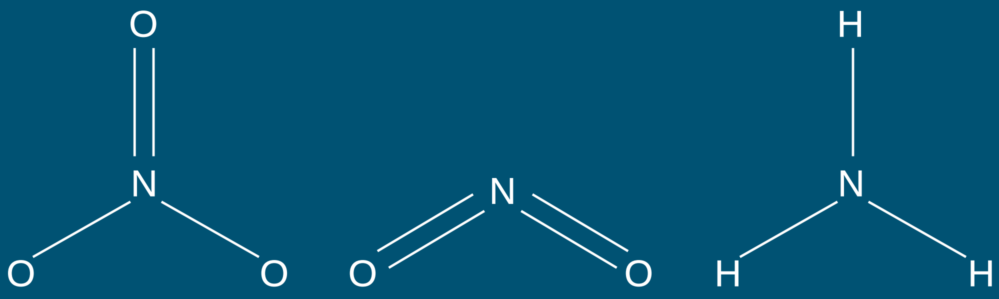
HELCOM – ENVIRONMENTAL FOCAL POINT INFORMATION



Airborne nitrogen loads to the Baltic Sea

Helsinki Commission

Baltic Marine Environment Protection Commission

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Abstract

This report presents an overview of the different sources contributing to the deposition of airborne nitrogen to the Baltic Sea based on reports and data collected mainly by the Co-operative Program for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) and produced for HELCOM. The report examines whether pollution reduction requirements already exist for each identified significant source and to what extent they have been implemented.

Approximately a quarter of the total nitrogen input into the Baltic Sea comes from airborne nitrogen deposited directly into the sea. In addition to direct deposition, some of the nitrogen deposited into the Baltic Sea catchment area reaches the sea via runoff from land. Furthermore, distant sources outside the Baltic Sea catchment area account for almost 40 % of the total airborne deposition of nitrogen and this should be considered when evaluating possible further developments and the adequacy of measures taken to reduce airborne nitrogen pollution.

Nitrogen compounds are emitted into the atmosphere as nitrogen oxides and ammonia. Shipping, road transportation and energy combustion are the main sources of nitrogen oxides emissions in the Baltic Sea region. In the case of ammonia, roughly 90 % of the emissions originate from agriculture. Agriculture is the most significant contributor of total airborne nitrogen, accounting for 43 % of total air emissions of nitrogen from the HELCOM Contracting Parties. Consequently, the need to reduce emissions and discharges from agriculture has become increasingly important as this sector is also responsible for the majority of the waterborne nitrogen discharges into the Baltic Sea.

Background

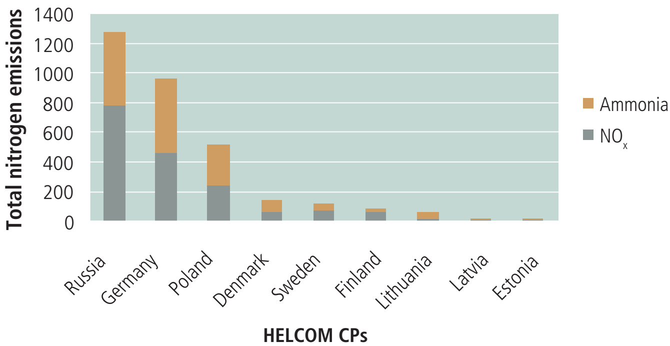
The identification of sources of airborne nitrogen pollution as well the solutions to reduce their emissions, have been defined as priority tasks of HELCOM LAND.

This report presents an overview of the different sources contributing to the deposition of airborne nitrogen into the Baltic Sea, based on information and data compiled mainly by EMEP for HELCOM. The study examines whether pollution reduction requirements already exist for each identified significant source and to what extent they have been implemented.

Emissions of nitrogen into the air

Airborne emissions of total nitrogen, i.e. nitrogen oxides (NO_x) and ammonia (reduced nitrogen), from the HELCOM Contracting Parties totalled 3,200,000 tonnes in 2002. This figure is based on total emissions from each country, including areas outside the Baltic Sea catchment area. This in turn explains the high figures for Germany and Russia. Of the HELCOM Contracting Parties, Russia (40 %) and Germany (30 %) had the most significant air emissions of nitrogen **(Figure 1)**, although not all emissions from the Baltic Sea Contracting Parties actually end up in the Baltic Sea.

Figure 1. Emissions of nitrogen (nitrogen oxides + ammonia) from individual HELCOM Contracting Parties in 2002. Units: kilotonnes of nitrogen (EMEP 2004a).



