11% respectively.

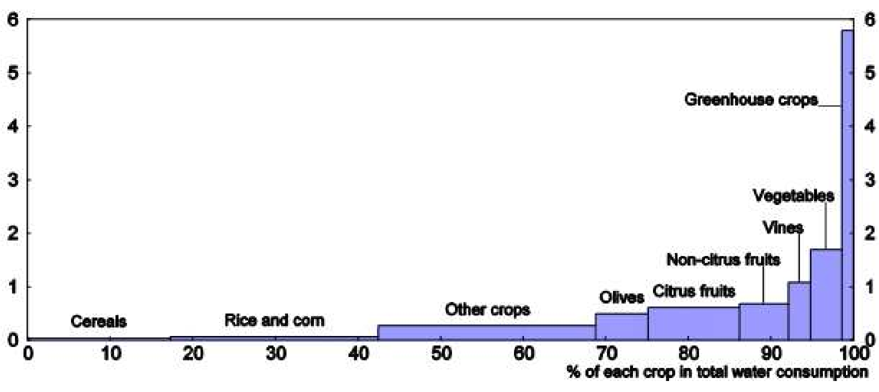
Graph 5 Water use intensity for industries in the Netherlands, 2003 and 2008



Source: Statistics Netherland, 2010

In order to gain a more detailed picture of water resource efficiency, water use intensities can be assessed within a sector. Graph 6 presents an example of assessing water productivity expressed as gross value added per cubic meter of water consumed for irrigation of particular type of crops. (Indicator #7). This is a good example, where the added value per m3 in a water stressed environment may influence the agricultural strategies on which crops to grow for optimisation of income.The share of water consumption for each crop type is displayed on X-axis. The differences in water productivity across crops grown in Spain are large, 75% of value added generated in irrigated agriculture consumes just 9% of irrigated water. The cultivation of crops which generate low value added relative to their water needs (such as cereals) is typically characterized by low efficiency in irrigation, i.e. a more extensive use of irrigation techniques that supply more water to the land than the crops require (such as flood techniques). By contrast, cultivation of high value added crops achieves efficiency rates of 90%. This situation is also likely, to some extent, to reflect the incentives generated by quantity constraints and the limited allocate role of prices: incentives to raise the technical efficiency may therefore only be strong when the value added generated by additional water input is high. More reliance on market signals, such as cost-reflective water pricing and water trading, would help to generate incentives to use water-saving technology in all agricultural production.

Graph 6 Gross value added at market prices of water consumed in irrigated agriculture in Spain, 2001/02

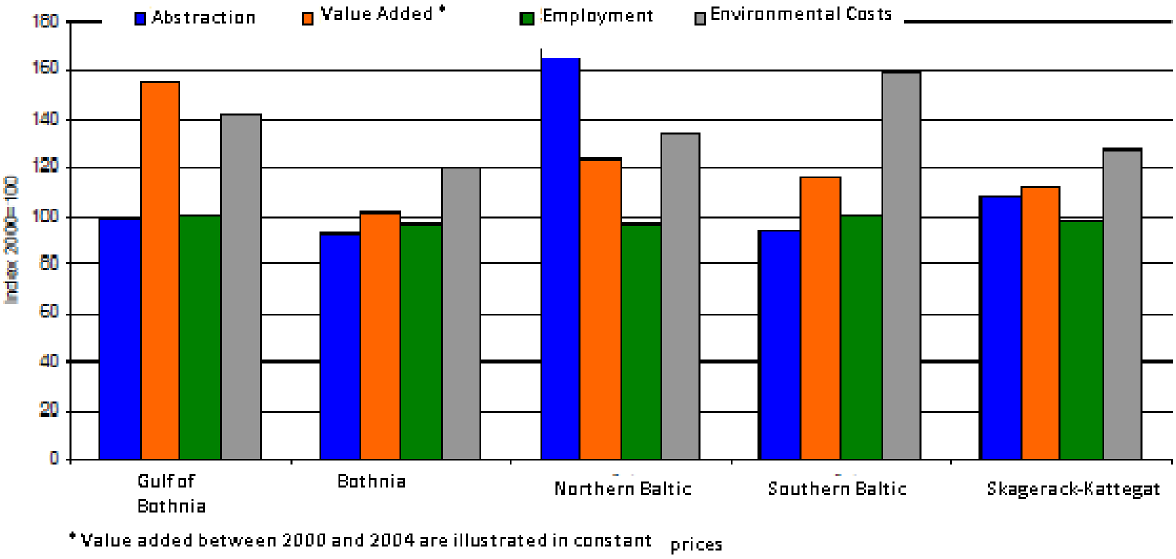


1. Each rectangle area is proportional to the share of each crop in the value added of irrigated agriculture.

Source: MMA (2007), *El agua en la economía Española: situación y perspectivas, Ministerio de Medio Ambiente.*

Instead of focusing on specific industries, however, the water use intensity can also be assessed for river basin districts and can be compared across the country. For example, Graph 7 presents the evolution of water abstractions, value added and employment for water- intensive industries in Sweden's river basin districts between 2000 and 2005 (Indicator # 9). Further, the costs invested for treating and preventing environmental impact are depicted. The decoupling of economic activity in the water intense industry and water resource use clearly occurred in the river basin districts of Gulf of Bothnia and Southern Baltic, with water abstraction remaining constant or even decreasing and value added increasing significantly. Water abstraction has increased significantly in the Northern Baltic (60%), while value added increased only by 22%. This indicates that the economic activity in the water intense industry and water resources use are still strongly linked. Decoupling can be seen to a lesser extent in the river basin districts of Bothnia and Skagerack-Kattegat. Investments for treating and preventing environmental impact increased most in the Southern Baltic.

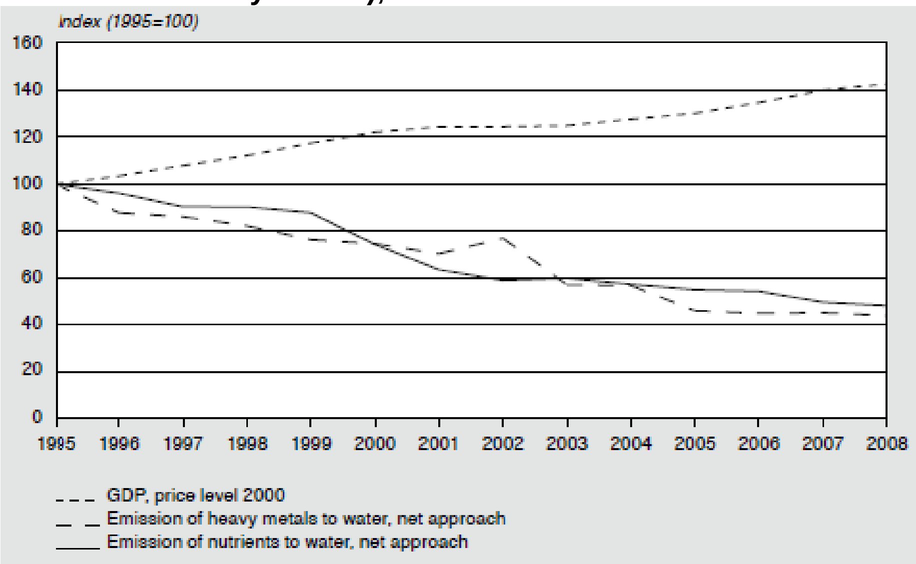
Graph 7 Evolution of water abstractions, value added and employment in Sweden's river basin districts for water-intensive industries, 2000-2005.



Source: Sweden Statistics, 2007

When seeking more information on the water pollution which is caused by economic activity, it is of interest to relate economic growth to the emissions of water (Indicator #4). Graph 8 attempts to assess whether economic growth in industries and households and water emissions have been decoupled over the period 1995-2008 or not. Starting from a common point in 1995 (=100), the subsequent development of water emissions and economic growth is graphically depicted. The widening gap between the GDP and water emission trend lines clearly shows two opposite trends. While the Dutch economy (industries and households) grew by 43% over the period 1995-2008, heavy metal emissions from point sources decreased by 56% and nutrient emissions from point sources decreased by 52%. This shows that emissions of heavy metals and nutrients to water and economic growth have been decoupled over the period 1995-2008.

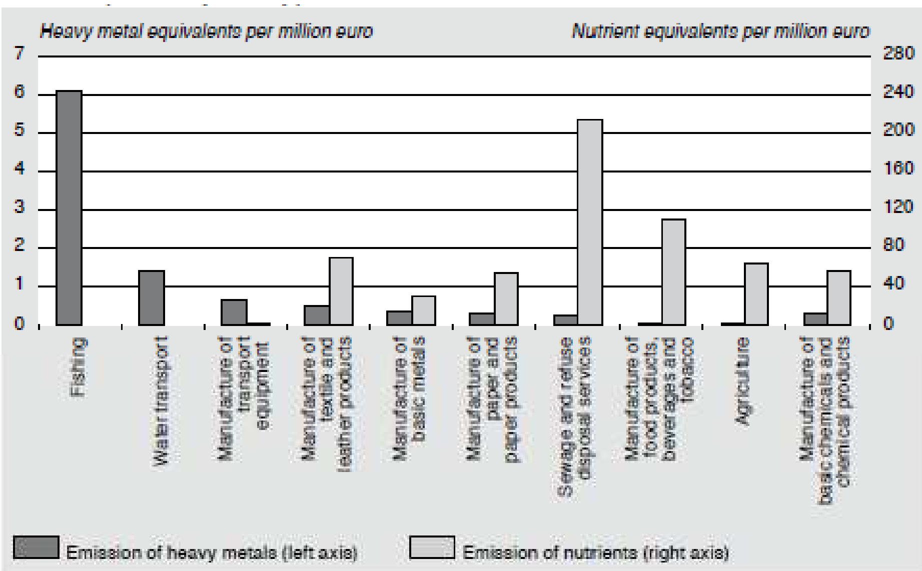
Graph 8 Economic growth and contribution of the Dutch economy to water emissions (nutrients and heavy metals), 1995-2008



Source: Statistics Netherlands, 2010

Similar as has been illustrated above for water use intensity, the degree of pollution can be related to the value added as a consequence of the water use which resulted in pollution. Graph 9 illustrates the emissions intensity, i.e. the emissions per million euro value added, for key industries. The emissions are split between heavy metal and nutrient equivalents. The emissions intensity differs highly between industries. "Fishing" was responsible for the highest emissions of heavy metal equivalents per million euro value added, while "Sewage and refuse disposal services" emitted the highest nutrient equivalents per million euro.

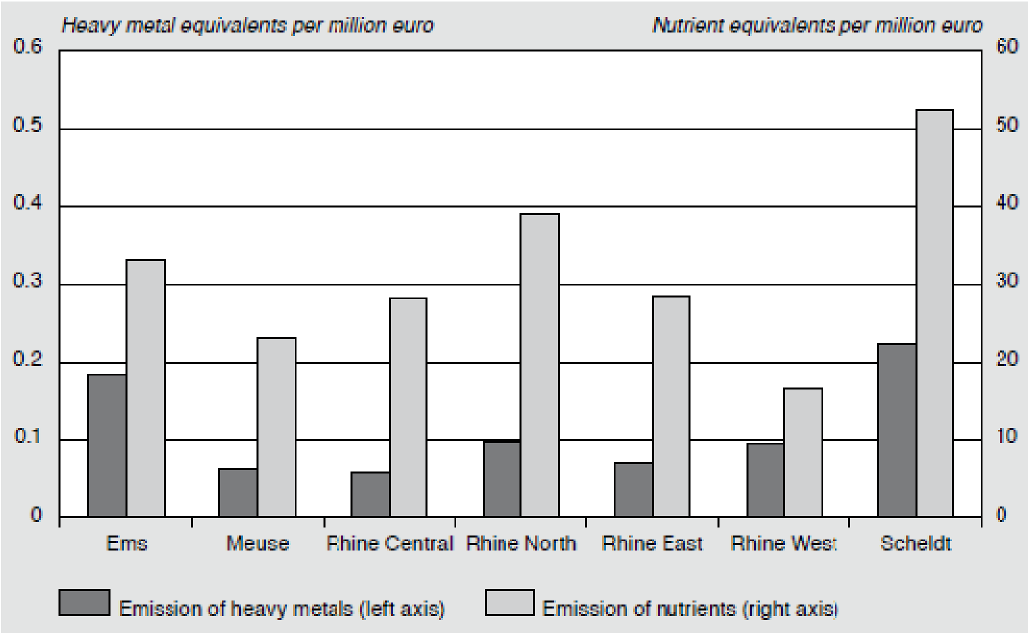
Graph 9 Emissions intensity in the Netherlands - water pollution by industry per million of Euro value added in 2008



Source: Statistics Netherlands, 2010

As water pollution is a mainly local environmental problem, water quality targets for the WFD are determined at river basin level. As above, the emissions intensity can also be illustrated for national river basin districts, instead of for industrial sectors (Graph 11). Overall water pollution per million euro value added is very high in the Scheldt and Ems river basin districts, while the Rhine West district has the lowest emissions intensity. The emissions are highly dependent on the economic activity in the basins, as well as on the environmental regulations in these districts.

Graph 10 Heavy metal and nutrient emissions intensity per river basin in the Netherlands, 2006



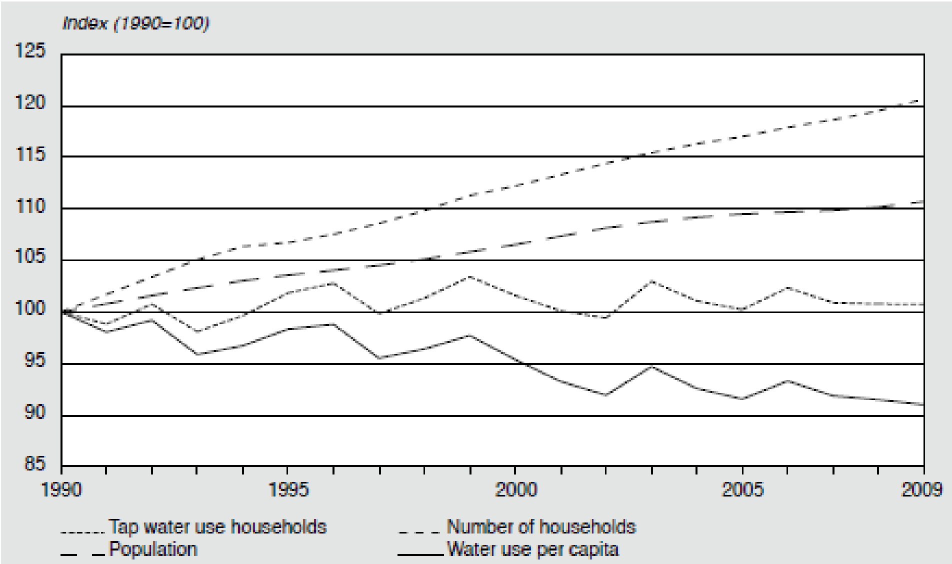
Source: Statistics Netherlands, 2010

Instead of assessing water resource efficiency in relation to economic development, the impact of population growth on water resources can be taken as a parameter. As such, Graph 11 depicts population growth and the tap water use per capita, as well as the increase of number of households with tap water use per household for the period 1990-2009. The data is indexed, using the year 1990 as the baseline.

Households account for nearly 2/3 (66%) of overall tap water use in the Netherlands. Despite population growth and an increase in the number of households, tap water use per capita has decreased. Tap water use per capita has been reduced by 9% from 48m³ in 1990 to 44m³ in 2009. The efficiency gains come from efficiency measures, such as water saving measures and appliances, such as washing machines, dishwashers etc. Daily tap water use per household has dropped by 16% from 322 litres in 1990 to 269 litres in 2009. This drop can be explained by the smaller size of the average household, partly due to an increase of one person households.

Despite increased population growth, the total annual amount of water used by households only increased by 1% since 1990, while per capita use decreased by 9%. These trends indicate a certain degree of improving domestic tap water use efficiency and decoupling of population growth and tap water use.

Graph 11 Development of tap water use by households, size of population and number of households in the Netherlands, 1990-2009



Source: VEWIN, 2010A, 2010B; CBS 2010.

Conclusions

This brief analysis shows that there are ample opportunities to assess water resource efficiency by means of indicators and graphical illustrations. Further analysis, particularly on the data situation, will be undertaken to assess their applicability on an EU-wide level.

Most indicators presented in the inventory have an economic angle towards resource efficiency, using value added and GDP as main variables. However, two indicators (#2 and #11) fail to match the definition of water resource efficiency used in this report and need to be further evaluated to assess their potential for adjustment to an EU-wide resource efficiency indicator.

