Environmental effects of ports and shipping

The efforts of the maritime sector to decouple the environmental pressures from growth in this sector, are having results. In the ports of the river Scheldt, the emissions of sulfur oxides, particulate matter and nitrogen oxides have risen at a lower pace than the volume of handled goods. In some cases the emissions even declined in absolute terms. Stricter emission standards, the use of low sulfur fuel and the renewal of ships undoubtedly play a role. There is also a break in the trend of CO_2 emissions, which increase less rapidly in relation to the volume of handled goods. The Scheldt ports seek more environmentally friendly modes of transport for freight to and from the hinterland. During 2010, statistics will become available to display trends in this modal split of freight transport.

Why monitor this indicator?

The Long-term Vision [1] aims to optimize the economic and social value of the ports in the Scheldt estuary, and keep it in balance with the other priority functions of the estuary (safety, naturalness). The trading of goods and creation of employment and added value in ports offer new opportunities for economy and prosperity (see indicator "Socio-economic importance of ports').
In addition, the port areas are contributing increasingly in achieving local targets in terms of environmental conservation. These objectives are determined and evaluated through instruments such as international guidelines, spatial structure plans, strategic environmental programmes for ports, and environmental information systems. There is also a growing focus on optimizing space, use of raw materials and energy, sustainable solutions for the hinterland transport and a reduction in emissions of pollutants. The maritime cluster (shipping, ports and maritime industry) is a growing economic sector and existing analyses indicates that this trend will continue in the future. Reducing the environmental impact is also about achieving "decoupling". The term "decoupling" refers to breaking the pattern between economic growth and the associated environmental impacts. Decoupling is achieved if the pressures are not proportionately increasing with the activities of a particular sector.

The EU 'Common Transport Policy' [2] promotes the modal split as a priority action for "decoupling". A strategic deployment of all transportation modes may further contribute to the competitiveness of the port and the establishment and planning of its future infrastructure needs.
Both the Dutch and Flemish Scheldt ports consider a shift to more environmentally friendly modes (barge, rail) for the transport connection to the hinterland as one of the strategic actions. In the 2007-2011 Action Plan for Freight transport in the province of Zeeland, one of the objectives says ".... For new business in the port areas of Zeeland Seaports (ZSP, ports of Vlissingen and Terneuzen), the ambition is to handle at least 50 percent of the in- and outbound shipment over the waterways'[3]. The Port Authority of Antwerp (GHA) sets the 2030 targets [4, 5] for modal split at a ratio of 42% by road, 43% by barges and 15% inland rail (see below). In its 2010-2020 strategic plan, the Port of Ghent's ambitions for 2020 are set at 35% road, 50% inland waterways and 15% by rail (Port of Ghent, pers. Comm., [6]).

Besides increasing the proportion of freight by rail and inland waterways, and reducing the pressure on road infrastructure, the maritime sector aims at decreasing the pollutants in emissions from shipping. Because of the transnational character of the sector, the (environmental) laws for shipping are mainly of international and European origin. The MARPOL 73/78 Convention (Annex VI) of the International Maritime Organization (IMO) sets global agreements to prevent air pollution from ships, specific chemicals such as nitrogen oxides, sulfur oxides, volatile organic compounds and ozone depleting substances. From late 2007, the North Sea is also known as 'SOx Emission Control Area (SECA)': in these sensitive areas, stricter emission standards for sulfur oxides apply.
Both the Netherlands and Flanders translated these standards into national (and often stricter) standards [7, 8]. The international standards are tightened further in the 'Emission Control Areas (ECA)' following the revision of Annex VI, which enters into force from July 2010. While the contribution of shipping to total national emissions can be regarded as rather limited compared with e.g. road freight, there is a strong pressure to reduce these emissions. Partly because the share of emissions from maritime transport will continue to grow as the sector continues experiencing strong growth, and because emissions from the maritime sector will be included in the so-called 'European National Emission Ceilings, NEC'.

What does the indicator show?

Modal split of freight transport to and from the hinterland

The 'modal split' is a measure of how goods are transported to and from the hinterland. The modal split indicates what percentage each of the modes (rail, road, water) occupies the total freight to and from the port. The modal distribution was included in all strategic plans of ports along the river Scheldt. Although the specific features of each port (economic niche, location, available infrastructure) largely determines the potential ratio between different modes, (port) authorities are generally striving to restrict the share of 'road' transport in the total freight to the hinterland connections as much as possible.