Emissions from different sources in the Contracting Parties

Nitrogen oxides emissions

Nitrogen oxides emissions from all of the HELCOM Contracting Parties totalled 1,720,000 tonnes in 2002. **Figure 2** gives an overview of total nitrogen oxides emissions for each sector. Corresponding figures for each HELCOM Contracting Party can be found in the tables in Annex 1. In all HELCOM Contracting Parties, transportation (sectors 7 and 8) and combustion (sectors 1, 2 and 3) are the main sources of nitrogen oxides emissions into the atmosphere. The transportation sectors dominate in all the HELCOM Contracting Parties except in the cases of Poland and the Russian Federation, where combustion in the energy and transformation industry (sector 1) is the major contributor to emissions. However, road transportation (sector 7) is still the second largest contributor in these countries.

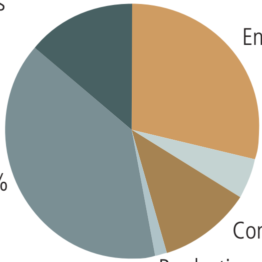


Figure 2. Percentage of total emissions of nitrogen oxides (NO_x) from different sectors in the HELCOM Contracting Parties (EMEP 2004a).

Data on nitrogen oxides emissions from international shipping traffic on the Baltic Sea are still only available for one year – 1990. Even so, total annual emissions of nitrogen oxides from international shipping on the Baltic Sea are relatively high - 107,000 tonnes. In comparison to the annual emissions levels of nitrogen oxides from countries such as Finland, Sweden or Denmark (slightly more than 60,000 tonnes in each country), the significance of emissions from this sector can easily be seen (see tables in Annex 1).

Ammonia emissions

Total ammonia emissions from the Contracting Parties amounted to 1,460,000 tonnes in 2002. Ammonia (reduced nitrogen) emissions from agriculture (sector 10) are much higher than emissions from any other sector in all of the HELCOM Contracting Parties. The contribution of agricultural emissions to total ammonia emissions in 2002 is: 95% for Denmark, 90% for Estonia, 92% for Finland, 92% for Germany, 96% for Latvia, 86% for Lithuania, 96% for Poland, 95% for Russia and 80% for Sweden.

Nitrogen emissions from agriculture make up roughly 43 % of total nitrogen emissions (oxides + ammonia) from all of the HELCOM Contracting Parties and are therefore the main source of nitrogen among all of the sectors. Ammonia is emitted mainly from livestock farming systems and from the use of mineral fertilizers. Although some of the ammonia emitted is deposited locally, it may also be transported over thousands of kilometres, thereby contributing to transboundary air pollution.

Ammonia emissions from sectors other than agriculture are significantly lower for all HELCOM Contracting Parties. Examples of other relatively significant sources are: industrial processes in Lithuania (sector 4), which account for 12 % of national emissions, and waste treatment and disposal in Sweden (sector 9), responsible for 10 % of national ammonia emissions.

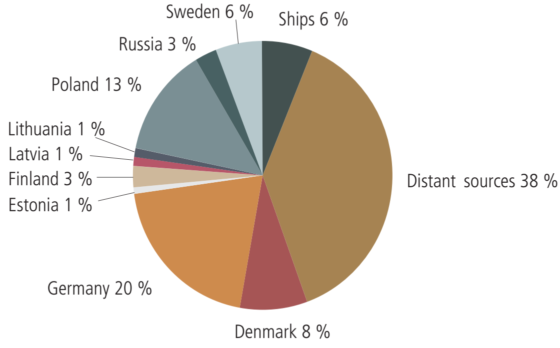
Atmospheric deposition of nitrogen directly into the Baltic Sea

Total nitrogen

The atmospheric deposition of nitrogen directly into the Baltic Sea amounted to approximately 268,000 tonnes in 2000, of which 154,000 tonnes were nitrogen oxides and 114,000 tonnes ammonia. This represented roughly one quarter of all nitrogen deposited into the Baltic Sea. In addition to direct deposition, a portion of the nitrogen deposited in the Baltic Sea catchment area will finally end up in the sea via runoff from land. The deposition of nitrogen into the catchment area is more than 5 times higher than direct deposits into the Baltic Sea.

Of the HELCOM countries, the main contributors were Germany, Poland and Denmark. However 38 % of the total atmospheric deposition to the Baltic Sea came from contributors outside the HELCOM area. Further, shipping on the Baltic Sea is also a significant source, accounting for 6 % of total nitrogen deposition **(Figure 3)**. The top ten contributors including sources from outside the catchment area are shown in **Figure 4**. The figures refer to emissions from countries as a whole, not only to their portions of the Baltic Sea catchment area.

Figure 3. Proportion of atmospheric deposition of nitrogen into the Baltic Sea according to country and source in 2000.