As water pollution and water scarcity issues are mainly local environmental problems, the option to assess water resource efficiency at a river basin district level, as is presented above, is of great interest for the further development of EU-wide water resource efficiency indicators.

The graphical representations, including the bar charts as well as the indexed trend graphs, offer a powerful communication tool of achieved or not achieved water resource efficiency. This type of graphical representation will be aimed at in the development of new EU-wide water resource efficiency indicators.

The development of water resource efficiency indicators, as illustrated above, and the development of a water accounting framework are closely linked. As has been illustrated in the case of e.g. the Netherlands, the content of their water accounts has been beneficially used for the development of detailed and insightful water resource efficiency indicators. Alternatives need to be found to cover EU Member States which have not introduced such accounting system.

While the illustrated water resource efficiency indicators allow insights into the situation of water resource use and its pollution, they do not provide insights into other resource uses. Efficiency gains in the water sector may lead to e.g. disproportionate higher energy use. Where possible, the various resource uses needs to be interlinked.

3. Proposals for new EU wide resource efficiency indicators

This chapter is divided into two sections. The first section illustrates resource efficiency indicators which have been proposed to the EEA, with a concrete description of their objective/use, their development, data sources and their application. The second section illustrates resource efficiency indicators which still lack this concrete description due to uncertainties of e.g. current data sources. Jointly these sections shall serve as a basis for assessing the feasibility of the development of the proposed indicators as well as a basis for a substantiated discussion between the partners for this task.

3.1. Detailed description of proposed resource efficiency indicators

Agricultural Water Use Efficiency Index

Objective/Use: As an example of the work in this area for next year, we propose the development of an agricultural water use efficiency index, to gain an overview of geographical water efficiency in growing certain produces and subsequent trading patterns. By decoupling water use and national production unsustainable production patterns shall be illuminated.

Development: The indicator shall be based on virtual water calculations, i.e. the amount of water used to produce a good. To include the importantce of the national (and if data is available regional) level of water scarcity, the analyzed countries are sorted into categories following the indicator “Withdrawal to Availability (WTA)”which is the ratio of annual water withdrawal and annual water availability.

$$\frac{GDP\_share_{produce\_a}}{Virtual\_water\_content_{produce\_a}}$$

Data: Expanding upon the Fast Track Ecosystem Capital Account by the EEA, data relating to agricultural production can easily be obtained from FAOSTAT, while crop water requirements are available in Mekonnen and Hoekstra and Hung (2010), the pioneers in virtual water calculations. Data for the WTA is available from FAO Aquastat. The option to distinguish between green and blue virtual[24] water can be discussed.

Application: Data on water use efficiencies for various agricultural products or for the entire agricultural production can be assessed for each EU member state and be compared EU-wide. Country-level data could further be aggregated to EU-level and serve for international comparisons and benchmarking. Further, the agricultural water use efficiency can also be compared over time to incorporate changes in policies and production. The results can be presented graphically in bar charts, maps, indicating levels of water use efficiency.. The relative (regional) comparison of water use efficiency can be important for future decisions as where to produce e.g. biofuels, water intense crops etc.

[24] Green water refers to soil water, soil moisture etc, while blue water refers to surface and groundwater

Water-indexed GDP generation

Objective/ Use: This indicator can convey information on how efficiently in terms of economic benefits is the water used across the economic sectors (agriculture, industry, tourism). Furthermore if compared with the unit cost of water (for each sector) it can provide metrics of profit level made from the unit (cost of m^3 water vs. earning from m^3 of water spent for X activity). By developing an indicator which illuminates the water productivity by industry, water inefficient industries nationally and in international (inter EU) comparison can be highlighted. This indicator will shed interesting information on EU-wide sectoral differences in water use efficiency.

Development: The indicator shall be developed as the following ratio:

$$\frac{GDP_{SectorA}}{m^3\_water\_used_{SectorA}}$$

Data: Sectoral data on water withdrawals can be accessed from FAO Aquastat or from WISE-SoE#3 Water Quantity and Eurostat for water use. Data on value added (%of GDP) can be accessed per sector from the World Bank database, among others (e.g Eurostat).

Application: The results of this indicator can be displayed in bar charts with the GDP/m^3 water use on the y-axis and the sectors on the x-axis. A comparison over time nationally, or a comparison of sectors within the EU can be graphically visualized. For the economic sectors were data are available (e.g. agriculture, industry) a map assessing the efficient use of the water from this sector can be created, comparing the water use with the income generated by this sector. The proposed spatial scale is RBD or country level, and the temporal scale in annual.

UWWTPs emission index (alternatine proposal "Household emission index)

Objective/Use: Proposed indicator shall illustrate decoupling of loads of pollutant discharged from population growth. Emission will include both treated and untreated wastewater.

Development: The indicator shall be based on data of BOD, N and P discharged loads, and weighted against the total national population.

UWWTP emission index= (1/national population)(total annual load discharged t/y) [t/person]*

Data: Data on discharged loads can be obtained from the UWWTD production database, WISE SoE Emission database, and EUROSTAT (JQ IW), which is also a source of data on national population. Alternative option is a use of EPRT-R data, addressing only large polluters.

Application: EU wide application of UWWTP emission index is determined by availability of data on discharged loads (e.g. 8 MS reported under the UWWTD, 13 MS via WISE SoE Emissions). Data shall be presented in charts, showing development of the UWWTP emission index (with use of time series where available) over time or in maps, displaying countries or RBD polygons in color corresponding to the specific range of the index. In the future development, the UWWTP emission index as production indicator, should be supplemented with a consumption indicator(s) , illustrating drinking water consumption as well as consumption of specific products, that are known to be major source of nutrients (e.g.domestic detergents).

Industry emission index

Objective/Use: Proposed indicator shall illustrate industry specific substances intensity.

Development: The indicator shall be based on data of heavy metals and hazardous substances discharged loads weighted against industry GDP.

Industry emission index= *(1/GDP_{ind})*(total annual load discharged t/y) [t/GDP]*

Data: Data on discharged loads can be obtained from the WISE SoE Emission database Alternative option is a use of EPRT-R data, addressing only large polluters. Macroeconomic data can be obtained from Eurostat or World bank database.

Application: EU wide application of industry emission index is determined by availability of data on discharged loads from all sources (12 MS via WISE SoE Emissions, loads exceeding set threshold reported in EPRT/R). Data shall be displayed in two modes. (1.overall industry intensity per selected hazardous substance, 2. specific industry sector intensity per per selected hazardous substance). Data shall be presented in maps displaying countries or RBD polygons in color corresponding to the specific range of the index.

Agriculture emission index (*development depending on time and resources available)*

Indicator addressing Agro eco- efficiency can be found at http://www.eea.europa.eu/data-and-maps/figures/agriculture-eco-efficiency

Impact (pressure) with regards to water quality is expressed as amount of fertilizers /pesticides consumed. This does not reflect the actual amount of polluting substances (potentially)reaching water. Therefore we suggest to extend (if agreed) the current indicator with data on nutrient (N, P)losess from agriculture expressed as nutrient surplus. (available only for nitrogen)
Objective/Use: Proposed indicator shall illustrate agriculture nutrients intensity.

Development: The indicator shall be based on data of nutrient losses from agriculture from weighted against agriculture GDP.

Agriculture N-emission index= *(1/GDP_{agri})*(total annual nitrogen lsurplus t/y) [t/GDP]*

Data: Data on nitrogen surplus as well as macroeconomicdata can be obtained from Eurostat, World bank database. or OECD .

Application: EU wide application of agriculture emission index is determined by availability of data on nutrient losses from agriculture. Data shall be presented in maps displaying countries or RBD polygons in color corresponding to the specific range of the index. In the future development, pesticides losses shall be addressed as well. Data on checmical status of SW and GW bodies can be used to illustrate the impact of pesticides use.

Water Recycling and Reuse Efficiency

Objective/Use: This indicator can provide metrics on the water saving (actual and potential), the uptake of this technology, as well as the dependency of an area on this alternative water resource.

Development: Total volume and percentage of recycled (and/or reused water) to total volume of water use

$$\frac{m^3\_water\_recycled}{m^3\_water\_used} \qquad \frac{m^3\_water\_reused}{m^3\_water\_used}$$

Data: WISE-SoE#3 Water Quantity and UWWT Directive

Application: A map showing the RBDs which recycle (and/or reuse) water. The volume can also be indicated, as well as the main sector which reuses (if available). The map can be complemented with information from the UWWT directive showing the locations (and volumes) of the wastewater treatment plans. The proposed spatial scale is the RBD or SU and the proposed temporal scale is annual.

Share of Returned Water

Objective/Use: This indicator can provide metrics on the percentage of abstracted water that is retuning to the area (either in the same source or a different, i.e. from groundwater to surface water). Thus, it is actually water added to the freshwater available at a different time step. Yet, this water may be returned to another area than where abstracted if it was transported for use elsewhere.

Development: Total volume and percentage of returned water to total volume of water abstracted

$$\frac{m^3\_water\_returned}{m^3\_water\_abstracted}$$

Data: WISE-SoE#3

Application: A map showing the RBDs and the volume of returned water as percentage of the total abstracted volume. The map can be complemented with information showing whether the water is returned to the same area where abstracted or elsewhere (i.e. water transported for use)

Water Distribution Efficiency

Objective/Use: A difference between total water abstraction and total water use can be calculated to assess water losses and thus water distribution efficiency.

Development: Total volume and percentage of water actually used over the total volume of water abstracted

$$\frac{m^3\_water\_used}{m^3\_water\_abstracted}$$

Data: WISE-SoE#3 Water Quantity and 2010 WFD reported schemas

Application: A map can be produced showing the spatial distribution of the miss-match between total water abstraction and total water use per RBD at annual scale. This is an indicator of water loss and relates to the water use and water distribution efficiency.

Water Exploitation Index+ (WEI+)

Objective/Use: There are many suggestions currently available for expressing the exploitation of water resources and capturing the balance between water demand and availability, bearing different names and definitions, developed by EU and other initiatives, as presented in the following table:

Table 2 Water Exploitation Indicators developed by EU and other initiatives

Indicator/ Index	Reference	Spatial Scale	Required Data
Water Exploitation Index (WEI)	EEA	Country, some RBs	annual freshwater abstractions long term annual availability (LTAA)
Intensity of use of water resources	OECD, 2001	country, region	annual freshwater abstractions total renewable water resources
Index of Watershed Indicators (IWI)	EPA, 2002	watershed	15 condition and vulnerability indicators
Exploitation index of renewable resources	Plan Bleu	country	
Water Stress Index (WSI) per source	EWP Water Stewardship Programme	Site specific	water abstraction/ consumption as percentage of available water per source (%) with the water abstraction volume per source in [m3/month or season] and average [m3/year]
Water discharge index (WDI)	EWP Water Stewardship Programme	Site specific	total amount of water discharge [m3/time period] in relation to total amount of available water body [m^3/time period
Indicator of water scarcity	Heap et al., 1998	country, region	annual freshwater abstractions desalinated water resources internal renewable water resources external renewable water resources ratio of the ERWR that can be used
Water availability index WAI	Meigh et al., 1999	region	time-series of surface runoff (monthly) time-series of groundwater resources (monthly) water demands of domestic, agricultural and industrial sector
Vulnerability of Water Systems	Gleick, 1990	watershed	storage volume (of dams) total renewable water resources consumptive use proportion of hydroelectricity to total electricity groundwater withdrawals groundwater resources time-series of surface runoff
Water Resources Vulnerability Index (WRVI)	Raskin, 1997	country	annual water withdrawals total renewable water resources GDP per capita national reservoir storage volume time-series of precipitation percentage of external water resources
Water Poverty Index (WPI)	Sullivan, 2002	country, region	internal renewable water resources external renewable water resources access to safe water, access to sanitation irrigated land, total arable land, total area GDP per capita under-5 mortality rate UNDP education index Gini coefficient domestic water use per capita GDP per sector Water quality variables, use of pesticides Environmental data (ESI)

The proposed WEI+ indicator is designed to depict the balance between natural renewable water resources and abstraction, in order to assess the prevailing water stress conditions in a catchment. It also aims in tackling some of the cons of the Water Exploitation Index (WEI), not only the spatial and temporal disaggregation issues, but mostly redefining the actual potential water to be exploited, since it incorporates returns and environmental requirements. The level of stress or relevant water scarcity in a catchment changes if we subtract an amount of water that is not actually available for abstraction since it needs to be left in the catchment to maintain its ecological status (in line with WFD).
The rationale behind this indicator and its main innovation is that it aims in reflecting the "true" volume of water which is available for exploitation. This amount is generated from the precipitation distributed over the territory and from inflows (both surface and groundwater). Additionally we have to account for the amount of returned water that is added to the system. On the other hand, this amount is reduced by the quantity that evapotranspirates, but we also need to account for a minimum volume that flows out of the system in order to meet environmental requirements (and thus this amount is not actually available for exploitation) plus other requirements that may be mandatory (e.g. treaties in tranboundwary river basins). There may also be some losses or percentage of water that can not be exploited due to specific circumstances (e.g. karstic geology where groundwater path is difficult to track and thus exploit). The current indicators on water availability which are stand-alone (e.g. Falkenmark Water Stress Indicator) or constitute a part of water stress and exploitation indices (such as the WEI, the OECD Water Scarcity Index etc.) do not usually reflect the availability in this context, since they do not account e.g. for environmental flow requirements. The proposed indicator of considers Environmental Requirements as "non-available for exploitation" water, accounts for the returned water as addition to the system (which is extremely important especially in cases where water is abstracted and returned elsewhere), while the analytical expression of the indicator can reflects the dependency ratio on resources from outside the territory (external inflows as percent of the total). Potential losses like described above are considered negligible and omitted from the indicator's formula especially because it is very difficult to calculate them at EU wide level. This indicator can draw a clear picture on the available for exploitation water and in combination with the indicator on water abstraction or use can be used in mapping water scarcity and water exploitation, while it can also be used for management purposes especially when combined with additional indicators on drivers, impacts, response etc.

Development: volume of abstracted water over the total volume of renewable water availability (RWA)

$$\frac{m^3\_water\_abstracted}{m^3\_RWA}$$

Where,

$$RWA = \mathrm{Pr}\,ecipitation - Evapotranspiration(actual) + External\_Inflow - Water\_\mathrm{Re}\,quirements + \mathrm{Re}\,turned\_Water$$

Note:
Water Requirements refers to the environmental requiremenets, plus other additional requirements that may exist is an area (e.g. treaties in transboundary rivers)
This indicator is currently under testing witrh pilot river basins

<u>Alternative expression for this indicator</u>: the difference between the abstracted water and the renewable water availability (RWA). When this has a negative value, water stress conditions are prevailing.

$$\Delta[(m^3\_water\_abstarcted) - (m^3\_RWA)]$$

Data: WISE-SoE#3 Water Quantity and 2010 WFD reported schemas

Application: A map can be produced showing the spatial distribution of the miss-match between total water abstraction and renewable water availability.

3.2. Overview of proposed potential resource efficiency indicators

Table 3 presents an overview of resource efficiency indicators in the water sector which have been proposed to the EEA for the development of this task, but still require further research and coordination, e.g. with the EEA Fast Track Ecosystem Accounts undertaking, before their feasibility and significance can be judged.

Table 3 List of proposed resource efficiency indicators

Name	Description	Comments
Use of chemicals for wastewater treatment	Amount of chemicals used per unit of Phosphorus removed	
Energy intensity of wastewater treatment	Amount of energy per unit of (BOD, nutrients) removed	
$ Value of water use efficiency (productivity) for a particular economic activity	The $ value (GVA) of this activity x divided by the ratio of amount of water withdrawn for activity x and water returned from activity x	Direct link to indicators used in the EEA Fast Track Ecosystem Accounts (indicator development could be postponed depending on EEA Fast Track developments)
Efficiency of Storing Water	Ratio of consumption, evaporation or leakage of water and the storage in user systems	Direct link to indicators used in the EEA Fast Track Ecosystem Accounts (indicator development could be postponed depending on EEA Fast Track developments)
Clean production efficiency	Ratio of direct emissions to water from (economic) activity x and water used for economic activity x	Direct link to SEEAW emission accounts – could link this to employment statistics. Cross-country comparisons can shed light on sectoral (in-) efficiencies (Postponement possible until SEEAW accounts exist for all Member States)
Water efficiency in touristic establishments	Comparison of domestic water use, tourist revenue and collective tourist accommodation establishments *(Bo: As prices in this sector are highly fluctuating, normalisation per hotel overnights may be better than revenue)*	
Environmental Impact caused by gross value added economic activities	Ratio of number of environmental pressures per River Basin Unit or country and Gross Value Added (GVA) per main industry sectors.	See below Direct link to the implementation of the WFD. Specifically exemptions and issues of disproportionate costs.