Port of Antwerp

The Port Authority (GHA) is working on a standardized method to quantify the 'overall modal split', for all goods including liquid bulk, dry bulk, general cargo, containers, etc. The new method will also allow to distinguish between the strictly maritime and industrial-born trade. These overall figures for modal split will be made available after review in 2010. For the port of Antwerp, revised figures are for the moment only available for the goods 'containers' (see figure 1). The figures show a gradual trend towards the targets for 2030. The proportion of 'rail' increased since 1996 from 6.2 to 11% (target is 15%), the proportion of 'barge or inland waterways' increased from 24.3 to 32.4% (target is 43%). A downward trend was evident in the proportion of 'road': from 69.5% in 1996 to 56.6% in 2008. To sustain this positive trend, further efforts are needed to achieve the target of 42% modal share of 'road transport'. The port of Antwerp strives towards achieving the ratio of 42% (road) - 43% (inland) - 15% (rail) already by 2015 [4].

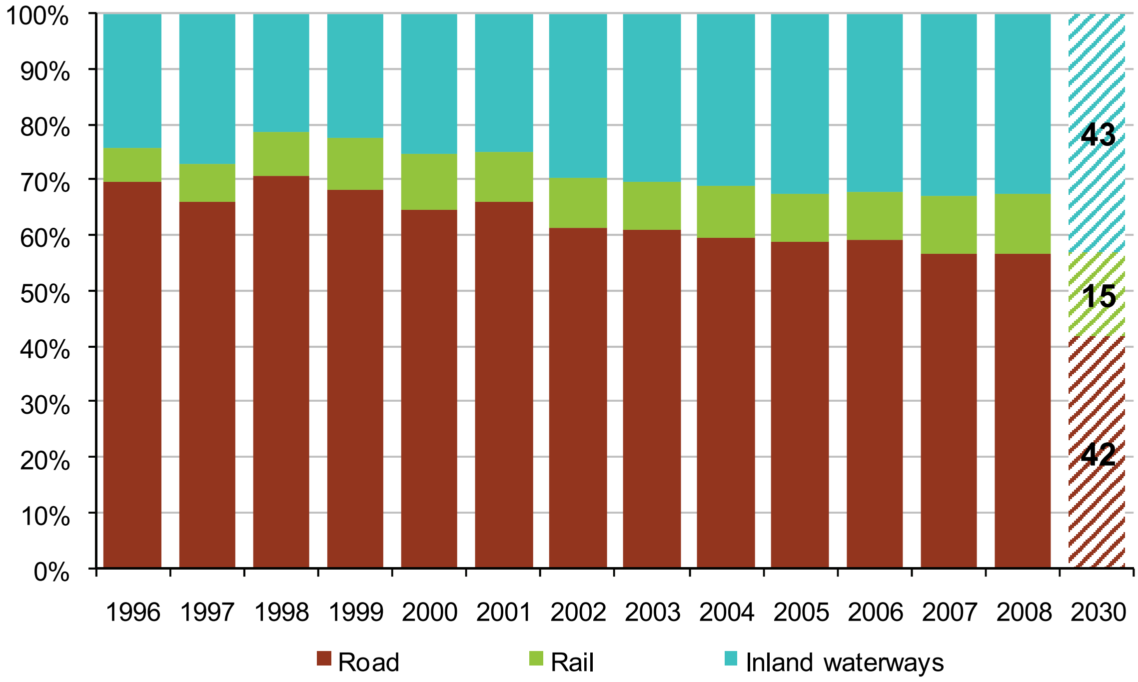

Figure 1: Trend in "modal split of the network, Port of Antwerp, including total rail freight to/from Zeebrugge and Rotterdam and the total inland waterways to and from Rotterdam Including share of truck (road transport) pro rata traffic Zeebrugge and Rotterdam". Partial data for 'containers' 1996-2008. Objectives for 2030 are indicated in the graph. Source: Port authorities Antwerp, Strategy & Development.

Port of Ghent

Figures for the Port of Ghent (2004) showed a modal distribution with 43% inland waterways (barges), 10% rail and 47% road freight (see figure 2). In 2010, new figures for 2008 and 2009 are announced. These figures will make clear what progress has been made and what distance still needs to be covered to achieve the targets in 2020 (35% share of road transport, 50% of inland waterways and 15% by rail).