The Czech Republic is the 11th largest depositor of total nitrogen into the Baltic Sea, which makes it a larger contributor than Finland or Russia. Ukraine and Belarus rank 15th and 16th on the list of the most significant contributors, accounting for more than the airborne nitrogen coming from Estonia, Latvia or Lithuania.

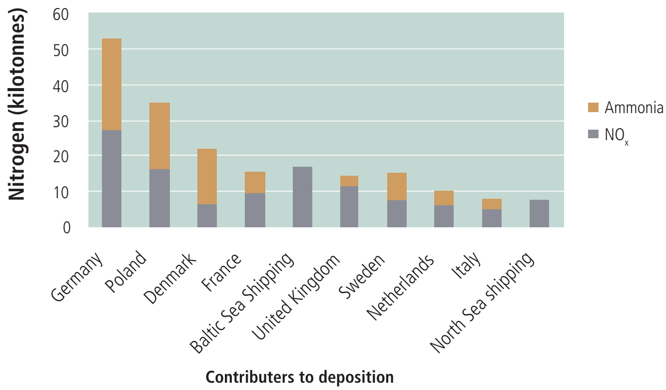


Figure 4.
Top ten contributors to atmospheric nitrogen (oxides + ammonia) deposition into the Baltic Sea in 2000 (EMEP 2004a).

Nitrogen oxides

Germany is the largest contributor to nitrogen oxides deposition. Emissions from international shipping traffic on the Baltic Sea are the second largest factor, accounting for approximately the same level of deposition to the Baltic Sea as Polish sources (the third largest). Furthermore, the contribution from distant sources such as emissions from the UK, France and Italy is also significant. Emissions from international shipping traffic on the North Sea are also substantial – number six on the list.

Table 1, below, indicates the three largest contributors of nitrogen oxides in each sub-basin of the Baltic Sea.

Gulf of Bothnia	Gulf of Finland	Gulf of Riga	Baltic Proper	Belt Sea	Kattegatt
Baltic shipping-3.62	DE-1.22	DE-1.03	DE-16.10	DE-2.84	DE-2.60
DE-3.38	PL-1.07	Baltic shipping - 0.83	PL-11.38	GB-1.54	GB-1.71
SE-2.79	RU-0.94	PL-0.74	Baltic shipping - 9.76	France-1.05	France-1.24

Table 1.
Three main contributors to deposition of nitrogen oxides into the different sub-basins of the Baltic Sea in 2002.
Units: kilotonnes of nitrogen.

Ammonia

The major sources of ammonia deposition into the Baltic Sea are emissions in Germany, Poland, Denmark and Sweden. However, distant countries such as the Netherlands and Italy are also among the ten major contributors. Unlike the deposition of nitrogen oxides, local sources are more important factors contributing to ammonia deposition. **Table 2**, below, indicates the three largest contributors to deposition in each sub-basin of the Baltic Sea.

Table 2. Three main contributors to deposition of ammonia into the different sub-basins of the Baltic Sea in 2002. Units: kilotonnes of nitrogen.

Gulf of Bothnia	Gulf of Finland	Gulf of Riga	Baltic Proper	Belt Sea	Kattegatt
PL-2.54	DE-0.75	LV-0.68	PL-14.11	DE-6.48	DK-4.99
DE-2.21	PL-0.59	PL-0.61	DE-13.12	DK-4.59	DE-2.81
FI-1.98	RU-0.53	DE-0.60	DK-4.83	France-0.95	France-1.03

Trends in emissions and deposition

Total nitrogen

Since 1980 there has been a reduction of approximately 40 % in the levels of total nitrogen emissions from the HELCOM Contracting Parties. On the other hand, deposition levels have only declined by roughly 15 % during the same time period. Additionally, since 1990 deposition has remained at the same level as in 1980. This is due to the fact that the deposition of nitrogen into the Baltic Sea is highly dependent on meteorological conditions, which change from year to year. As a result, reductions in nitrogen emissions do not necessarily lead to corresponding reductions in deposition.

Emissions from the individual HELCOM Contracting Parties for the period 1980-2002 as well as deposition into the different sub-regions are shown in Annex 2.

Nitrogen oxides

According to reported EMEP figures, NO_x emissions in Europe declined by approximately 25 % between 1980 and 2000, while the corresponding reduction among the HELCOM Contracting Parties was roughly 40 % between 1990 and 2002. There are noticeable differences in the declines in all of the countries, with the largest decreases generally observed in Eastern Europe and in Germany (around 50 %).