4. Overview on related activities at EEA, Eurostat and DG ENV

Currently a number of activities related to the application of water accounts are taking place at different European bodies. A workshop on water accounting and economics was organized by the EEA on 7 and 8 October 2010 to get an overview on these activities, to identify synergies and need for coordination. It is mainly DG ENV, EEA and Eurostat who are actively developing water accounts and/or considering themselves as potential users.

4.1. Overview on water accounting activities at DG ENV, EEA and Eurostat

Related activities at DG ENV:

In 2012 DG ENV plans to publish the **"Blue Print to safeguard Europe's water",** which will include:

- Assessments of River Basin Management Plans (RBMPs)
- A review of the strategy for water scarcity and droughts
- A review of the vulnerability of water and environmental resources to climate impacts and man-made pressures

The Blue Print will be completed with information from the "EEA report on state of Europe's water" and will also involve EEA's staff. In this context water accounts are considered as a tool supporting the analysis of various water policies in a consistent and coherent way. They should support the following:

- A policy aiming at a more resource efficient use of water
- A policy promoting implementation of ecosystem based approaches for water provision
- Development of a tool for demand management at River Basin level

Related activities at the European Environment Agency:

One of the current priority works of the EEA is the **assessment of water stress in the frame of the Scarcity and Droughts policy**, which will also be reflected in the above mentioned Blue Print.
SEEA-Water provides the conceptual frame for this assessment, which is done for small sub-catchments (analytical units) on a monthly basis. This allows an analysis on local and sub-annual level as well as the calculation of water stress indicators which consider local and seasonal variations. The ECRINS as reference system developed by EEA provides the basis to model natural water exchanges and for aggregation.
The resource efficiency indicators developed in this context are also investigating the usefulness of SEEA-Water as the conceptual frame which allows consistency and coherence of the various indicators.

Another important work related to environmental-economic accounting in general (including the module water accounts) is the **valuation of ecosystem services based on ecosystem capital accounts**. This work will result in a 'Total Ecosystem Potential' indicator next to a so-called Water Index (see also section 1.2). The SEEA and SEEA-Water Framework provide the conceptual background and are used to connect physical accounts with monetary accounts, qualitative and quantitative aspects and the different data sources. For the water component (asset accounts) ECRINS provides the necessary reference.

<u>Related activities at Eurostat:</u>

Eurostat runs the data centre on natural resources and products and sees its focus on physical supply and use of water. European water accounting tables are currently developed by Eurostat (within the frame of SEEA-Water) to **support the assessment of sustainable consumption and production** with water data.
The overall goal is to add "Water-Vectors" to the Input-Output framework (e.g. to calculate water embodied in products imported into the EU27). To achieve this Eurostat together with a consultant is running a project with the following goals:

- To develop a set of tables for water accounts
- To clarify conceptual issues
- To provide guidance on compilation methods (compilation handbook)

First results of this work were presented to the NAMEA Task force on Water (22-23 October 2010). A next meeting of the Task Force is planned to be in autumn 2011. A voluntary data collection from NSIs is planned.

Eurostat is an **important data provider on water use and wastewater emissions** data within the Group of 4. The OECD/Eurostat Joint Questionnaire on Inland Waters follows already implicitly some water accounting rules.

4.2. Overview on existing data flows

As for physical water flows and stocks of water (including emissions and water quality) the most relevant data sources are those of EIONET Water and those under the existing water legislation in Europe (i.e. Water Framework Directive, Urban Wastewater Treatment Directive). As for industrial emissions the most relevant data source seems to be the annual reporting of ePRTR data.
Furthermore, the OECD/Eurostat Joint Questionnaire on Inland Waters has been one of the most important data sources to derive water indicators on national and annual level.
For economic data it will be mainly the System of National Accounts and its related reporting to Eurostat but also the (still) voluntary reporting on environmental expenditures.

All these data flows provide annually aggregated data and thus do not qualify to analyse seasonal variations. This still needs to be done by modelling. Collection of seasonal data on water uses and wastewater emissions has been done only voluntarily but cannot be repeated on a regular basis at the time being.

ePRTR and the OECD/Eurostat Joint Questionnaire on Inland Waters use NACE classifications and can be directly linked to the SEEA-Water framework (with some care, as maybe not all national data providers did refer to NACE – e.g. when reporting irrigation water supplied via canals).
For a disaggregation on River Basin Level not all data qualify. ePRTR and UWWTD data are geo-referenced for each individual object (ePRTR installation or UWWTP) whereas data from the OECD/Eurostat Joint Questionnaire on Inland Water is aggregated to national totals.

As for the asset accounts work is in progress at the EEA and ETC/ICM (see task 1.4.1.d: Improving water balance assessment for the water accounts).

4.3. Water accounting as the central concept: advantages and limitations

Using SEEA-Water as a central concept to arrange data from different data sources to get a full picture on the natural and economic hydrological cycle is very promising as this framework is conceptually sound and provides the necessary links between physical and economic data.

However, it does not solve the problem that some of the European data flows are not fully coherent and consistent with each other. For example overlaps the reporting under the Urban Wastewater

Treatment Directive partly with ePRTR reporting and does not provide a full picture on wastewater treatment (agglomerations of less than 2,000 p.e. are not included). On the other hand efforts to streamline data flows have been already successful (e.g. streamlining of UWWTD-reporting and data with reporting under the Water Framework Directive).

SEEA-Water provides a sound conceptual basis to arrange data from the various data sources and to derive a variety of indicators referring to both physical and economic use of water. However, SEEA-Water is a global standard which needs to be further disaggregated an modified in different directions to match European needs. This disaggregation includes:

- Spatial disaggregation to match the River Basin approach (which leads to practical difficulties for the economic data)
- Temporal disaggregation to match the seasonal variations of water demand and the actual availability of water resources
- Disaggregation of the industry-classification (ISIC/NACE 2 level) to the needed levels
- Disaggregation of the standard data items of the physical supply and use tables (PSUT) to better match existing data sources and to separate flows of unpolluted water from those of polluted water (e.g. wastewater from water supply, e.g. cooling water from process water etc.).

SEEA-Water furthermore uses a terminology and definitions that does not fully match the terminology and definitions used by OECD/Eurostat Joint Questionnaire and the European reporting obligations on water. When matching data from different sources with SEEA-Water tables it is very important to investigate on the definitions and terms used by the different frameworks (one example is the term "wastewater" which is differently defined in SEEA-Water and the OECD/Eurostat Joint Questionnaire on Inland Waters). Other potential sources of error are the different understanding of the terms "water use" and "water consumption" by different expert communities as well as the fact that "water use" can be composed of different kind of uses (e.g. cooling water included or excluded, water use for hydropower included or excluded, etc.).

As SEEA-Water uses statistical classifications (such as ISIC/NACE) they do not in all cases match the classifications used in the European reporting frameworks. For example for the reporting under the Urban Wastewater Treatment Directive it is of minor importance by which economic sector a particular treatment plant is operated (in the case of industrial treatment plants serving also agglomerations). For the correct allocation within the SEEA-Water framework it is important to investigate whether a particular industrial treatment plant is part of an industrial establishment (thus considered an ancillary activity) or operated independently (thus allocated to NACE 37).

5. Conclusions

While there has been a wide range of policy and research developments regarding resource efficiency and themes related to the green economy approach, there have been no noteworthy studies developing EU-wide resource efficiency indicators in the water sector.

The manifold aspects of the water sector require the consideration of a great variety of resource efficiency indicators. Quantitative aspects need equal consideration to qualitative aspects, covering all relevant sectors.

To assess existing efforts of EU Member States to measure water resource efficiency, this paper presents an inventory of existing water resource efficiency indicators. The analysis of which provides valuable insights for the further development of EU-wide water resource efficiency indicators. As such, ideas can be drawn regarding the scale of resource efficiency indicators, their focus and their graphical representation.

SEEA-Water could serve as a promising central concept to arrange data from different data sources to get the necessary fully picture on the natural and economic hydrological cycle and the linked economic aspects. As the European data flows have developed over time and are neither fully coherent with each other nor fully consistent with the SEEA-Water concept and its terminology, this kind of work has to be done with caution. Furthermore, it is necessary to disaggregate the SEEA-Water standard in several directions, such as spatial and temporal and to apply modelling techniques to fully match the needs of analysis of water stress on the River Basin level and to consider seasonal variations. The result of this work will be water accounts that could serve multiple purposes by different European bodies, ensuring full consistency of derived indicators and water policy assessments.

Tbc..

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Annex – Inventory of existing water related resource efficiency indicators

#1

1

Theme (category) of the indicator set:

Interdependency of economic output per sector and environmental (impact) indicators

Publisher:

Australian Bureau of Statistics

Policy background:

Australia suffers water scarcity. There is a high variety of the dependency of economic output from water consumption between the different industries

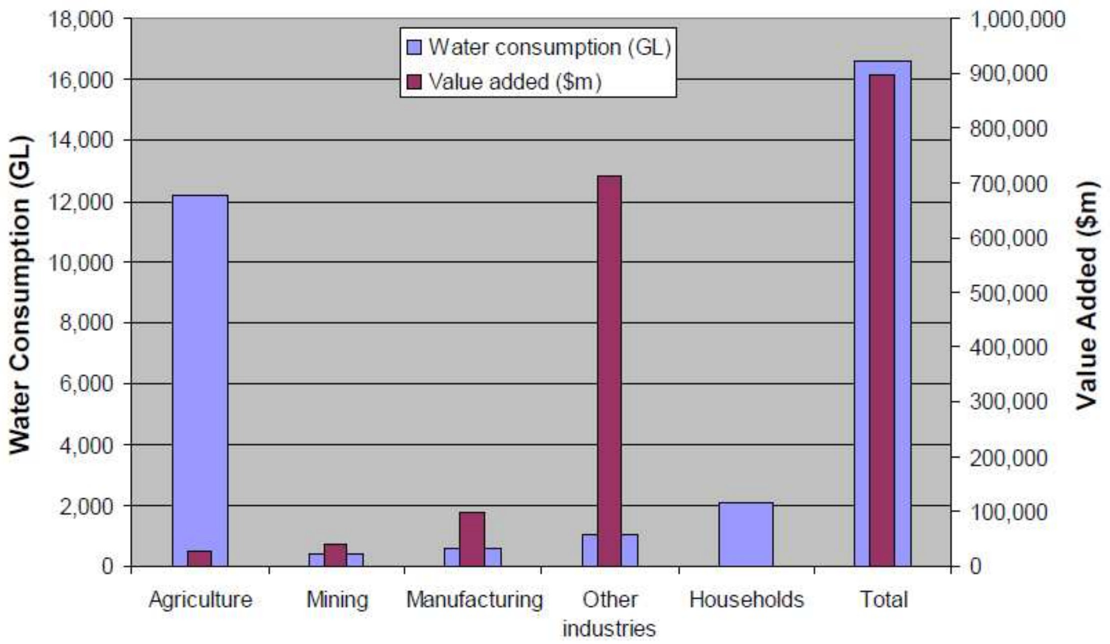
Key messages (problem statement):

Water is an important production factor in certain economic sectors, most important in agriculture. For policy makers it is important to see the relation between water consumption and economic output in order to decide upon measures to increase water use efficiency in high-water consuming sectors and to allocate more water to sectors generating a higher economic output per volume of water consumed.

2

Main Indicator title and graph:

Water consumption and value added (2004-2005)



Description:

This graph brings the value added in relation to the water consumption per sector. (NOTE: Australia makes a clear semantic distinction between USE of water and CONSUMPTION of water – consistent with SEEA-Water)

Key message/s:

Agriculture generates the highest pressure on the Australian water resources (in terms of water consumption), but is the industry with the lowest GDP contribution (in terms of value added). Other industries are the third largest water consumers, but generate the highest value added. Households are the second largest water consumers.

Coverage:

Geographical:	Australia
Temporal:	2004-2005
Frequency of Update:	unknown

Methodology:

It compares the consumed water (as defined by SEEA-Water 2007) with the value added per industry.

Data sources:

Australian Water Accounts 2004-2005

4

Other references (inc. web links):

http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4610.0Main+Features12004-05
http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4610.0.55.0052004-05?OpenDocument

#2

1

Theme (category) of the indicator set:
Water use and payments (response)

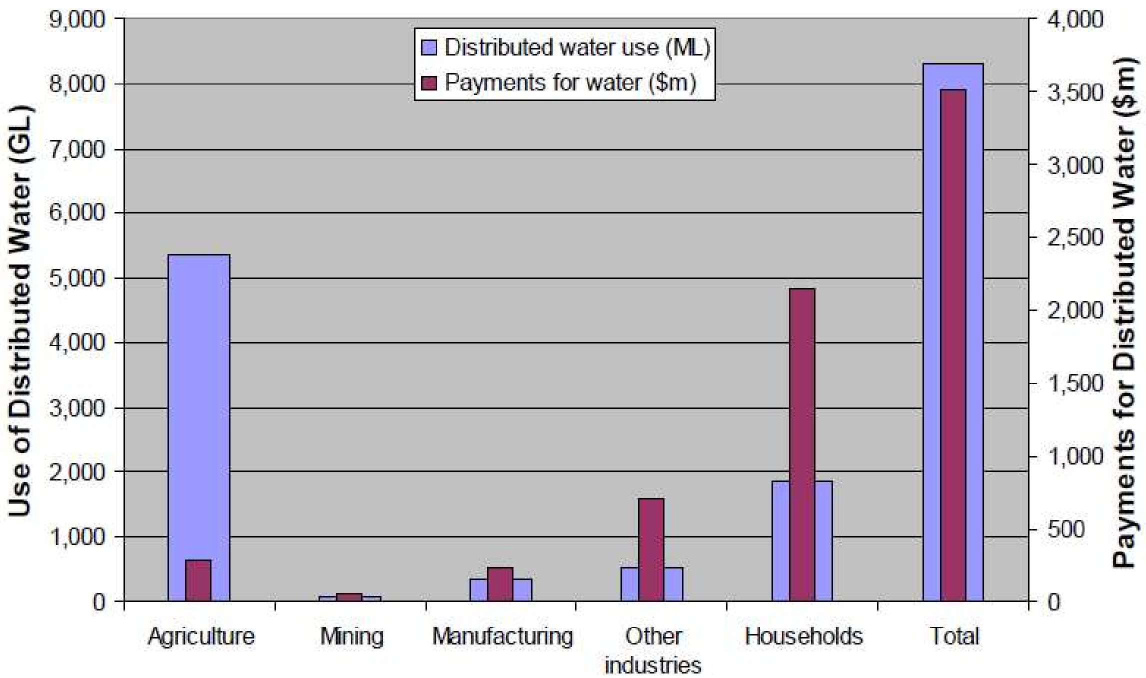
Publisher:
Australian Bureau of Statistics

Policy background:
Australia suffers water scarcity. Water pricing is an important measure to increase or decrease the water use efficiency and the different sectors.

Key messages (problem statement):
Payment for water reflects costs associated with storage, treatment and distribution of water (rather than the value of water itself). A sector-specific pricing structure is the result of complex economic and social considerations.

2

Main Indicator title and graph:
Water use and payments for water (2004-2005)



Description:
This graph brings the water price in relation to the use of distributed water per sector. (NOTE: Australia makes a clear semantic distinction between USE of water and CONSUMPTION of water – consistent with SEEA-Water)

Key message/s:
Agriculture is the largest user of distributed water (but also the largest user and consumer of water) in Australia, paying the lowest price per unit of water. Households as the second largest water users in the country have to pay the highest water price.