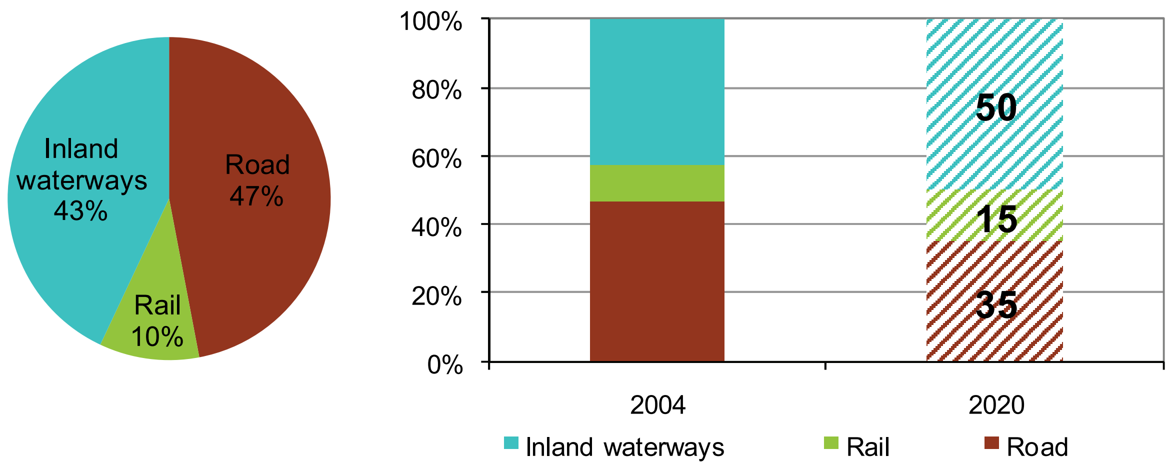

Figure 2: General modal split of freight transport in the hinterland connections to and from the Port of Ghent (2004). Target for 2020 is indicated in the right bar diagram. Source: Port of Ghent, from Meersman *et al.* 2008 [9].

Inland waterways and road freight accounted for a similar proportion in 2004. Rail played a minor role compared to other modes. A further detailed study and analysis of in- and outbound flows and the ratio of type of goods in total freight is available in the study of the project group Kanaal Gent - Terneuzen (KGT) [10].

Zeeland Seaports

The study of the project group KGT [10] reported preliminary figures on the modal split in the port of Terneuzen (no data for Vlissingen). In this study, all freight types were accounted for: sea, rail, road, inland waterways and pipeline. The flow of goods generated by Dow Chemicals before the locks, was also included. To compare with the other Scheldt ports, only the figures for transport modes 'road', 'rail' and 'inland' were selected (see figure 3).

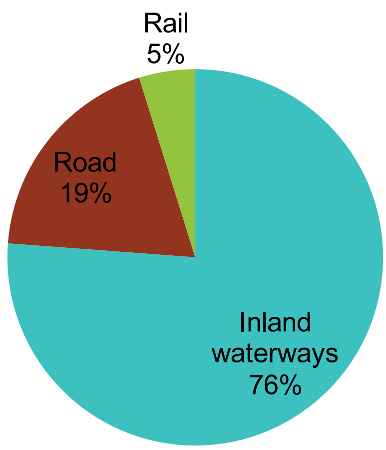

Figure 3: Ratio of road, rail and inland waterways in the overall modal split of freight transport in the hinterland and from the Port of Terneuzen (2005). Source: Data from the Port of Terneuzen, Zeeland Seaports (ZSP), edited by "How To Advisory, Rebel Group Advisory '.

With regard to the port area of Terneuzen (Dutch Canal zone) the inland waterways or barge transport makes an important contribution to the subtotal of freight transport considered here (road / rail / inland waterways), while the rail remained relatively unimportant.

The calculation methods for the modal split of freight transport between the hinterland and the Scheldt ports are quite different between ports. No data are available as yet to define trends in modal shift for the ports of Ghent and Zeeland. For the Port of Antwerp, revised figures are available only for the component of container transport.

The average emissions by freight transport expressed in grams per tonne-kilometre of components such as e.g. CO_2 are sensitively lower for rail (18-35 g/tkm), maritime transport (2-7 g/tkm) and inland waterways freight or barges (30-49 g/tkm) compared to road transport (62-110 g/tkm) and air freight (> 665 g/tkm) [11].

Depending on the weight and volume of goods, type of transport and efficiency of the logistics support, the specific emission performance can be optimized. As the maritime industry continues to grow, it is important that not only the relative share of more environmentally friendly transport modes (such as rail, river) increases but also the absolute emissions of pollutants in the emissions of each of these modes is limited by technical developments, stricter emission standards and logistics optimization.

Emissions from shipping (from, to and in the ports)

The current research in terms of emissions from shipping and their potential effects on human health and the environment, focuses particularly on the substances SO_2, NO_x, CO, particulate matter (PM10, PM2.5 and others), PAHs and heavy metals. These emission data are available per substance and per port, and are further broken down by (ship) activity (manoeuvring, unloading/loading at the dock, waiting in locks) and the type of transport (ro-ro, container, bulk, other). In this summary, only the overall emissions of SO_2, NO_x and CO_2 are discussed. The emissions of NO_x and PM10 are highly dependent on the type of engine. SO_2 emissions are mainly determined by the type of fuel.

Sulfur dioxides (SO_2)

In the Dutch Zeeland Seaports, a decrease in SO_2 emissions from shipping is visible since 2003, after a period of increase in SO_2 emissions (1994-1997), followed by a 'plateau' (1997-2003) (see figure 4). The total SO_2 emissions from shipping in 2008 was comparable to that in 1994. Despite the sharp increase of almost 20% of total cargo throughput (tonnes) over the period 2003-2008, the SO_2 emissions have decreased by 38% over the same period.