Emissions reductions observed since 1990 are due to a decrease in emissions, particularly from power plants, industry and residential heating. Progress in the transportation sector has not been as positive, in spite of major reductions in the emissions of air pollutants from new vehicles during the last decade. As a result, two further rounds of significant cuts in emissions from this sector have been agreed to in the EU. In the Baltic States, developing strategies to reduce NO_x emissions from both new and existing vehicles remains a challenge; however, the contribution from transportation in these countries to the total deposition of nitrogen to the Baltic Sea is quite small.

A growing focus point is the level of emissions from shipping, but reliable figures are not available to support this concern.

According to recent estimates (EEB, 2004), nitrogen oxides emissions from international shipping traffic on the European seas increased by more than 28 % between 1990 and 2000. The emissions of NO_x from international shipping are expected to increase by two-thirds by the year 2020, even after the implementation of MARPOL Annex VI concerning air pollution by ships. According to this estimate, by 2020 emissions from international shipping throughout Europe will surpass emissions from all land-based sources in the 25 EU member states combined (Entec, 2002).

Ammonia

Emissions of ammonia in Europe decreased by roughly 20 % between 1980 and 2000 overall, but there are notable differences among regions. The largest reductions have been reported in eastern and central European countries such as the Baltic States, and are probably due to a significant decrease in agricultural production in the early 1990s. In most other areas the decrease has been around 10 %. Between 1990 and 2002, ammonia emissions fell by 36 % in the HELCOM Contracting Parties. This means that the total emission targets in the Gothenburg Protocol to the UNECE Convention on Long-range Transboundary Air Pollution and the EU National Emissions Ceilings (EU NEC) Directive for these countries have been achieved (see Annex 3).

Existing requirements governing nitrogen emissions into the air

Existing requirements for land-based sources

HELCOM

HELCOM Recommendations contain provisions relating to NO_x emissions for sectors such as the pulp and glass industries, which are significant contributors of emissions in some of the Contracting Parties. However, there are no requirements governing sectors such as energy production or incineration, which are the major contributors, apart from the transportation sector.

HELCOM Recommendation 17/1 concerning the transportation sector includes provisions to develop goals and programmes for the reduction of emissions as well as for the introduction of the Polluter Pays Principle and the use of the Best Available Technology (BAT) to the sector. There are, however, no specific requirements to limit NO_x emissions from this sector.

HELCOM requirements concerning ammonia emissions from agriculture, which is the main source of ammonia, are quite well covered by the provisions in Annex III to the Convention and Recommendation 24/3 on the reduction of discharges and emissions from agriculture.

UNECE

In Europe, long-range transboundary air pollution has been regulated in the context of the Framework Convention on Long-Range Transboundary Air Pollution (CLRTAP) of UNECE. It governs all HELCOM Contracting Parties, in addition to other European countries from which significant quantities of NO_x enter the Baltic Sea area.

The 1991 Gothenburg Protocol to the UNECE CLRTAP sets emission targets for eutrophying, acidifying and ozone-forming air pollutants to be achieved by 2010, including commitments and a series of mandatory control measures that the Parties are required to employ in order to control pollution from nitrogen oxides and ammonia. For example, the Parties are required to establish codes of good agricultural practice to control ammonia emissions within one year of the entry into force of the Protocol. The required reduction targets for the HELCOM Contracting Parties are presented in Annex 3. Estonia is not a Party to the Gothenburg protocol, but has similar objectives set under the corresponding EU NEC Directive (see below).

EU

European Union policy on air quality aims to develop and implement appropriate instruments to improve air quality. The control of emissions from mobile sources, improving fuel quality and promoting and integrating environmental protection requirements into the transportation and energy sector are part of these aims.

The EU has adopted new directives to regulate air emissions in recent years, which are complementary to the UNECE CLRTAP work. Directive 2001/81/EC of the European Parliament and of the Council on National Emission Ceilings for certain pollutants (NECs) sets upper limits for total emissions of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution (SO_2, NO_x, VOCs and ammonia), which each Member State must achieve by 2010. However, it is largely left to the Member States to decide which measures to take in order to comply with the Directive. These upper limits constitute the first steps towards the achievement of the long-term objectives of not exceeding the so-called critical loads and effectively protecting human health. The Directive required Member States to draw up national programmes for the reduction of emissions by 2002 in order to comply with the emission ceilings. The programmes are to be updated in 2006 as necessary and in 2008 the Commission shall report on the progress of the implementation of the Directive, draw up proposals for modifications of the national ceilings and propose possible further emission reductions with the aim of meeting the long-term objectives of the Directive, preferably by 2020. The NEC Directive is expected to reduce NO_x emissions by 51 % from 1990 to 2010 in the EU 15-region.

For Germany and Latvia, the emission ceilings for nitrogen oxides are somewhat stricter than required by the Gothenburg Protocol to the UNECE Convention on Long-range Transboundary Air Pollution (see Annex 3 for comparison).