Coverage:
Geographical:	Australia
Temporal:	2004-2005
Frequency of Update:	unknown

	Methodology: It compares the amounts of distributed (billed) water with the corresponding water prices per economic sector and households.
	Data sources: Australian Water Accounts 2004-2005
4	**Other references (inc. web links):** http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4610.0Main+Features12004-05 http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4610.0.55.0052004-05?OpenDocument

#3

1

Theme (category) of the indicator set:
Water abstraction and use

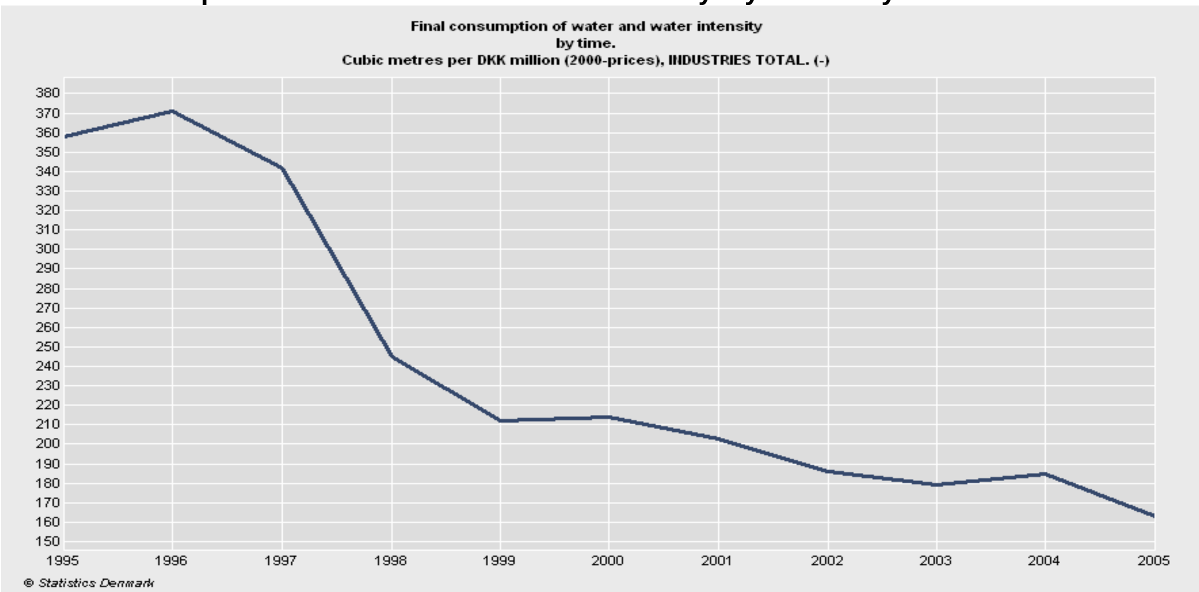
Publisher:
Statistics Denmark

Policy background:
Consequences of economic activities with regard to water quality and quantity have been analysed under the WFD- the River basin management plans. Study of the link between economy and water status (quality and quantity) is important issue for the estimating the costs (and benefits) of the implementing the WFD and consequently for the decision making.

Key messages (problem statement):
See key message of the main indicator and sub-indicators

2

Main Indicator title and graph:
Final consumption of water and water intensity by industry and unit



Description:
The graph displays trend in water consumed in industry per production (value added) expressed in constant prices (2000) in DKK. It shows clearly that there has been steep drop in water consumed per unit of production in Danish industry since late 90ies.

Key message/s:
The chart indicates steep drop in water intensity in Danish industry, where the amount of water used to produce 1 mil. of added value decreased from 370 to 165 m^3 between 1996 and 2005 (55 % decrease).

Coverage:
Geographical:¨Denmark
Temporal:1996-2006
Frequency of update:annual

Methodology:

$$\text{Water use intensity (sector)} = \frac{\text{Tap water used}_{\text{Sector X}}}{\text{Value\_added}_{\text{Sector X}}}$$

Value added ins expressed in constant prices of 2000

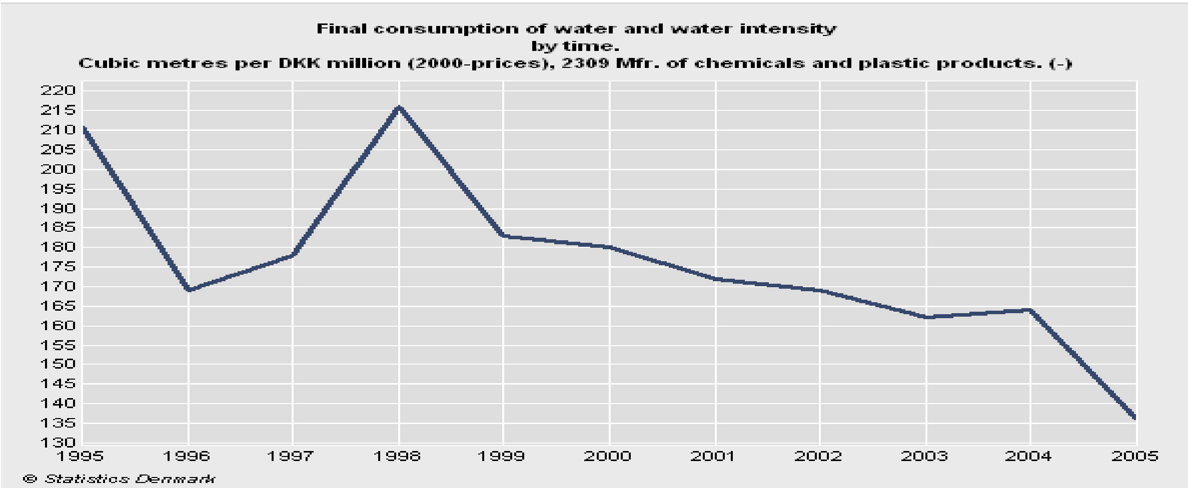
Data sources:

Data on water intensity (total industry, and per industry sector) in Statistics Denmark:
under: http://www.statbank.dk/statbank5a/default.asp?w=1280

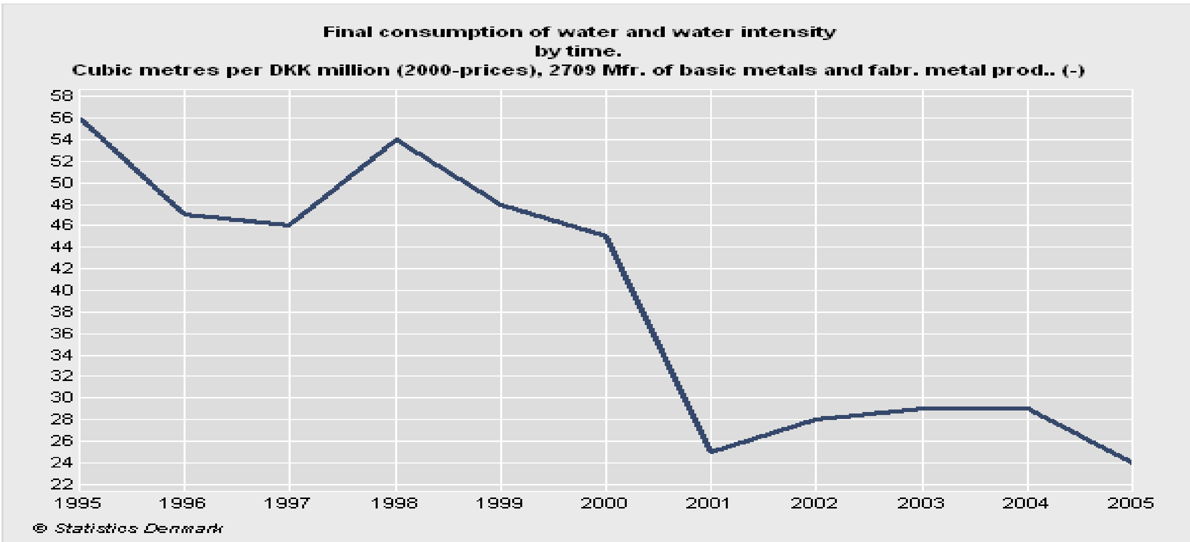
3

Sub-Indicator/s title and graphs:

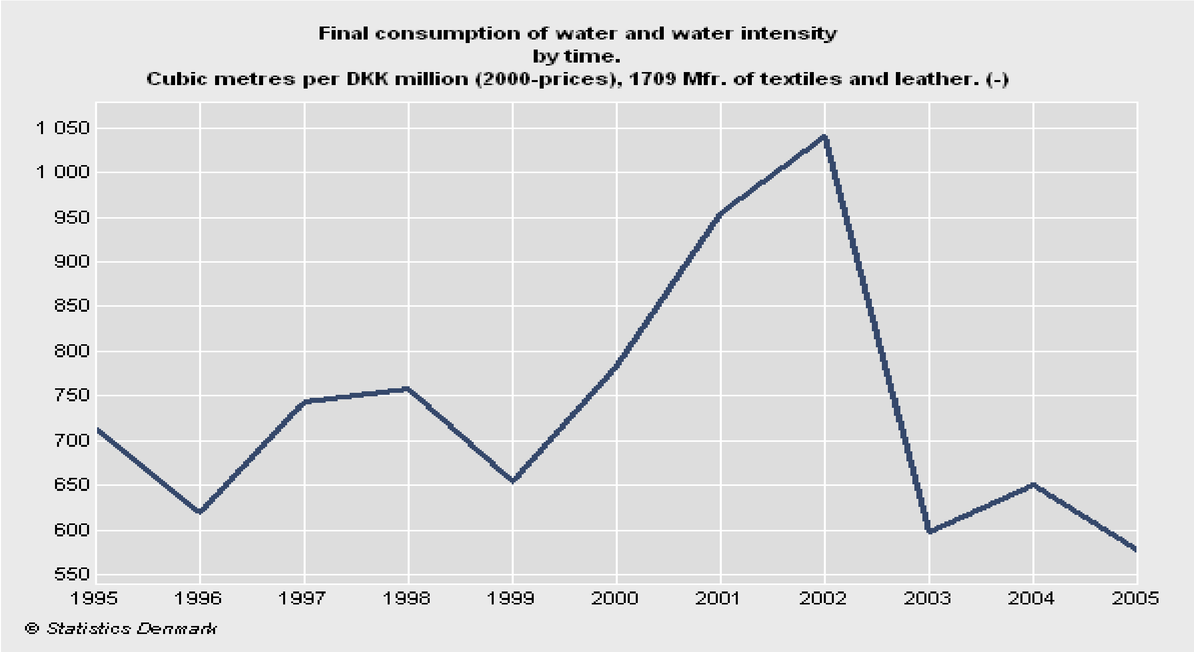
Final consumption of water and water intensity by industry and unit- chemicals and plastic products



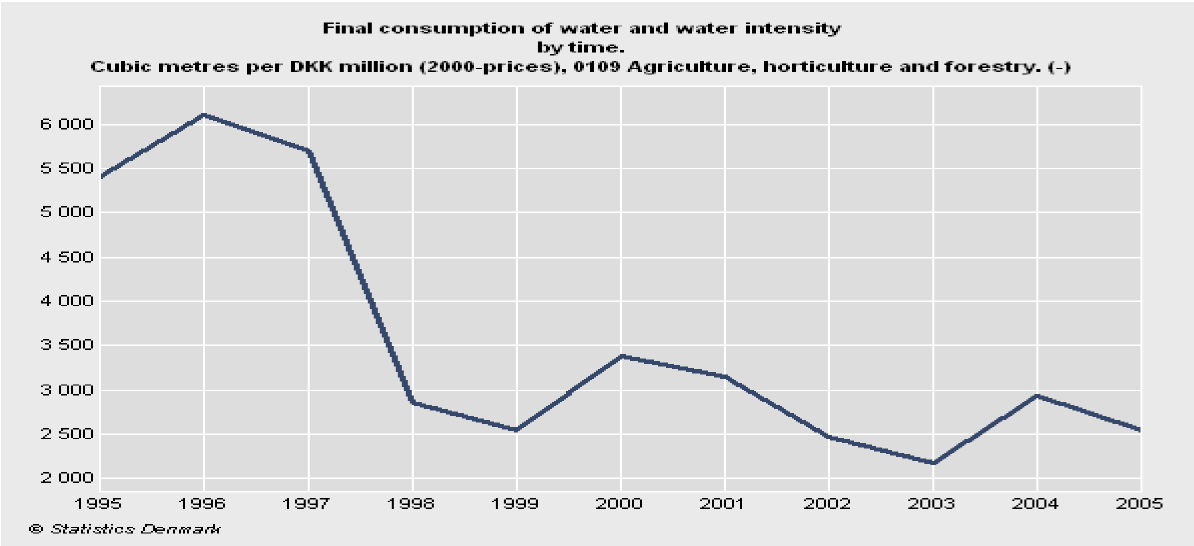
Final consumption of water and water intensity by industry and unit- metals and metal products



Final consumption of water and water intensity by industry and unit- textile and leather products



Final consumption of water and water intensity by industry and unit- agriculture, horticulture and forestry



Description:

The graphs displays trend in water consumed in particular economic sector (industry of chemicals and plastic, metal processing industry, textile and leather industry and agriculture) per production (value added) expressed in constant prices (2000) in DKK.

Key message/s:

Water intensity varies among individual economic sectors. The highest water intensity was recorded in agriculture (ranging from 6 000 – 2500 m3 per Million DKK in late 90ies and 2005 respectively). Water intensity in industry is one order of magnitude lower than water intensity in agriculture. Drop in water intensity since the late 90ies can be seen in all the charts. The decrease recorded for metal processing industry was 55%, 37 % for industry of chemicals and plastics and 18 % for textile industry (with a sudden increase in 2002). Same decrease as for metal processing industry has been recorded for agriculture; however here the water intensity is still remains one order of magnitude higher than in industrial sectors. In order to understand (and use) the message implying from the indicators, more parameters (e.g. level of water reuse, also other macroeconomic parameters, etc.) have to be combined together with water used and added value.

Coverage:

Geographical:¨Denmark

Temporal:1996-2006

Frequency of update:annual

Methodology:

See methodology of main indicator

Data sources:

Data on water intensity (total industry, and per industry sector) in Statistics Denmark:
under http://www.statbank.dk/statbank5a/default.asp?w=1280

4 **Other references (inc. web links):**

N/A

#4

1

Theme (category) of the indicator set:
Development of GDP and environmental (impact) indicators

Publisher:
Environmental Accounts of the Netherlands 2009, Statistics Netherlands (2010); Journal of sustainable development, Vol. 2, No.3

Policy background:
The EU Water Framework Directive (WFD 2000) introduced certain environmental quality and quantity standards which countries have to comply with. Two important groups of substances were identified in relation to water pollution, namely heavy metals and nutrients.

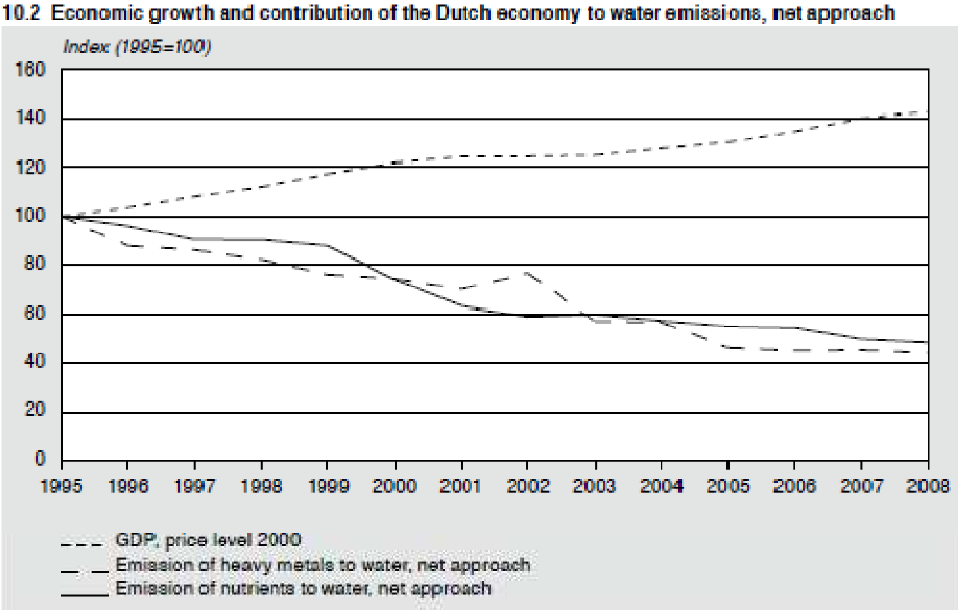
Consequences of economic activities with regard to water quality and quantity have been analysed under the WFD- the River basin management plans. Study of the link between economy and water status (quality and quantity) is important issue for the estimating the costs (and benefits) of the implementing the WFD and consequently for the decision making.

Key messages (problem statement):
As economic activities are often directly linked to the emission of pollutants to water, it is essential to decouple the emissions to water and economic growth to guarantee future good water quality.

2

Main Indicator title and graph:
Decoupling economic growth and emissions to water (nutrients, heavy metals)

10.2 Economic growth and contribution of the Dutch economy to water emissions, net approach



Description:
This graph assesses whether economic growth and water emissions have been decoupled over the period 1995-2008 or not. Starting from a common point in 1995 (=100), the subsequent development of water emissions and economic growth is graphically depicted. The widening gap between the GDP and water emission trend lines clearly shows two opposite trends.

Key message/s:
While the Dutch economy grew by 43% over the period 1995-2008, heavy metal emissions decreased by 56% and nutrient emissions decreased by 52%. This shows that emissions to water and economic growth have been decoupled over the period 1995-2008.

Coverage:

Geographical: Netherlands

Temporal: 1995-2008

Frequency of Update: Annually

Methodology:

Emissions to water are expressed as “heavy metal or nutrient equivalents”. In these equivalents, the damaging nature of heavy metal and nutrient types are accounted for in a weighting procedure. As such, the weight of phosphorous, e.g. is the equivalent of ten times that of nitrogen.