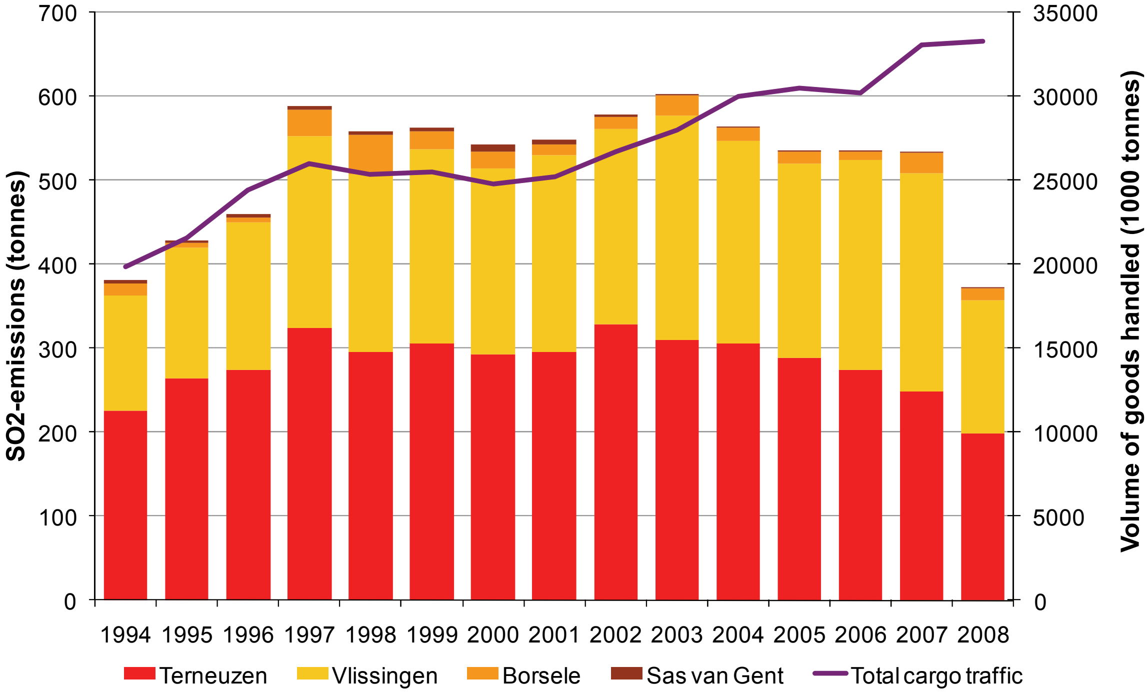

Figure 4: Development in the annual SO_2 emissions from shipping, from and within the ports of Zeeland (1994-2008). Source: Netherlands Emission Registry based on data TNO (EMS model). Data transhipment Zeeland Seaports.

The emission of SO_2 in the Flemish Scheldt ports of Antwerp and Ghent showed a similar decrease in 2007 and 2008, after a long period of increasing SO_2 emissions (1990-2006) (see figure 5). Also in these ports, SO_2 emissions in 2008 fell by over 21% compared to 2003 despite a 30% increase in handled cargo. The total emission of SO_2 in these ports in 2008 was comparable with the figures in 1997. Given the importance of container transport in the port of Antwerp (see indicator 'Socio-economic importance of ports') this a positive result. The (larger) container ships have a relatively higher share of emissions of SO_2 (and particulate matter), because until recently the engines of larger vessels were driven with high sulfur fuel [12, 13]. The tightening of standards on the use of low sulfur fuel has clearly played a role in this decrease.