Emissions from large point sources are regulated by EU legislation. Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (LCP), regulates emissions from all combustion plants with a capacity larger than 50 MW. Together, the NEC and the revised LCP Directives are the main instruments employed to achieve the EU's long term goals for air quality.

Directive 1996/61/EC on Integrated Pollution Prevention and Control (IPPC) regulates large installations by setting common rules for issuing permits. So-called BREFs (EU-wide BAT reference documents) are produced for sectors under the IPPC Directive and intended to assist the licensing authorities. The relevant BREFs for nitrogen emissions to air include the BREFs for refineries, intensive livestock farming and large combustion plants.

Directive 2000/76/EC on the incineration of waste sets out limits for NO and NO_2 and the aim is to prevent, or when that is not practicable, as far as possible mitigate negative effects on the environment (including marine ecosystems).

Further proposals for measures are likely to be considered in the context of the EU's "Clean Air for Europe (CAFE) programme" under the Sixth Environmental Action Programme. Based on work conducted by this programme, by July 2005 the Commission is to deliver a communication to the Parliament and the Council, presenting its thematic strategy on air pollution.

Emissions from the transportation sector have been regulated in the context of the Auto-Oil programmes in the EU. Emissions specifications for new cars, heavy-duty vehicles and off-road vehicles are being progressively tightened. Altogether, these measures promise very significant reductions in harmful air pollutant emissions from the transportation sector in the near and medium term (Syri *et al.*, 2004).

Existing requirements for shipping

HELCOM

HELCOM has adopted one Recommendation - 11/2 - concerning the reduction of air pollution from ships. It contains a general recommendation to cooperate with the International Maritime

Organisation (IMO) in order to establish reduction objectives and target dates and to rapidly limit to an environmentally acceptable level the emission of harmful components such as nitrogen oxides in exhaust gases by applying best available technology.

IMO

Air pollution from ships is regulated by Annex VI of MARPOL 73/78, which includes NO_x emission limits, mainly for diesel engines with a power output of more than 130 kW and the NO_x Technical Code. The revised Annex VI of MARPOL will enter into force in May 2005, but the rate of ratification is still quite poor among the HELCOM Contracting Parties. As a result, the HELCOM MARITIME Group has urged the HELCOM Contracting Parties to ratify the new Annex VI as soon as possible.

The MARPOL Conference in 1997 invited the Marine Environment Protection Committee (MEPC), as a matter of urgency, to review the nitrogen oxide emission limits at a minimum of five year intervals after the entry into force of the 1997 Protocol, and if appropriate as a result of such review, to prepare amendments to the provisions of Annex VI of MARPOL 73/78 and the NO_x Technical Code. The NO_x Technical Code was developed at the IMO during the mid-1990s, and since then further technical developments relating to the reduction of NO_x emissions from diesel engines have occurred.

EU

To date, the bulk of the European Community legislation on atmospheric emissions does not apply to ships. There are, however, a number of Community measures requiring the Commission to take action on ship emissions such as the previously mentioned Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants, which commits the Commission to report on the extent to which emissions from maritime traffic contribute to acidification, eutrophication and the formation of ground-level ozone.

In November 2002, the European Commission adopted a European Union strategy to reduce atmospheric emissions from seagoing ships. The strategy reports on the magnitude and impact of ship emissions in the EU and sets out a number of actions, including economic incentives, to reduce the contribution of shipping to acidification, ground-level ozone, eutrophication, health problems, as well as climate change and ozone depletion. The communication outlines a number of actions to achieve these objectives, including:

– coordinating the positions of EU Member States within the IMO to press for tougher measures to reduce ship emissions. The entry into force of MARPOL Annex VI, which establishes regulations for the prevention of air pollution from ships, is a fundamental aspect of the strategy;
– amending NO_x and particulate matter emissions standards in Directive 97/68/EC concerning emissions from non-road mobile machinery;
– if the IMO has not proposed tighter international standards by 2007, to bring forward a proposal to reduce NO_x emissions from seagoing vessels;
– to examine the use of a set of economic instruments which would offer incentives to lower ships' atmospheric emissions below regulatory requirements.

Status of implementation

Land-based air emissions are quite well regulated at all levels and programmes for the reduction of emissions from the different sectors have been adopted in EU. Additionally, there are regulations to reduce ammonia emissions from agriculture; however there is the issue of a farm-level lack of implementation of regulations that already have been adopted. This was one of the findings outlined by a Danish project that assessed the implementation of HELCOM and EU requirements in agriculture (Percy-Smith *et al.*, 2003).