Using the year 1995 as a starting point, the percentage change in GPD growth and water emissions is calculated annually and graphically displayed.

Data sources:

The data information is provided by the Dutch water accounts; their concept being consistent with the national accounts. The consistency between the national and water accounting framework made a direct comparison of economic information, e.g. value added, and water information, e.g. emissions to water, feasible.

The data of the water accounts can be found on StatLine (Statistics Netherlands)
http://statline.cbs.nl/StatWeb/selection/?DM=SLNL&PA=71467NED&VW=T

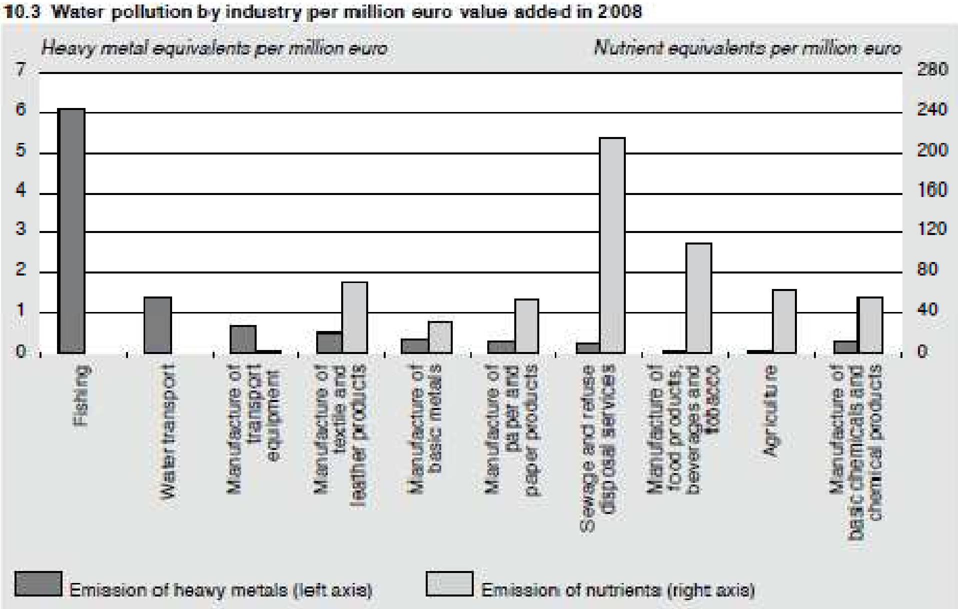
The data on value added per sector can be found under StatLine (Statistics Netherlands):
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71542NED&D1=2-6&D2=0-2,6-17&D3=12-13&VW=T

3.1

Sub-Indicator/s title and graphs:

Emissions intensity (water emissions per euro value added)

10.3 Water pollution by industry per million euro value added in 2008



Description:

This indicator illustrates the emissions intensity, i.e. the emissions per million euro value added, for key industries. The emissions are split between heavy metal and nutrient equivalents.

Key message/s:

The emissions intensity differs highly between industries. “Fishing” was responsible for the highest emissions of heavy metal equivalents per million euro value added, while “Sewage and refuse disposal services” emitted the highest nutrient equivalents per million euro.

Coverage:

Geographical: Netherlands
Temporal: 2008
Frequency of Update: Annually

Methodology:

Emissions to water are expressed as “heavy metal or nutrient equivalents”. In these equivalents, the damaging nature of heavy metal and nutrient types are accounted for in a weighting procedure. As such, the weight of phosphorous, e.g. is the equivalent of ten times that of nitrogen.

$$\text{Heavy metal intensity} = \frac{\text{emissions of heavy metal equivalent}_{\text{Sector X}}}{value\_added_{SectorX}}$$

$$Nutrient\_Intensity = \frac{emissions\_of\_nutrient\_equivalents_{SectorX}}{value\_added_{SectorX}}$$

Data sources:

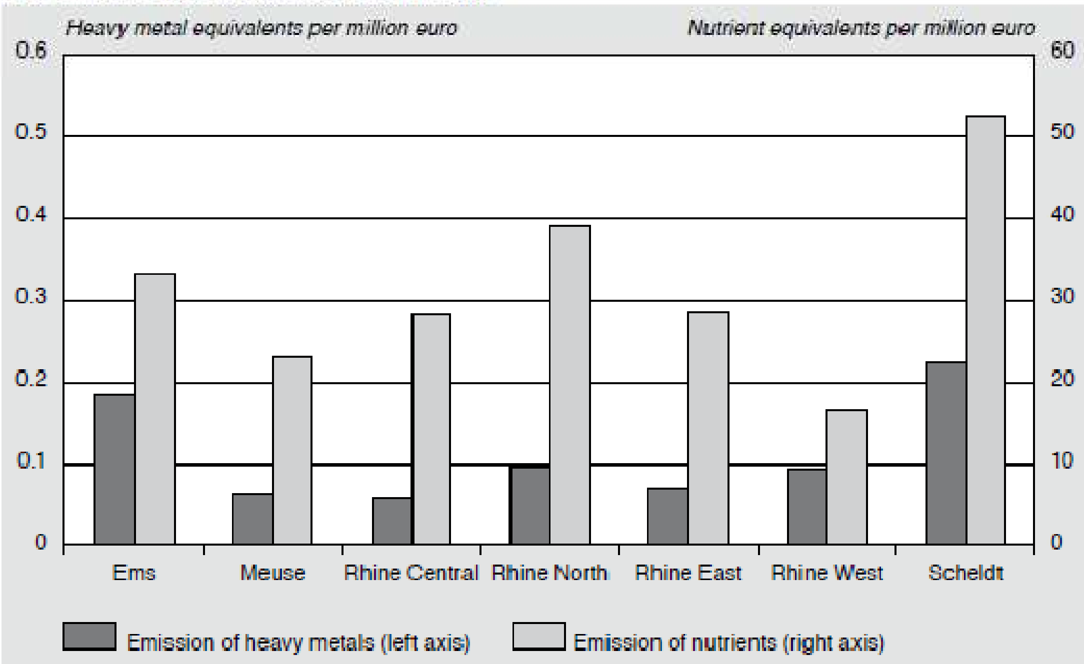
The data information is provided by the Dutch water accounts; their concept being consistent with the national accounts. The consistency between the national and water accounting framework made a direct comparison of economic information, e.g. value added, and water information, e.g. emissions to water, feasible.
The data of the water accounts can be found on StatLine (Statistics Netherlands)
http://statline.cbs.nl/StatWeb/selection/?DM=SLNL&PA=71467NED&VW=T
The data on value added per sector can be found under StatLine (Statistics Netherlands):
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71542NED&D1=2-6&D2=0-2,6-17&D3=12-13&VW=T

3.2

Sub-Indicator/s title and graphs:

Emissions intensity (water emissions per million euro value added)

11.3 Emission intensity per river basin in 2006



Description:

As water pollution is a mainly local environmental problem, water quality targets for the WFD are determined at river basin level. The Netherlands have four main river basin districts, namely the Rhine, Meuse, Scheldt and Ems. The Rhine basin is split up into four sub regions, as it covers around 70% of the country. The indicator shows the emissions to water from nutrients and heavy metal equivalents per million euro value added in each river basin (sub-) district.

Key message/s:

Overall water pollution per million euro value added is very high in the Scheldt and Ems river basin districts, while the Rhine West district has the lowest emissions intensity. The emissions are highly dependent on the economic activity in the basins, as well as on the environmental regulations in these districts.

Coverage:

Geographical:	Netherlands
Temporal:	2006
Frequency of Update:	

Methodology:

Emissions to water are expressed as "heavy metal or nutrient equivalents". In these equivalents, the damaging nature of heavy metal and nutrient types are accounted for in a weighting procedure. As such, the weight of phosphorous, e.g. is the equivalent of ten times that of nitrogen.

$$\text{Heavy metal intensity} = \frac{\text{emissions of heavy metal equivalent}_{\text{River Basin x}}}{value\_added_{RIverBasin\,X}}$$

$$Nutrient\_Intensity = \frac{emissions\_of\_nutrient\_equivalents_{RiverBasin\,X}}{value\_added_{RiverBasin\,X}}$$

Data sources:

The data information is provided by the Dutch water accounts, NAMWARIB (National Accounting Matrix, incl Water Accounts for River Basins). The consistency between the regional water and national accounting frameworks made a direct comparison of economic information, e.g. value added, and water information, e.g. emissions to water, feasible.

The data of the regional water emissions can be found in the Pollutant Release and Transfer Register: **http://www.emissieregistratie.nl/ERPUBLIEK/bumper.nl.aspx**

3.3

Sub-Indicator/s title and graphs:

Value added and emission to water in 7 River Basin Districts in Netherland

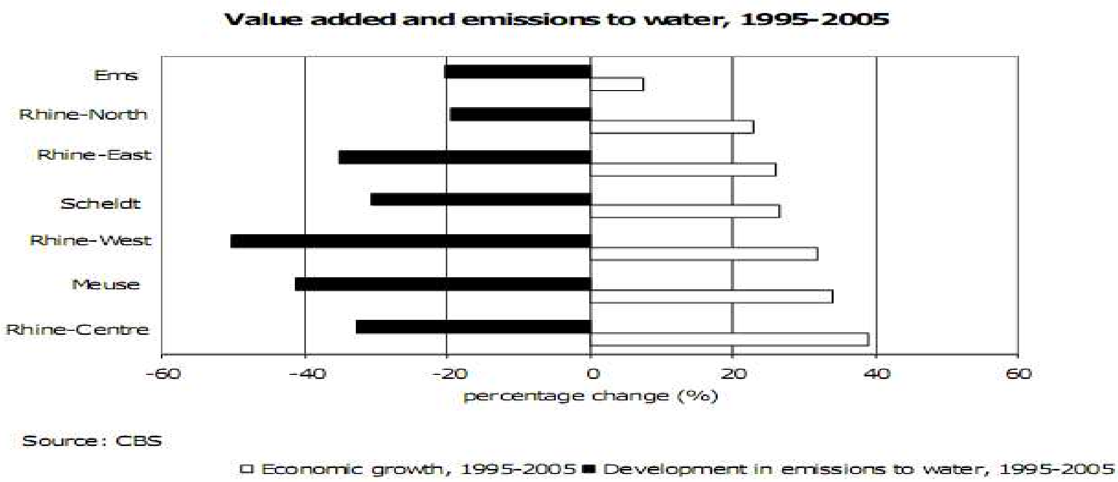


Figure 3. Value added and emissions to water in the various river basins, 1995-2005

Description:

The chart displays trend in reduction of emissions (nutrients and heavy metals- aggregated) to water combined with trend in value added (in basic prices), calculated at river basin level (7 RBDS)for 1995 and 2005 in Netherland. Data is used on emissions and economic variables for 58 different sectors (aggregated to 3 sectors- agriculture, manufacturing, and services) in the economy. The emitted heavy metals included in the assessment are arsenic, cadmium, chrome, copper, mercury, lead, nickel and zinc. The emitted
Nutrients are phosphor and nitrogen.

Key message/s:

Growth in value added and reduction in emissions for the different river basins is presented. In the period 1995-2005 economic growth in the river basin Rhine Central was 39 percent, while in the Ems river basin it was only 8 percent. In the Ems area emissions of heavy metals fell only slightly, while emissions in Rhine West dropped considerably. As a result, the emission intensity dropped the most in the Rhine West area. In spite of high economic growth in this region, emissions decreased substantially. One reason for this was the reorganisation of the fertiliser industry in the area. This industry emitted large amounts of heavy metals. The decrease in emission intensity was smallest in the Ems river basin.

Coverage:

Geographical: The Netherlands
Temporal: 1995-2005
Frequency of Update: -

Methodology:

$X_r^{in} = \frac{E_r^{in}}{Y_r^{in}}$, emission intensity industry in in region r

Where:

- E = emissions to water E
- Y = value added in basic prices

Data sources:

http://www.cbs.nl
http://www.emissieregistratie.nl

3.4

Sub-Indicator/s title and graphs:

1.Emission intensity of agriculture calculated for RBDs reduced by overall emission intensity calculated at national level

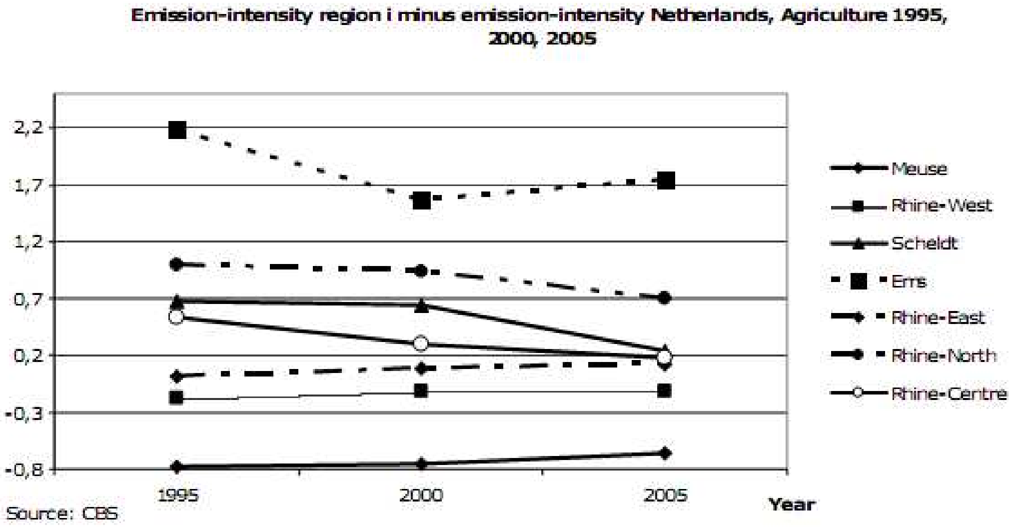


Figure 6. Pollution per euro added value for the various river basins in the years 1995, 2000 and 2005, agriculture

2.Emission intensity of manufacturing calculated for RBDs reduced by overall emission intensity calculated at national level

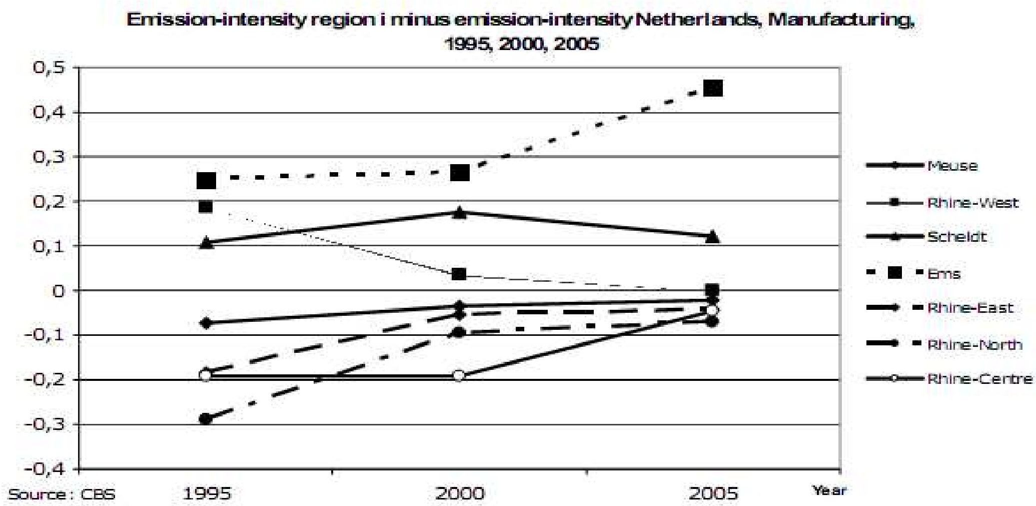


Figure 7. Pollution per euro added value for the various river basins in the years 1995, 2000 and 2005, manufacturing

Description:

The first chart presents pollution originating in agriculture per euro added value for different river basins in the years 1995, 2000 and 2005 lowered by pollution intensity in agriculture calculated at national level.

The second chart presents pollution originating in manufacturing per euro added value for different river basins in the years 1995, 2000 and 2005 lowered by pollution intensity in manufacturing calculated at national level.

Negative values of intensity indicate that the pollution intensity for particular RBD is lower than national value.

Key message/s:

1.The emission-intensity for the sector agriculture in Rhine-West is lower than the Dutch average, which is explained by the large horticulture sector in this area. This sector is creating a lot of value added while emissions to water are relatively small. In contrast, arable farming is relatively large in the Ems river basin. This sub sector of agriculture creates relatively little value added while the activities go along with a lot of emissions to water. Here the economic structure plays an important role in explaining overall emission-intensity. Transportation of produced manure is a way to improve environmental efficiency of agriculture in one region. Still this measurement creates an environmental problem for another region.