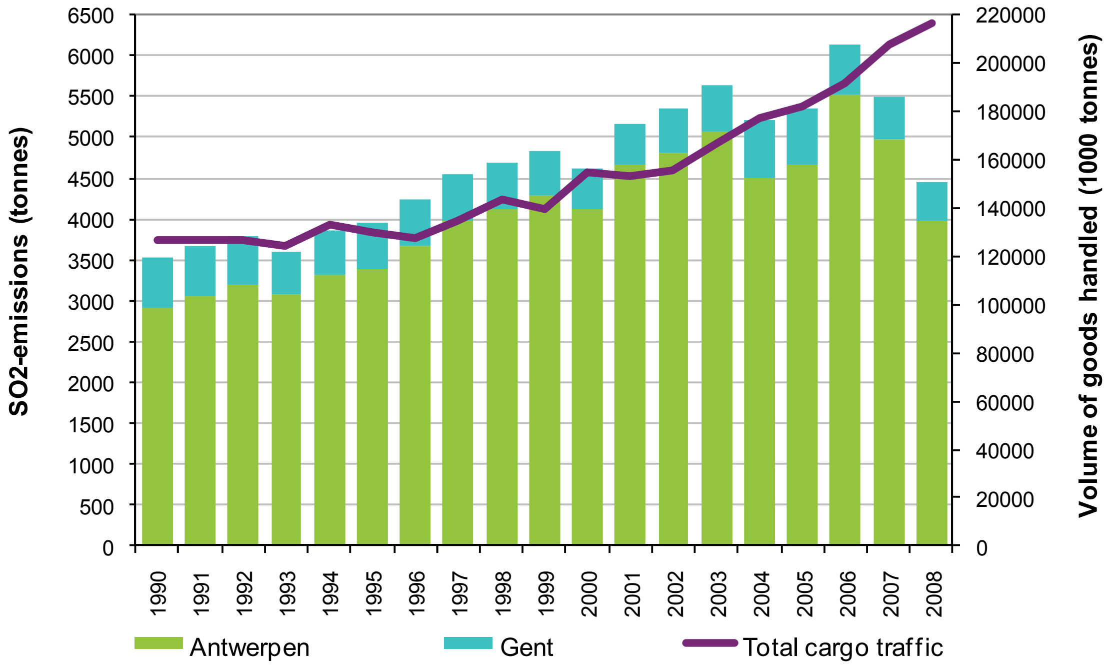

Figure 5: Trend in annual SO_2 emissions from shipping, from and in the Flemish Scheldt ports Antwerp and Ghent (1990-2008). Source: EMMOSS model TML commissioned by VMM. Data transhipment: Flemish Port Commission [14].

Nitrogen oxides (NO_x)

The trend in emissions of nitrogen oxides was less pronounced than the trend in SO_2, although a tendency to 'decoupling' in relation to the volume of handled goods also seems to be the case. In 2004, a slight decrease occurred in NO_x emissions from ships registered in the ports of Antwerp and Ghent over the period 1998-2003 (see figure 6). Whether this relative decrease -compared to the growth in volume of handled cargo- actually is maintained as a trend, needs to be confirmed.

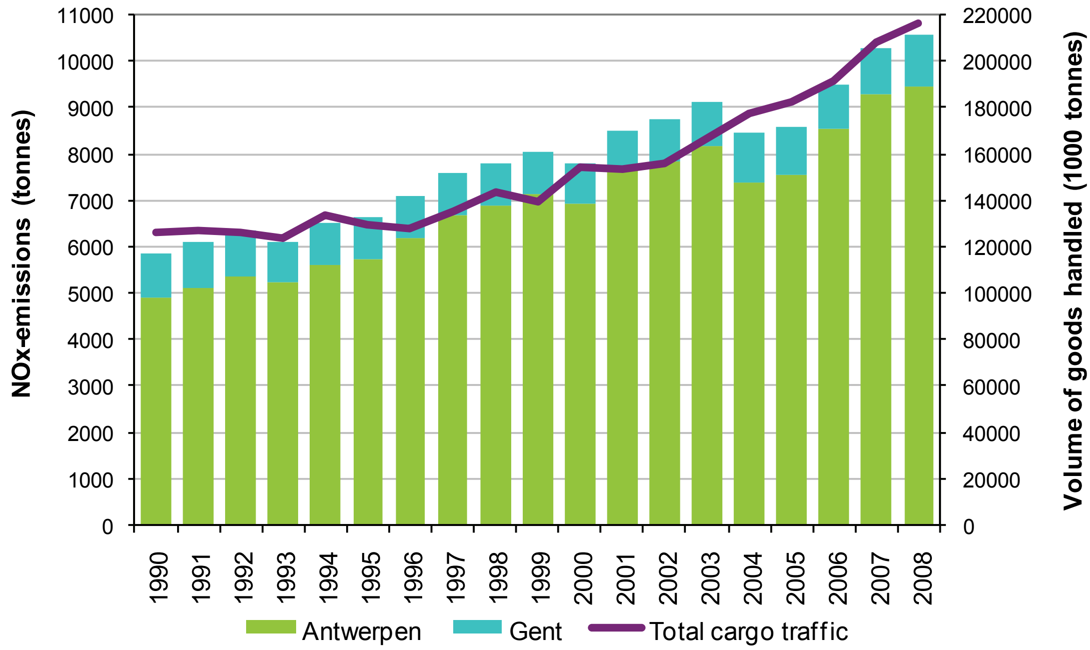

Figure 6: Development in the annual NO_x emissions from shipping to, from and within GHA and Port of Ghent (1990-2008). Source: EMMOSS model TML commissioned by VMM. Data transhipment Flemish Port Commission [14].

In Zeeland Seaports a positive trend is clearly visible from 2004. The relative increase in NO_x was not only smaller than the growth in volume of handled goods: also in absolute terms (tonnes) emissions of NO_x fell by 16% in 2008 compared to 2003 (see figure 7).