Although reductions in nitrogen oxides emissions were achieved by 2002, the emission ceilings of the Gothenburg Protocol to the UNECE CLRTAP and the EU NEC Directive for 2010 may be difficult to achieve for some of the Contracting Parties, particularly Germany, Denmark, Finland and Sweden, which are having difficulties reducing traffic emissions. For these countries, 20-39 % of NO_x needs to be reduced from their 2002 levels in order to reach the 2010 targets (see tables in Annex 3). Estonia, Latvia, Lithuania, Russia and Poland have already reached the required emission levels.

Some Contracting Parties also have difficulties achieving the targets for ammonia required by the Gothenburg Protocol to the UNECE CLRTAP and the EU NEC Directive. Estimates of further reductions required are presented in Annex 3, showing that members such as Denmark still need to reduce current ammonia emission levels by 32 % (which means that 60 % of the required reduction between 1990 and 2010 will still have to be dealt with). Finland and Germany must still reduce their 2002 emission levels by 6 % and 9 % respectively, to reach the targets. The other HELCOM Contracting Parties have already achieved the reduction requirement.

According to a progress report (ETC/ACC, 2004) which considers early EU Members, only Finland and the UK expect to meet all their emission ceilings in 2010, while Germany and Sweden hope to do so with additional proposed measures. Denmark expects their emissions of both NO_x and ammonia to exceed the emission ceilings. Among the countries contributing significantly to the deposition of nitrogen into the Baltic Sea, France, Italy and the Netherlands expect to miss their targets for nitrogen oxides. It should be noted that the reports largely lack emission projections that incorporate projected policies and measures as well as the quantification of their impacts.

The Gothenburg Protocol to the UNECE CLRTAP contains requirements to propose codes of good agricultural practices (GAP codes) for the reduction of ammonia emissions. According to information received, it seems that some of the Contracting Parties have adopted GAP codes which also deal with ammonia emissions, but not all of them specifically for the purpose of the Gothenburg Protocol.

Proposals for action

Actions on land

Land-based emissions to air are quite well regulated at all levels and programmes for the reduction of emissions from the different sectors have been adopted in the EU. Additionally, there are regulations to reduce ammonia emissions from agriculture; however there is the issue of a lack of implementation of existing regulations. Further possible measures to be considered in reducing ammonia emissions from agriculture include:

- Input to the reform of the EU Common Agricultural Policy;
- Agri-Environmental Schemes for protection of the marine environment;
- Assessment and recommendation of codes for good agricultural practice;
- Identification and promotion of techniques to reduce ammonia emissions;
- Limitation of animal density per hectare to sustainable numbers;
- Development of recommendations for BAT at plants not subject to approval under the IPPC Directive.

Nitrogen emissions have declined since the 1990s. However, some Contracting Parties must further reduce nitrogen emissions to fulfil the 2010 reduction requirements of the Gothenburg Protocol to the UNECE CLRTAP and the corresponding EU Directive on National Emissions Ceilings for certain pollutants (NECs). These are among the most important regulatory instruments at European level. At this stage it is not certain how well the obligations can be fulfilled by all of the countries that contribute to deposition, nor how significant are the fulfilment of obligations under these instruments to the status of the Baltic Sea. The biggest challenges lie in the transportation and agriculture sectors. The national programmes under the EU NEC Directive are to be updated in 2006 and the European Commission will propose modifications to the targets as well as further measures in 2008.

In order to assess the impacts of the foreseen total nitrogen emission levels on the eutrophication status of the Baltic Sea, HELCOM will also include data on airborne nitrogen depositions in the ongoing HELCOM Project "Assessment of implication of different policy scenarios on nutrient inputs", which currently only considers waterborne nitrogen inputs into the Baltic and their effect on the sea. EMEP will assess changes in the levels of nitrogen deposition into the Baltic Sea following the fulfilment of the nitrogen targets in the Gothenburg Protocol to the UNECE CLRTAP and the EU NEC Directive and/or the foreseen levels achieved by 2010.

The results of these studies will be used as input from HELCOM to update the programmes under the EU NEC Directive in the Member States in 2006 and to develop proposals for possible modification to the EU NEC Directive in 2008. The results will also be used as input from HELCOM to guide the revision of programmes under the UNECE Convention.

Actions at sea

The shipping sector is not regulated as extensively as land-based sources and as a result, in contrast to the expected progress in reducing emissions from land-based sources, shipping emissions of NO_x are expected to continue increasing. Due to the international nature of shipping, the measures adopted at the HELCOM/EU level can only have limited impact on NO_x emissions from shipping in the Baltic. HELCOM must therefore take active part in global actions initiated within the IMO to reduce NO_x emissions. HELCOM Contracting Parties are also encouraged to take part in the work of the IMO to review the current nitrogen oxides emission limits of Annex VI of MARPOL 73/78 as well as the corresponding provisions of the NO_x Technical Code.