2. Manufacturing in Ems and Scheldt emit more to water per euro value added created than the Dutch average. This is explained by the large chemical sector which is quite emission intensive in these two regions. The metal sector is also quite large here, especially in the Scheldt region. This is partly explained by the favorable locations of industrial zones nearby important shipping routes in these river basins. Bad environmental efficiency of manufacturing in Scheldt and Ems is partly explained by more flexible environmental regulation directed by local authorities.

Differences in economic structure have an important role in explaining the variance in emission-intensity between regions. Even if one corrects for differences in economic structure, differences in emission intensity remain. This leads to an assumption that a difference in environmental efficiency of industries between river basins also plays an important role. It is important to note that differences in emission-intensities between river basins are very large, especially in agriculture. The differences in emission-intensities for the sector agriculture are much larger than the differences seen in manufacturing and services. This indicates that the structures of the agricultural sector as well as the environmental performance of a particular sub sector of agriculture are both very important indicators for the overall emission intensity of a particular region.

Problems related to water emissions cannot properly be analysed if one looks at national data and to emissions of heavy metal equivalents and nutrients equivalents only. Data at river basin level can help to get a better picture of the problems in the river basin and can ultimately help in developing better water quality measurements for the river basin.

Coverage:

Geographical: Netherlands, 7 river basin districts
Temporal: 1995 - 2005
Frequency of Update:

Methodology:

$X_r^{in} = \frac{E_r^{in}}{Y_r^{in}}$, emission intensity industry *in* in region *r*

$X_{nl} = \sum_{in} P_{nl}^{in} X_{nl}^{in}$, emission-intensity Netherlands

Where:

- E = emissions to water E
- Y = value added in basic prices
- X_{nl} =emission intensity the Netherlands

Data sources:

http://www.cbs.nl
http://www.emissieregistratie.nl

4 **Other references (inc. web links):**

- Graveland, C., Dutch Waterflow Accounts, 2006. Statistics Netherland.
- Statistics Netherland (CBS), De Nederlandse milieurekeningen: methoden.
- Statistics Netherland (CBS), 2010, The Dutch environmental accounts: present status and future developments.
- Statistics Netherland (CBS), 2009, Milieurekeningen 2008.
- http://balwois.com/balwois/administration/full_paper/ffp-1448.pdf
- http://www.cbs.nl/en-GB/menu/themas/macro-economie/publicaties/artikelen/archief/2008/2008-2615-wm.htm
- http://www.cbs.nl/NR/rdonlyres/ACFC0821-CBA7-4A9E-B4F8-71797170E095/0/2011x1013.pdf
- http://www.cbs.nl/NR/rdonlyres/68DCDF0D-76C6-458F-B3EC-073E8447DF13/0/2009c174pub.pdf

#5

1

Theme (category) of the indicator set:

Population growth and tap water usage

Publisher:

Environmental Accounts of the Netherlands 2009, Statistics Netherlands (2010)

Policy background:

Water plays a key role in the Dutch economy. The integration of water data with socio-economic data makes it possible to monitor water conservation policies.

Key messages (problem statement):

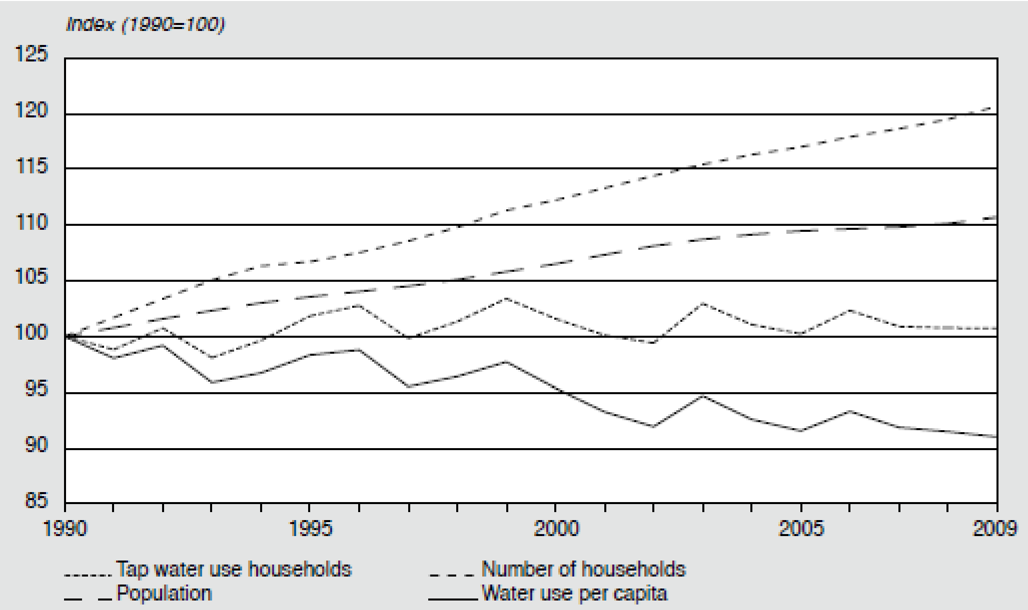
See main indicators

2

Main Indicator title and graph:

Decoupling population growth from household tap water usage

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



Source: VEWIN, 2010A, 2010B; CBS 2010.

Description:

The indicator depicts population growth and the tap water use per capita, as well as the increase of number of households with tap water use per household for the period 1990-2009. The data is indexed, using the year 1990 as the baseline.

Key message/s:

Households account for nearly 2/3 (66%) of overall tap water use in the Netherlands. Despite population growth and an increase in the number of households, tap water use per capita has decreased. Tap water use per capita has been reduced by 9% from 48m³ in 1990 to 44m³ in 2009. The efficiency gains come from efficiency measures, such as water saving measures and appliances, such as washing machines, dishwashers etc. Daily tap water use per household has dropped by 16% from 322 litres in 1990 to 269 litres in 2009. This drop can be explained by the smaller size of the average household, partly due to an increase of one person households.

Despite increased population growth, the total annual amount of water used by households only increased by 1% since 1990, while per capita use decreased by 9%. These trends indicate a certain degree of decoupling of population growth and tap water use.

Coverage:

Geographical: Netherlands
Temporal: 1990-2009
Frequency of Update: Annually

Methodology:

The data points were indexed so that the baseline is reflected in 1990. Changes from this baseline are depicted in the graph.

Data sources:

Information on the water uses in households can be found on VEWIN's homepage:
http://www.vewin.nl/Watergebruik_thuis_2010/Pages/default.aspx
The data of the tap water use can be found on StatLine (Statistics Netherlands)
http://statline.cbs.nl/StatWeb/selection/default.aspx?DM=SLNL&PA=80693NED&VW=T

3

Sub-Indicator/s title and graphs:

N/A

Description:

Key message/s:

Coverage:

Geographical:
Temporal:
Frequency of Update:

Methodology:

Data sources:

4

Other references (inc. web links):

- Graveland, C., Dutch Waterflow Accounts, 2006. Statistics Netherland.
- Statistics Netherland (CBS), De Nederlandse milieurekeningen: methoden.
- Statistics Netherland (CBS), 2010, The Dutch environmental accounts: present status and future developments.
- Statistics Netherland (CBS), 2009, Milieurekeningen 2008.
- Vewin (2010A). Drinking Water Fact sheet 2010. Association of Dutch Water Companies (Vewin). Rijswijk. The Netherlands. 2p.
- Vewin (2010B). Dutch Drinking Water Statistics 2008. The water cycle from source to tap. Association of Dutch Water Companies (Vewin). Rijswijk. The Netherlands. 85p. Vewin no. 2009/95/6259.

#6

1

Theme (category) of the indicator set:
Water abstraction and use

Publisher:
Environmental Accounts of the Netherlands 2009, Statistics Netherlands (2010)

Policy background:
Water plays a key role in the Dutch Economy, with groundwater being abstracted in large quantities to produce tap water of drinking water quality which then can be used by industries and households. The integration of economic information with water data makes it possible to monitor water conservation policies.

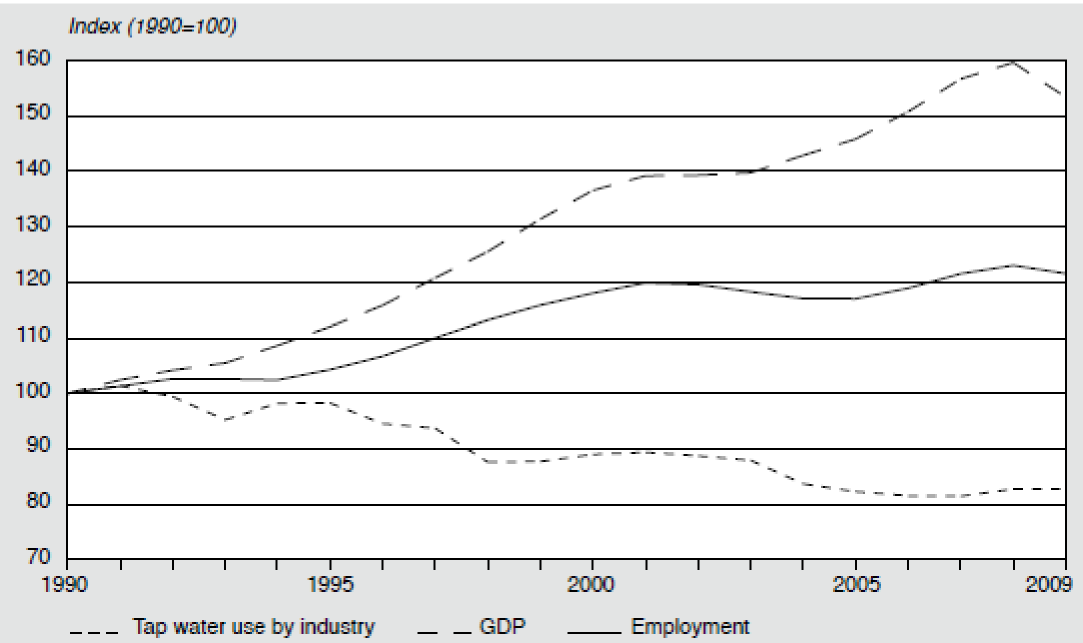
Linking the information on physical pressures exerted on water and its related economic activities enables policy makers and water managers at national and river basin scale to assess the necessary measures to reduce these pressures and meet the environmental objectives in the WFD in an integrated and consistent way.

Key messages (problem statement):
See key message of main indicator

2

Main Indicator title and graph:
Industrial water use, GDP growth and employment

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



Source: VEWIN, 2010A, 2010B, CBS 2010.

Description:
The graph depicts the development of GDP, employment and industrial tap water use in the Netherlands over the period 1990-2009. The data is indexed; the baseline is reflected in the year 1990.

Key message/s:
Industries have used progressively less tap water since 1990, despite GDP growth. This indicates a decoupling between GDP growth and tap water usage. However, other water sources are not included in this indicator, which prevents the conclusion that overall GDP growth has been decoupled from industrial water usage.

Coverage:

Geographical: Netherlands

Temporal: 1990-2009

Frequency of Update: Annually (most likely)

Methodology:

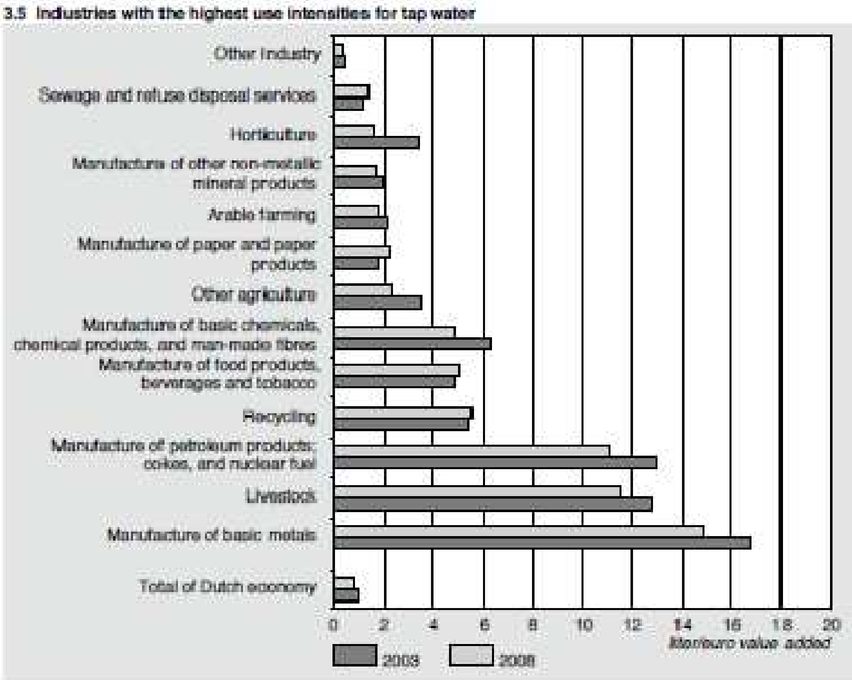
The data sources were indexed to the baseline of 1990. Subsequent changes are depicted in the graph.

Data sources:

The data of the tap water use can be found on StatLine (Statistics Netherlands)
http://statline.cbs.nl/StatWeb/selection/default.aspx?DM=SLNL&PA=80693NED&VW=T

Sub-Indicator/s title and graphs:

Water Use Intensity for industries



3

Description:

This indicator shows the water use intensities of tap water for selected industries for the years 2003 and 2008. Water use intensity for an industry is defined here as the use of tap water (l) per Euro value added in the respective industrial sector.

Key message/s:

On average, 0.85 litres were used for every euro of value added generated by the Dutch economy in 2008. This is an improvement when realizing that 1.04 litres were used for every euro value added in 2003.

High water use intensive industries, such as “manufacture of basic metals” can be distinguished from low water use intensive industries, such as “sewage and refuse disposal services”.

The comparison of water use intensity in industries in 2003 and 2008 gives insights into the development of water use intensity over the past years and sheds light on the trends of water use for the main industrial water users. For example, this graph shows that some water intensive industries, such as “manufacture of basic metals”, “livestock” and “manufacture of petroleum products” significantly reduced their tap water use intensity rates by 12%, 10% and 15% respectively. On the other hand, sectors such as the "manufacture of paper and paper products" and "sewage and refuse disposal services" increased their tap water intensity rates by 22% and 11% respectively.

Coverage:

Geographical: Netherlands

Temporal: 2003 and 2008

Frequency of Update:

Methodology:

$$\text{Water use intensity (sector)} = \frac{\text{Tap water used}_{\text{Sector X}}}{\text{Value\_added}_{\text{Sector X}}}$$

Value added ins expressed in constant prices of 2000

Data sources:

Water uses per sector can be found in StatLine under:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=80693ned&D1=0-1,4&D2=0-3,9-11,13,15-16,18-19,25,28-33&D3=a&HDR=T&STB=G1,G2&VW=T

The data on value added per sector can be found under StatLine (Statistics Netherlands):
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71542NED&D1=2-6&D2=0-2,6-17&D3=12-13&VW=T

4

Other references (inc. web links):

- Graveland, C., Dutch Waterflow Accounts, 2006. Statistics Netherland.
- Statistics Netherland (CBS), De Nederlandse milieurekeningen: methoden.
- Statistics Netherland (CBS), 2010, The Dutch environmental accounts: present status and future developments.
- Statistics Netherland (CBS), 2009, Milieurekeningen 2008.
- Vewin (2010A). Drinking Water Fact sheet 2010. Association of Dutch Water Companies (Vewin). Rijswijk. The Netherlands. 2p.
- Vewin (2010B). Dutch Drinking Water Statistics 2008. The water cycle from source to tap. Association of Dutch Water Companies (Vewin). Rijswijk. The Netherlands. 85p. Vewin no. 2009/95/6259.

#7

1

Theme (category) of the indicator set:
Irrigation water productivity

Publisher:
OECD, Sustainable use of water in Spain

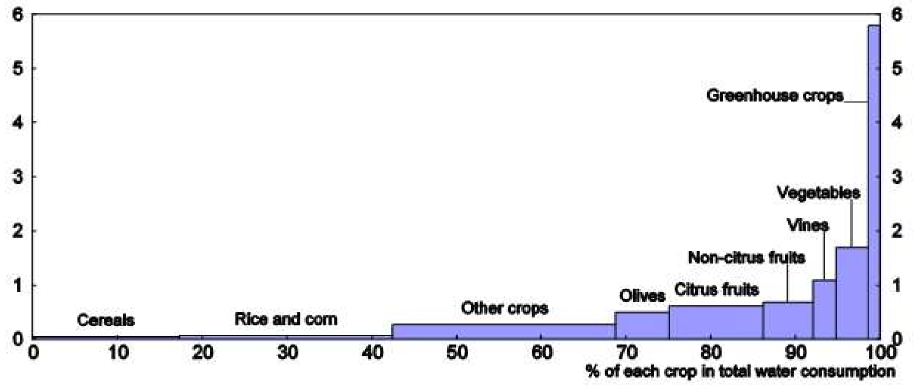
Policy background:
Consequences of economic activities with regard to water quality and quantity have been analysed under the WFD- the River basin management plans. Study of the link between economy and water status (quality and quantity) is important issue for the estimating the costs (and benefits) of the implementing the WFD and consequently for the decision making.