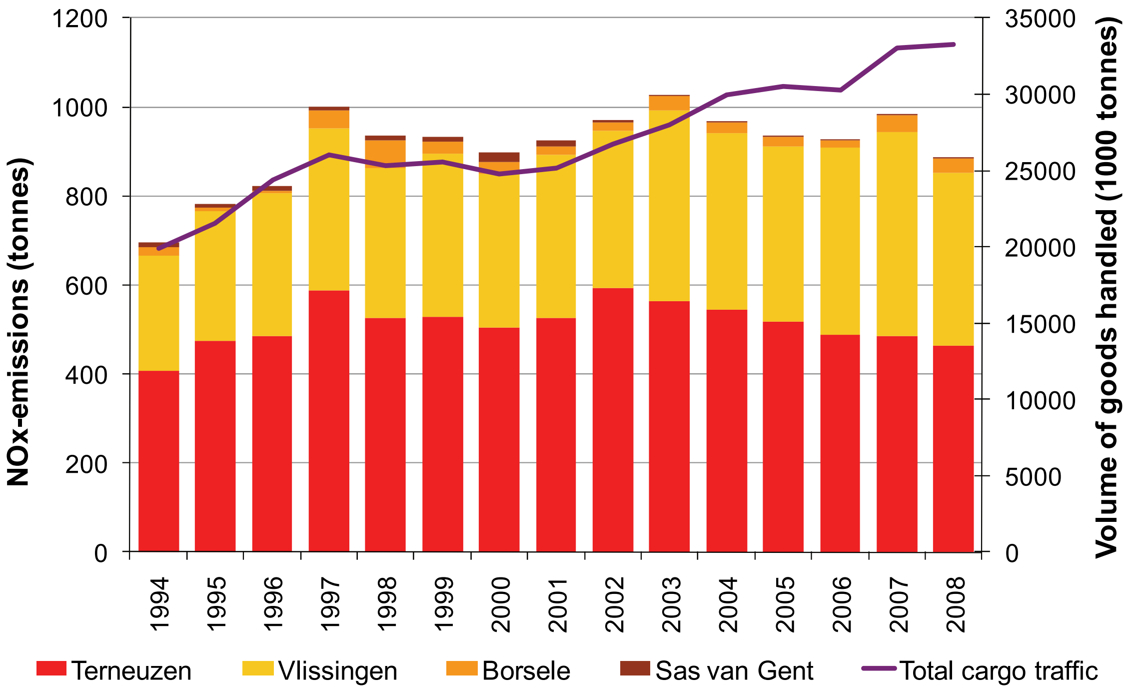

Figure 7: Trends in the annual NO_x emissions from shipping to, from and within ZSP 1994-2008. Source: Emission Registration Netherlands, based onTNO data (EMS model). Data transhipment ZSP.

Similar positive trends (decrease in emissions relative to the total volume of handled goods and a decrease in absolute emissions) were also recorded in Zeeland Seaports and the Flemish Scheldt ports for PM10 dust particles, carbon monoxide (CO) and volatile organic compounds (VOCs). Available data for finer dust particles PM2.5 in the Flemish ports, also confirmed this positive trend. Next to the fuel type, the type of engine and equipment on board contribute to this positive trend. Besides the main engine, ships also use auxiliary engines, boilers and generators to produce steam and energy. Each of these devices have different emission factors for NO_x and other substances [12].

Carbon dioxide (CO_2)

After a period of increased CO_2 emissions from shipping (1994-1997) in Zeeland Seaports, a 'plateau' in the CO_2 emissions is observed in 1998-2002 which still seemed linked to the total volume of goods handled (see figure 8). Since 2003 the trend indicates a relative decline, and even a decoupling of CO_2 emissions compared to the volume of handled goods.