It should be noted that economic incentives can significantly contribute to further reduction of NO_x emissions from individual vessels (using existing technical solutions to reduce the NO_x emissions). The impacts of the reduction of NO_x emissions, resulting from the use of economic incentives, will be evaluated at the HELCOM/EU level.

Annex 1. Emissions of nitrogen oxides and ammonia from HELCOM Contracting Parties by sector

The tables include emissions from the territories of the Contracting Parties which also lie outside the Baltic Sea catchment area. The figures are based on official reports to EMEP. However, Estonia and Poland have provided updated figures for NO_x and ammonia. The emissions of nitrogen from the part of Russia which lies within the Baltic Sea catchment area are 35 kilotonnes of NO_x and 4.6 kilotonnes of NH_3 (both calculated as nitrogen).

Table 1. Emissions of nitrogen oxides (NO_x) from the individual HELCOM Contracting Parties divided into SNAP-sectors. Units: kilotonnes of nitrogen in 2002.

Country	Sector									
	1	2	3	4	5	6	7	8	9	10	Total
Denmark	16.4	2.1	3.8	0.7	0.0	0.0	22.7	15.0	0.1	0.2	60.9
Estonia	4.8	0.4	0.7	0.0	0.0	0.0	4.8	1.4	0.0	0.1	12.2
Finland	10.3	2.6	11.1	1.0	0.0	0.0	24.3	14.0	0.0	0.0	63.3
Germany	71.7	30.1	44.7	7.5	0.0	0.0	241.7	60.1	0.4	0.0	456.2
Latvia	2.6	0.3	1.0	0.0	0.0	0.0	6.4	2.0	0.0	0.1	12.5
Lithuania	3.5	0.7	0.9	0.7	0.0	0.0	8.0	1.6	0.0	0.2	15.5
Poland	77.9	27.0	32.4	4.5	0.0	0.0	72.0	28.4	0.0	0.0	242.3
Russia	277.5	36.3	84.5	12.1	0.0	0.0	268.7	98.6	2.2	1.1	781.0
Sweden	8.4	2.0	12.7	0.9	0.0	0.0	33.8	15.8	0.0	0.0	73.7
Total	473.3	101.5	191.8	27.2	0.0	0.0	682.4	236.8	2.8	1.6	1717.4

Table 2. Emissions of ammonia from the individual HELCOM Contracting Parties divided into SNAP-sectors. Units: kilotonnes of nitrogen in 2002.

Country	Sector									
	1	2	3	4	5	6	7	8	9	10	Total
Denmark	0.4	0.2	0.0	0.2	0.0	0.0	1.2	0.0	2.9	78.4	83.2
Estonia	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.4	6.7	7.4
Finland	0.1	0.4	0.3	0.3	0.0	0.0	0.6	0.0	0.6	24.8	27.2
Germany	0.1	7.2	0.5	8.7	0.0	0.0	17.4	0.1	8.6	454.9	497.4
Latvia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	8.6	9.1
Lithuania	0.0	0.2	0.0	5.0	0.0	0.0	0.1	0.0	0.5	36.2	42.0
Poland	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	6.6	258.4	267.6
Russia	0.9	4.1	0.3	11.3	0.0	0.0	0.3	0.0	9.1	468.0	494.1
Sweden	0.3	0.6	0.3	0.1	0.0	0.0	3.1	0.0	4.3	36.6	45.3
Total	1.8	12.8	1.5	25.8	0.0	0.0	25.3	0.2	33.2		

Table 3. The list of 11 SNAP emissions sectors as specified in the EMEP-CORINAIR Emission Inventory Guidebook.

Sector 1	Combustion in energy and transformation industry
Sector 2	Non-industrial combustion plants
Sector 3	Combustion in manufacturing industry
Sector 4	Production processes
Sector 5	Extraction and distribution of fossil fuels and geothermal energy
Sector 6	Solvent and other product use
Sector 7	Road transportation
Sector 8	Other mobile sources and machinery (including ship traffic)
Sector 9	Waste treatment and disposal
Sector 10	Agriculture
Sector 11	Other sources and sinks

Annex 2. Data on emissions and depositions of total nitrogen

Table 1. Emissions of nitrogen into the air according to country, during 1980 – 2002. Units: kilotonnes of nitrogen/year.