Key messages (problem statement):
Agricultural use accounts for between 80 and 90% of water abstraction in Spanish basins of the south and in the basins of rivers flowing to the Mediterranean Sea. While some of the water used by irrigated agriculture is reused by other downstream users or diverted to meet environmental needs, a large share is consumed in evapotranspiration . In order to achieve the WFD objective (good status and full cost recovery for water services including environmental and resource costs), changes in the irrigation agriculture and agricultural systems will have to be implemented.

2

Main Indicator title and graph:
Value added and crop production from irrigated agriculture in Spain

Gross value added at market prices in euros per cubic metre of water consumed, 2001/02



1. Each rectangle area is proportional to the share of each crop in the value added of irrigated agriculture.

Source: MMA (2007), *El agua en la economía Española: situación y perspectivas, Ministerio de Medio Ambiente.*

Description:
The chart shows water productivity expressed as gross value added per cubic meter of water consumed for irrigation of particular type of crops. Share of water consumption for each crop type is displayed on X-axis.

Key message/s:
The differences in water productivity across crops grown in Spain are large, 75% of value added generated in irrigated agriculture consumes just 9% of irrigated water. The cultivation of crops which generate low value added relative to their water needs (such as cereals) is typically characterized by low efficiency in irrigation, i.e. a more extensive use of irrigation techniques
that supply more water to the land than the crops require (such as flood techniques). By

contrast, cultivation of high value added crops achieves efficiency rates of 90%. This situation is also likely, to some extent, to reflect the incentives generated by quantity constraints and the limited allocate role of prices: incentives to raise the technical efficiency may therefore only be strong when the value added generated by additional water input is high. More reliance on market signals, such as cost-reflective water pricing and water trading, would help to generate incentives to use water-saving technology in all agricultural production.

Coverage:

Geographical: Spain

Temporal:

Frequency of Update: -

Methodology:

Irrigation water productivity:

$$IWP\left(€\ m^{-3}\right) = \frac{Inc.\ annual\ value\ of\ agr.\ prod.\ from\ irrig.}{\text{Annual volume of irrigation water inflow}}$$

Data sources:

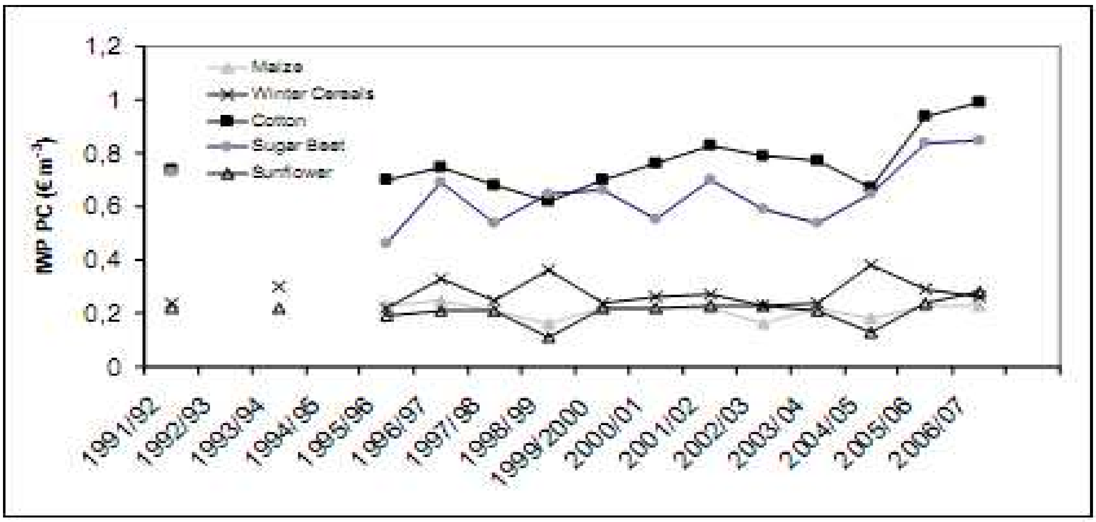
Data sources: report of the Ministry of Environment in Spain:
http://iagua.es/2007/05/el-agua-en-la-economa-espaola-situacin/

3

Sub-Indicator/s title and graphs:

Effects of CAP on the irrigation water management

Irrigation Water Productivity (IWP) using as reference the prices in 2000/01 for the main crops in GCIS



Description:

The chart shows Irrigation Water Productivity (IWP) for individual crops expressed as value of euro (prices in 2000/01)produced per m^3 of water used for irrigation in the Genil–Cabra Irrigation Scheme (GCIS) located in the province of Cordoba, Spain (GCIS). The indicator was used to assess the impact of Common agricultural Policy (CAP) on agricultural water productivity.

Key message/s:

Two clear groups of crops were identified in terms of the impact of CAP(subsidies) on water management. The first one composed by maize, olive, garlic and wheat, which were not affected by the CAP with regard to water management. In the other group are allocated sugar beet and cotton. Irrigation water productivity (IWP) values showed the increase in the water efficiency at field scale for cotton and sugar beet, while for other crops as maize or wheat the values were constant. The IWP for cotton increased from around 0,7 €/m3 during the previous years to the modification of the CAP policies to 0.99 €/m3 in the last analyzed irrigation season (2006/07), implying an increase of more than 40%. This increase was caused by the changes in irrigation water management (deficit irrigation applied to the crop, reducing the losses of the irrigation applied by runoff and deep percolation).

Coverage:

Geographical: Province Cordoba, Spain

Temporal: 1995 - 2005

Frequency of Update:

Methodology:

Irrigation water productivity:

$$IWP\left(\text{€}\ m^{-3}\right) = \frac{Inc.\, annual\ value\ of\ agr.\, prod.\, from\, irrig.}{\text{Annual volume of irrigation water inflow}}$$

Data sources:

4

Other references (inc. web links):

Link to the article: Effects of the decoupling of the subsidies on agricultural water productivity http://ageconsearch.umn.edu/handle/44017

#8

1

Theme (category) of the indicator set:

Decouple Value added and water resource use

Publisher:

Sweden Statistics (2007), Environmental accounts - The economic structures and environmental pressure in the Swedish river basin districts 1995- 2005.

Policy background:

The report is intended to complement the scientific research within the water districts and shall provide a basis for establishing measures and targets for the water authorities. This report covers the five Swedish river basin districts over the period 1995-2005.

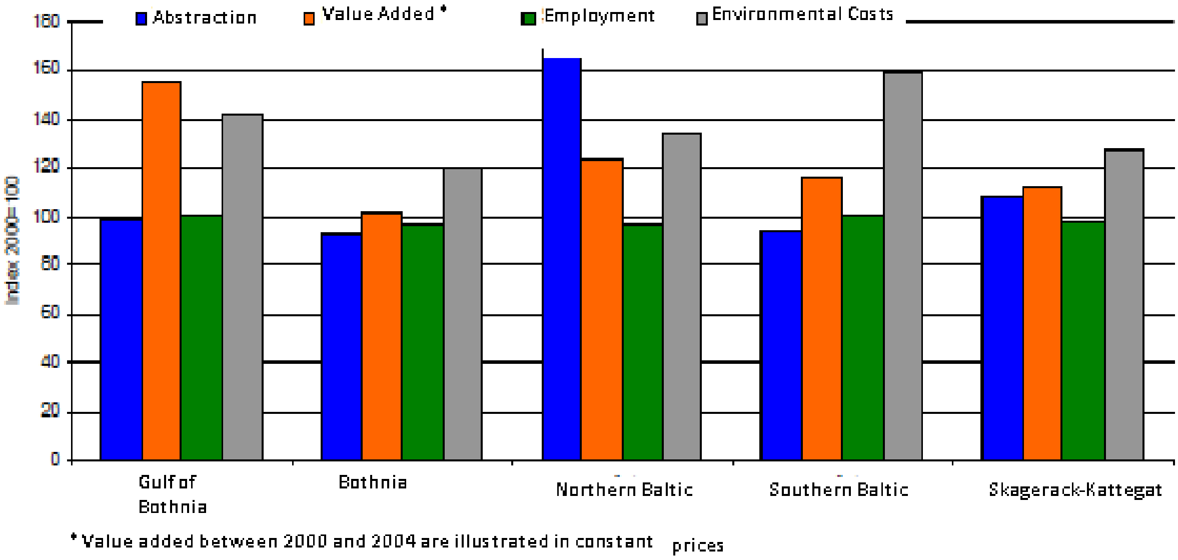
Key messages (problem statement):

From 1995 to 2005 the Swedish GDP increased by 32% and employment increased by 9%, while water abstraction has decreased by 2% over the same period. Water-intensive industries account for 62% of total water abstraction in Sweden; a share which has increased by 3% between 200 and 2005. It can be said that the link between the economy and the environment has weakened in Sweden as a whole.

2

Main Indicator title and graph:

Evolution of water abstractions, value added and employment in Sweden's river basin districts for water-intensive industries, 2000-2005.



(the graph has been translated from the original Swedish version)

Description:

This graph illustrates the evolution of water abstractions, value added and employment in the five Swedish river basin districts over the period 2000-2005. Further, the costs invested for treating and preventing environmental impact are depicted.

Key message/s:

The decoupling of economic activity in the water intense industry and water resource use clearly occurred in the river basin districts of Gulf of Bothnia and Southern Baltic, with water abstraction remaining constant or even decreasing and value added increasing significantly. Water abstraction has increased significantly in the Northern Baltic (60%), while value added increased only by 22%. This indicates that the economic activity in the water intense industry and water resources use are still strongly linked. Decoupling can be seen to a lesser extent in the river basin districts of Bothnia and Skagerack-Kattegat. Investments for treating and preventing environmental impact increased most in the Southern Baltic.

Coverage:

Geographical: Sweden

Temporal: 2000-2005

Frequency of Update: unclear

Methodology:

The data have been indexed with the baseline being the year 2000. Subsequent changes have been depicted in the graph.

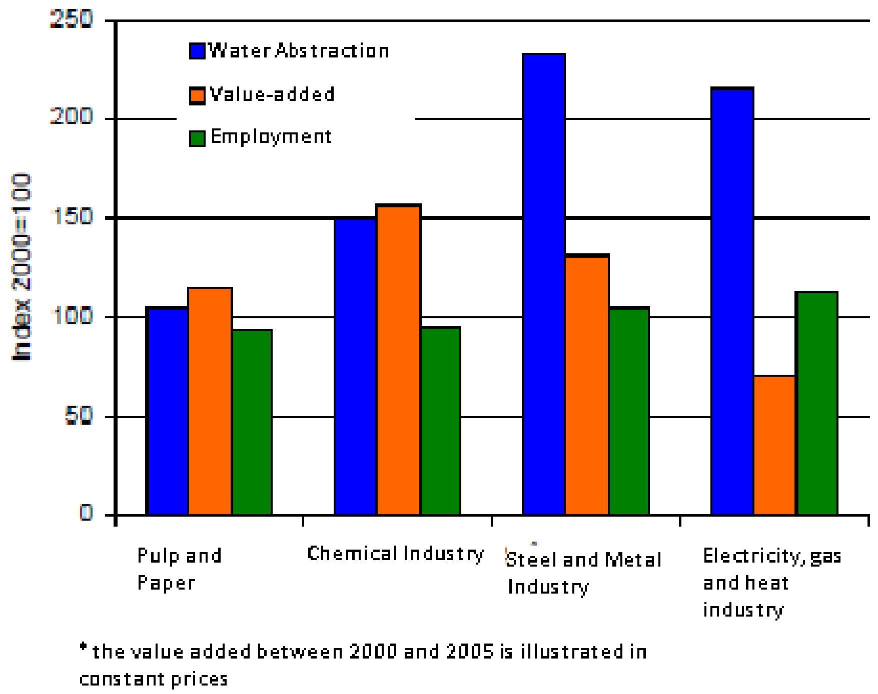
Data sources:

Underlying statistics can be found on the homepage of Statistics Sweden under www.scb.se/MI1301

3

Sub-Indicator/s title and graphs:

Evolution of water abstractions, value added and employment in the Northern Baltic river basin district, 2000-2005.



(the graph has been translated from the original Swedish version)

Description:

This graph illustrates the evolution of water abstractions, value added and employment in the Northern Baltic river basin district for four water-intense industrial sectors over the period 2000-2005.

Key message/s:

While the abstraction levels have increased significantly in the steel and metal as well as in the electricity, gas and heat industry, value added has only increased slightly, or has even decreased, respectively. In the pulp and paper industry, the level of abstraction roughly remained the same as in 2000, while value added increased by 16%. Water abstraction increased in the chemical industry by 51%, while value added increased by 57%. These trends show that economic growth and water resource use has not been decoupled in all water-intensive sectors yet in the Northern Baltic river basin district.

	Coverage: Geographical: Northern Baltic river basin district, Sweden Temporal: 2000-2005 Frequency of Update: unclear
	Methodology: The data have been indexed with the baseline being the year 2000. Subsequent changes have been depicted in the graph.
	Data sources: Underlying statistics can be found on the homepage of Statistics Sweden under www.scb.se/MI1301
4	**Other references (inc. web links):**

#9

1

Theme (category) of the indicator set:
Physical and monetary data connected to abstraction, use and discharge of water

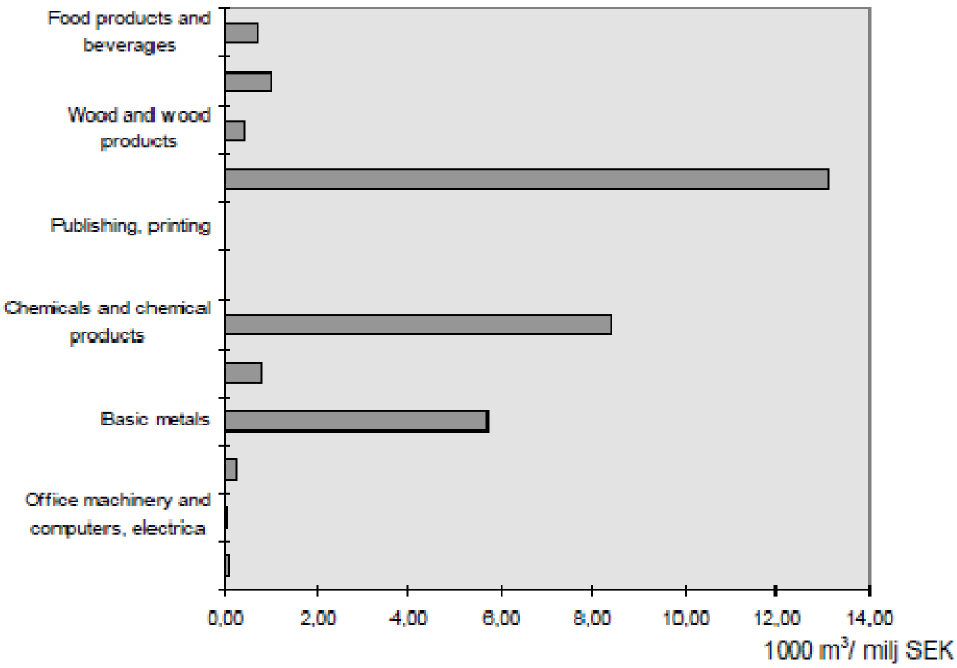
Publisher:
Statistics Sweden

Policy background:
Improvement of water use efficiency

Key messages (problem statement):
Water use by the various economic activities can affect the quality and quantity of available water resources and their dependent ecosystems. The water use efficiency in economic terms varies highly across the various industries.

2

Main Indicator title and graph:
Use of water in relation to production value in the manufacturing industries (1995), in litres per SEK



Description:
The graph describes the use of water in relation to the production value.

Key message/s:
The pulp and paper industry (longest bar, not labelled) uses about 13,000 m³ of water to generate a production value of 1 Mio. Swedish Crowns whereas all other industries need less to generate the same production values.