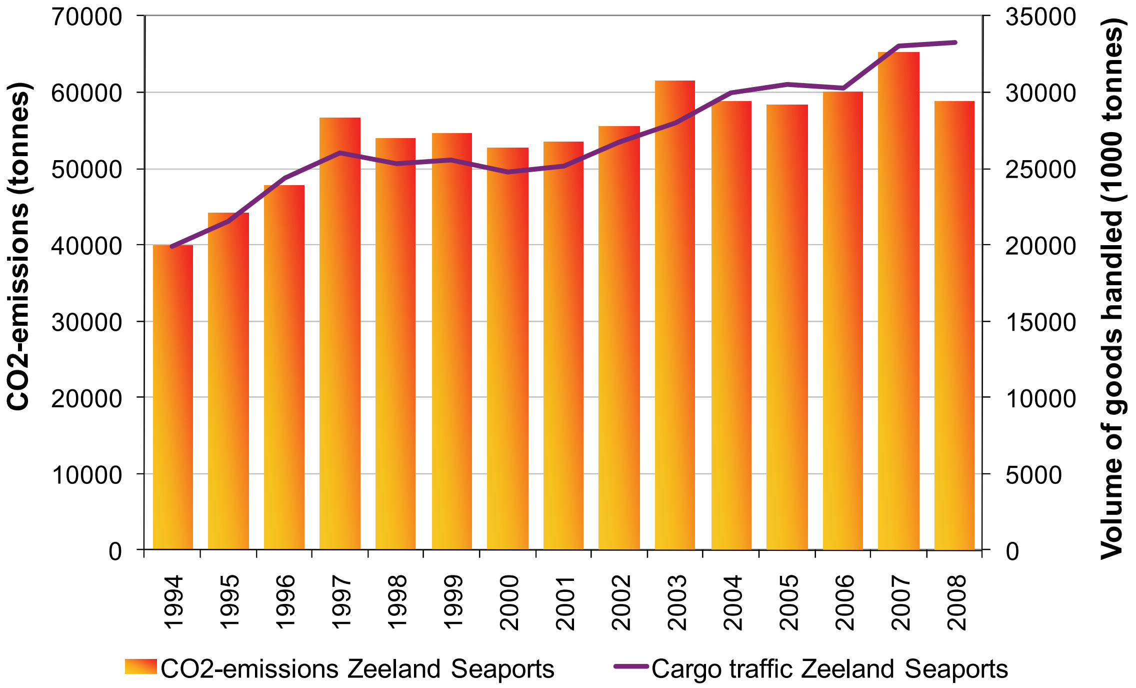

Figure 8: Trend in annual CO_2 emissions from shipping to, from and within ZSP (1994-2008). Source: EMS data. Emission Registration Netherlands (TNO). Data on volume of handled goods: ZSP.

For the ports of Antwerp and Ghent the data do not indicate a decrease in total absolute CO_2 emissions. The recent figures may validate the apparent improvement in the ratio of CO_2 emissions in relation to the total volume of handled goods, initiated in 2004.

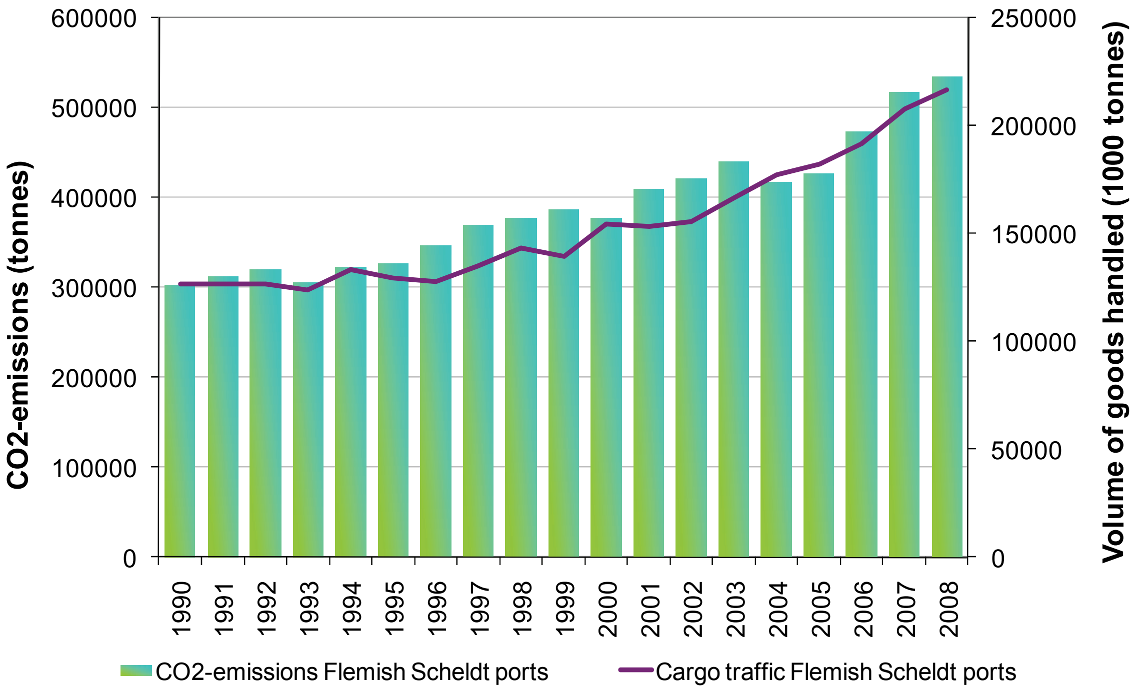

Figure 9: Trend in the annual CO_2 emissions from shipping to/from and in GHA and Port of Ghent, 1990-2008. Source: EMMOSS model TML Leuven commissioned by VMM. Data Transhipment Flemish Port Commission.

Where do the data come from?