Coverage:
Geographical: Sweden
Temporal: 1995
Frequency of Update: Unknown

Methodology:

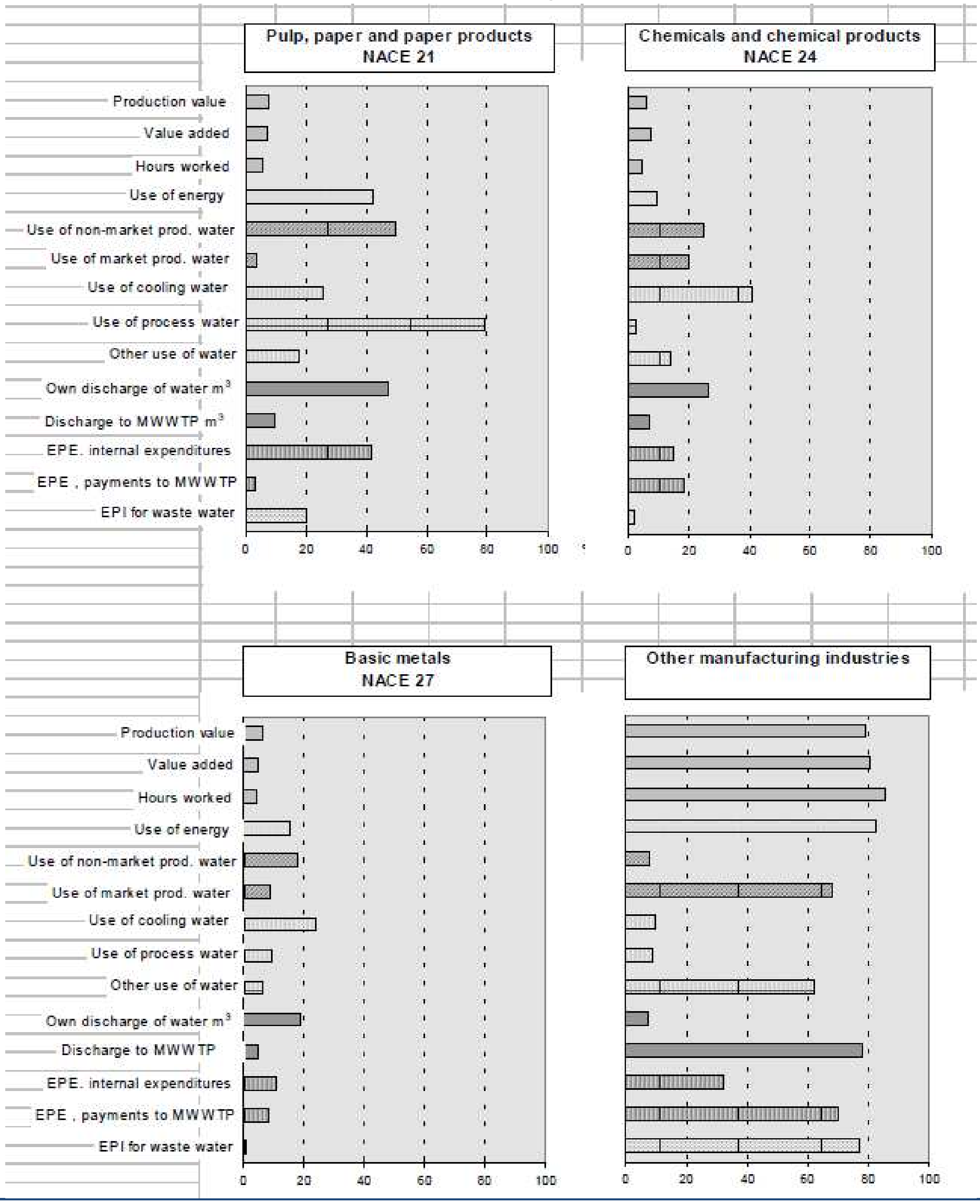
Data sources:

Swedish Water Accounts (NAMEA)

Sub-Indicator/s title and graphs:

Environmental Economic Profiles for some manufacturing industries

3



Description:

This indicator compares 14 economic and environmental (water) key variables across selected industries. The bars per sector show the percentage of the total of manufacturing industries.

	Key message/s: The water use and emission intensity (in terms of economic variables) varies highly across the different sec-tors.
	Coverage: Geographical:Sweden Temporal:1995 Frequency of Update: Unknown
	Methodology: Use of Swedish NAMEA
	Data sources: Swedish NAMEA
4	**Other references (inc. web links):** http://www.scb.se/statistik/_publikationer/MI0902_2000A01_BR_MI71OP0006ENG.pdf

#10

1

Theme (category) of the indicator set:
Water Resource Use and GDP

Publisher:
Department for Environment, Food and Rural Affairs (DEFRA), UK
http://www.defra.gov.uk/sustainable/government/progress/national/15.htm

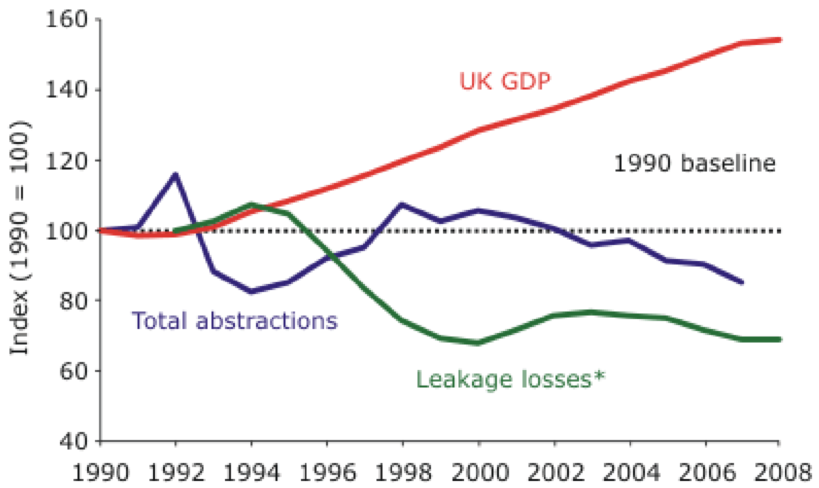
Policy background:
N/A

Key messages (problem statement):
See main indicator

2

Main Indicator title and graph:
Total abstractions from non-tidal surface and ground water, leakage losses and Gross Domestic Product, 1990 to 2008

United Kingdom/England and Wales



*Most water companies are now operating at their Economic Level of leakage. This is the level of leakage at which it would cost more for a water company to further reduce its leakage than to produce water from an alternative source, and balances the needs of consumers and the environment.

Description:
This indicator shows the development of GDP in comparison to total water abstractions and leakage losses over the time period 1990-2008. The baseline (i.e. index = 100) is set to the year 1990.
Note: data collection methodologies for abstraction data have significantly changed in 1991 and 1999. Thus, figures prior to 1999 are not strictly comparable.

Key message/s:
In the years 1990-1992 and 1994-1998, water abstractions increased in line with economic growth. Around 1998, the abstractions decreased while GDP increased, i.e. resource use and economic growth has been decoupled. Between 1992 and 1994 the leakage losses increased with GDP growth, while leakages decreased with GDP growth from 1994 onwards. In 2008/09 leakage losses were 31% lower than in 1992/03.

Coverage:
Geographical:	UK
Temporal:	1990-2008
Frequency of Update:	Most likely annually

Methodology:

The values for GDP, total abstractions and leakage losses were indexed so that their value in 1990 describes the baseline. Subsequent changes from this baseline are illustrated in the graph.

Data sources:

Total leakage losses can be accessed via the e-digest statistics (Department for Environment, Food and Rural Affairs):
http://www.defra.gov.uk/evidence/statistics/environment/inlwater/iwsupplyuse.htm
Data on total water abstraction (divided into electricity supply industry, fish farming, other industry, public water supply, other) can be accessed via the e-digest statistics (Department for Environment, Food and Rural Affairs):
http://www.defra.gov.uk/evidence/statistics/environment/inlwater/kf/iwkf12.htm

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3

Sub-Indicator/s title and graphs:

N/A

Description:

Key message/s:

Coverage:

Geographical:

Temporal:

Frequency of Update:

Methodology:

Data sources:

4

Other references (inc. web links):

#11

1

Theme (category) of the indicator set:

Decoupling of population not connected to WWTPs from total population

Publisher:

OECD

Policy background:

Consequences of economic activities with regard to water quality and quantity have been analysed under the WFD- the River basin management plans. Study of the link between economy and water status (quality and quantity) is important issue for the estimating the costs (and benefits) of the implementing the WFD and consequently for the decision making.

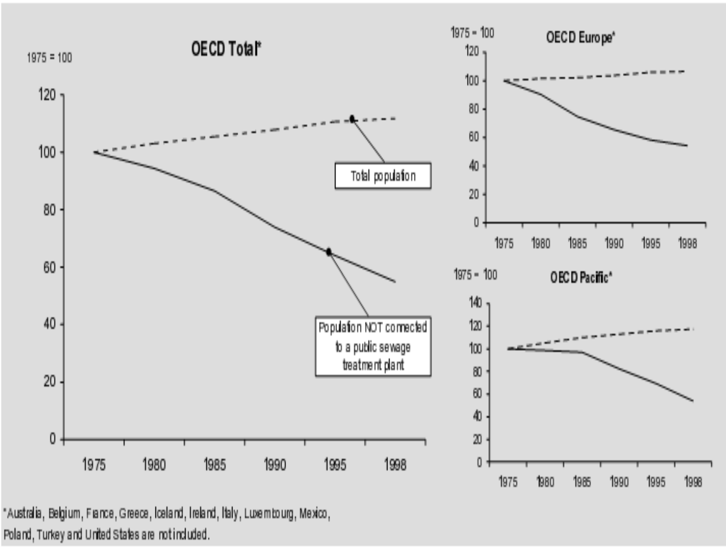
Key messages (problem statement):

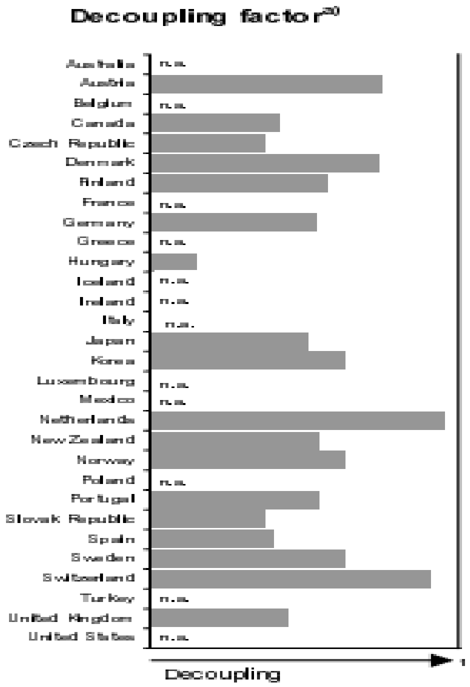
In order to restore receiving waters, both points and diffuse sources need to be further reduced. Reducing pollutant discharges from municipal and industrial WWTPs remains central element of decoupling pressures on aquatic environment and human activity. This is particularly true for nitrogen and phosphorus.

2

Main Indicator title and graph:

Decoupling of population not connected to WWTPs from total population





Description:

The graph displays decoupling of population not connected to the waste water treatment plants from the total population growth in OECD countries during the period from mid 70ies to late 90ies. The chart on the right shows decoupling factor defined under the Methodology.

Key message/s:

In the group of 18 member countries considered here, the number of people not connected to a public WWTPs fell by 45% during 1975-1998, whereas population increased by almost 12%.The presentation of this indicator in terms of share of total population not connected to WWTPs is not intended to imply that this share should approach zero. Large plants are not an economically and environmentally optimum solution for small dispersed communities. In fact, in OECD countries, the proportion of population that can be reasonably connected to community sewerage is approaching its economic optimum. On the other hand, provision of appropriate technologies for small settlements, can bring further progress at reasonable costs.

Coverage:

Geographical:¨OECD countries
Temporal:1975-1998
Frequency of update: annual(in given time range)

Methodology:

Decoupling factor is defined as $1-(EP/DF)_{1998}/(EP/DF)_{1990}$ where EP = environmental pressure and DF = driving force. Decoupling occurs when the value of decoupling factor is between 0 and 1.

Where DF is total population and EP population not connected.

Data sources:

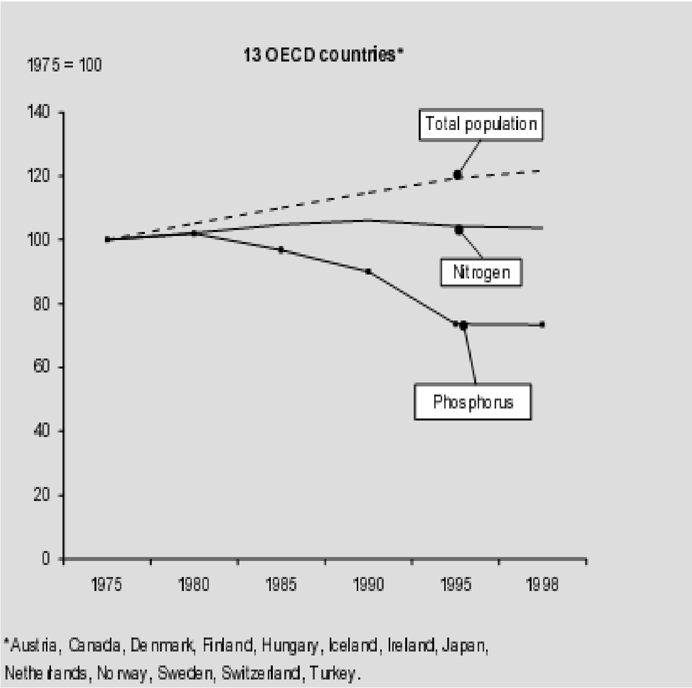
OECD,

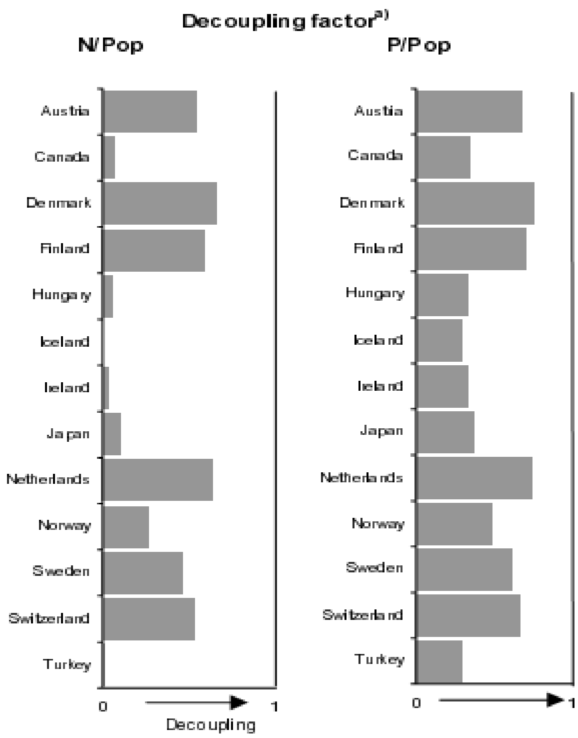
Eurostat

3

Sub-Indicator/s title and graphs:

Decoupling of N and P discharges from households from total population





Description:

The graph displays the amount of N and P per head of population that is discharged into the waters because it is not treated by collective or individual treatment facilities. Decoupling of discharges of nitrogen and phosphorus from households (UWWTPs) from the total population growth in OECD countries during the period from mid 70ies to late 90ies. The chart on the right shows decoupling factor defined under the Methodology.

Key message/s:

For the group of 13 countries considered here, there has been an absolute decoupling of discharges of P from households into water from population during 1975-198. Decoupling was absolute in 12 of 13 countries.

With regard to nitrogen discharge, a relative decoupling occurred, the total nitrogen discharge grew by 4 % while the population increased by more than 21%.For 8 countries the decoupling was absolute, for remaining five it was relative.

Coverage:

Geographical:¨OECD countries

Temporal:1975-1998

Frequency of update: annual(in given time range)

Methodology:

Decoupling factor is defined as $1-(EP/DF)_{1998}/(EP/DF)_{1990}$ where EP = environmental pressure and DF = driving force. Decoupling occurs when the value of decoupling factor is between 0 and 1.

Where DF is total population and EP is N or P load discharged .

Time series of data about changes in connection rate to municipal WWTPs, combined with per capita emission factors and the theoretical treatment efficiency of the respective levels of treatment are used to calculate the per capita emission loads after the treatment.

Data sources:

OECD,

Eurostat

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Other references (inc. web links):

Link to document OECD:

INDICATORS TO MEASURE DECOUPLING OF ENVIRONMENTAL PRESSURE FROM ECONOMIC GROWTH

http://www.un.org/esa/sustdev/natlinfo/indicators/idsd/pdf/decoupling_environment_&_economy.pdf