- Data on modal distribution in Terneuzen were collected as commissioned by the Project group Kanaal Gent - Terneuzen (KGT2008). The data of Zeeland Seaports (www.zeeland-seaports.com) were adapted by How To Advisory, Rebel Group Advisory.

- The data on modal distribution in the Flemish Scheldt ports are provided by the Antwerp Port Authority (GHA) and the Port of Ghent.

- Emissions from shipping in the Flemish Scheldt ports are provided by Flemish Environment Agency (VMM). Data are ordered by the VMM and calculated by Transport & Mobility Leuven (TML), based on the model EMMOSS.

- Zeeland Seaports emissions data are provided by the Emissions Inventory System: http://www.emissieregistratie.nl, an alliance of various organizations in the Netherlands (more info: http://www.emissieregistratie.nl/erpubliek/content/link.nl.aspx).

Opportunities and threats

Road transport is indispensable in the hinterland transport to and from the Scheldt ports, but the importance of rail and inland waterways will grow in the coming years. The current limits for road transport infrastructure can not continue to absorb the growth in the (maritime) trade.

The objective for a sustainable freight transport in Zeeland Seaports [3] is achieved i.a. by the 2007-2011 Zeeland Action Plan for Freight. In implementing this policy, the province of Zeeland works together with the Directorate General for Public Works and Water Management Zeeland, Zeeland Seaports port authority, Zeeland Environment Federation, Transport and Logistics Netherlands, the Shippers Organization, the Chamber of Commerce and with the regions outside the province. In addition to consolidating and strengthening the position of inland waterway transport as a transport mode, 'rail freight' will have to absorb a growing share of the Zeeland hinterland transport, including the handling of containers. This requires additional rail infrastructure and related investment budgets. This challenge is also a main issue in the European Union: 2/3 of the priority projects within the Trans-European Transport Network (TEN) is a rail project.
The challenges for the Flemish Scheldt ports are similar, if current growth needs to be absorbed by the capacity of existing and planned infrastructure and the projected emission levels need to be respected.

The emission levels of the maritime shipping in Flanders are generally growing at a slower pace than the volume of handled goods and in some cases even decreased in terms of absolute values. This indicates that the average emission performances have improved. The detailed data suggest that in Flanders, unlike in the Netherlands, more than half the emissions of the maritime shipping are related to the ports (locks, maneuvring, loading/unloading). This obviously has to do with the limited surface of the sea region in Belgium compared to the size of the port areas but it is also partly due to methodological and geographical boundaries of the model. Emissions in the Flemish part of the river Scheldt have been assigned as being emissions from the Port of Antwerp. The figures also indicate the relative importance of emissions during 'lying at the quay'. Therefore the 'SECA specification' (2007) and the EU requirement to use low sulfur fuel while lying at the quay (Directive 2005/33/EC), have generated a significant decrease of SO_2 in the (Flemish) Scheldt ports. The renewal of the fleet with more efficient engines further contributed to this decrease. On the other hand, the figures suggest that the effects of MARPOL annex VI to the NO_x emissions have been rather limited so far. The consequences of a stricter environmental policy on emissions from shipping are also clearly visible in Zeeland Seaports.

The technical fact sheets describe definitions, data and methodology. The fact sheets are available at: http://www.scheldemonitor.org/indicatorfiche.php?id=11

Integration with other indicators/measurements?

It is important that the above information about the 'environmental effects of ports and shipping' is explained in a wider perspective to underpin statements on whether or not ports and shipping in the Scheldt estuary are moving toward more sustainable situations. In this summary therefore, this has partly been addressed by linking the emissions to the volume of handled goods. Also in the indicator 'nautical management' a link is made between the emissions from shipping, the extent of shipping movements and the operational management of the nautical traffic. Other indicators that provide this context are 'socio-economic importance of ports', 'soil interfering activities' (including' cost of maintenance dredging'), 'status of species and habitats', 'morphology and dynamics in the estuary' (including changes in the ecotopes) and 'population pressure' (including 'welfare'). The indicator 'threats to biodiversity' refers to guidelines (including the IMO) for the control and treatment of ballast water in ships in order to reduce introduction and transfer of harmful organisms. The indicator 'surface water quality' refers to the possible contributions from shipping and port policies to improve the ecological and chemical status of surface waters.

There are also aspects of public health to be taken into account. Dutch research shows that emissions of nitrogen oxides (NO_x) and especially NO_2 may increase health risks in people with breathing problems and respiratory difficulties. NO_x/NO_2 concentrations can thus affect the health of people living near ports. The same applies to the share of fine particles associated with combustion processes. The proportion of most harmful components in the total PAH emissions from shipping on the other hand is not expected to cause health risks. Unfortunately figures that identify the effects of environmental pressure on public health is associated to research results and to a lesser extent available from formally established monitoring results.

How to cite this fact sheet?

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