Country/Year	1980	1985	1990	1995	2000	2002
Denmark	186	203	191	175	149	144
Germany	1705	1703	1371	1100	973	954
Estonia	41	41	40	22	20	20
Finland	122	119	123	107	99	90
Latvia	61	61	61	28	21	22
Lithuania	137	144	139	72	56	58
Poland	827	909	808	654	520	503
Russia	2085	2178	2076	1461	1253	1275
Sweden	167	174	146	141	124	119
Total HELCOM	5331	5532	4955	3760	3215	3190
Ship emissions*	107	107	107	107	107	107

* Please note that the figures for ship emissions are based on data collected in 1990

Table 2. Atmospheric deposition of nitrogen into the Baltic Sea sub-regions according to country, in 2000. Units: kilotonnes of nitrogen.

Sub-region/ Contracting Party	Denmark	Germany	Estonia	Finland	Latvia
Bothnian Bay	0.28	0.97	0.13	2.28	0.1
Bothnian Sea	0.84	3.71	0.27	1.73	0.3
Archipelago Sea	0.18	0.92	0.09	0.34	0.09
Gulf of Finland	0.46	1.97	0.91	1.06	0.25
Gulf of Riga	0.43	1.63	0.2	0.24	0.83
Baltic Proper	8.46	29.21	0.43	1.31	0.99
Belt Sea	5.27	9.32	0.01	0.02	0.01
The Kattegat	5.88	5.41	0.01	0.03	0.01
Total Baltic	21.8	53.14	2.05	7.01	2.58

Table 3. Atmospheric deposition of nitrogen into the Baltic Sea by sub-region from 1980 – 2000. Units: kilotonnes of nitrogen/year.

Sub-region/Year	1980	1985	1990	1995	2000
Bothnian Bay	8.4	9.3	11.8	10.1	11.6
Bothnian Sea	24.1	28.9	26.6	23.3	30
Archipelago Sea	5.4	7.8	6.3	5.5	6
Gulf of Finland	16.5	20.8	18.2	15	15.8
Gulf of Riga	15	18.3	16.7	11.7	11.4
Baltic Proper	181.3	215.3	173.9	135.1	140.2
Belt Sea	32	35.6	29.6	23.2	25
The Kattegat	27.6	31.8	25.2	19.8	24.1
Total Baltic	310.3	367.8	308.3	243.7	264.1

Lithuania	Poland	Russia	Sweden	Ships	Distant sources	Total EMEP
0.13	1.1	0.73	1.04	0.71	4.1	11.6
0.42	3.45	1.25	2.95	2.34	12.7	30
0.1	0.64	0.23	0.4	0.58	2.4	6.0
0.25	1.34	1.47	0.71	1.07	6.3	15.8
0.32	1.34	0.38	0.51	0.83	4.7	11.4
1.63	25.49	2.75	8.21	9.76	52	140.2
0.03	0.78	0.06	0.29	0.6	8.6	25
0.01	0.83	0.06	0.97	0.87	10.0	24.1
2.89	34.97	6.93	15.08	16.76	100.8	264.1

Annex 3. Emission ceilings for nitrogen oxides and ammonia (UNECE Gothenburg Protocol for NO_x and NH_3 and EUNEC Directive (EC 1999/30))

Table 1. Emission ceilings for nitrogen oxides. Units: kilotonnes of NO_2/year.

NO_x (as NO2)	Emission levels in 1990	Emission levels in 2002	UNECE and EU NEC Emission ceilings for 2010	Required % of reductions	Reduction achieved by 2002	Reduction needed from 2002 level
Denmark	282	200	127	55 %	29 %	37 %
Estonia*	68	40	60	12 %	41 %	-50 %
Finland	300	208	170	43 %	31 %	18 %
Germany	2693	1499	1081**	60 %	44 %	28 %
Latvia	93	41	84**	10 %	56 %	-105 %
Lithuania	158	51	110	30 %	68 %	-116 %
Poland	1280	796	879	31 %	38 %	-10 %
Russia	3600	2566	2653	26 %	29 %	-3 %
Sweden	338	242	148	56 %	28 %	39 %
Total	8812	5643	5312	40 %	36 %	6 %

* Estonia is not a Party to the Gothenburg Protocol

**The targets in the EU Directive are more stringent than in the Gothenburg Protocol for Germany (1,051 kilotonnes) and Latvia (61 kilotonnes).

Table 2. Emission ceilings for ammonia. Units: kilotonnes of NH_3/year.

NH_3	Emission levels in 1990	Emission levels in 2002	UNECE and EU NEC Emission ceilings for 2010	Required % of reductions	Reduction achieved by 2002	Reduction needed from 2002 level
Denmark	122	101	69	43 %	17 %	32 %
Estonia*	24	9	29	-21 %	63 %	-222 %
Finland	35	33	31	11 %	6 %	6 %
Germany	764	604	550	28 %	21 %	9 %
Latvia	44	11	44	0 %	75 %	-300 %
Lithuania	84	51	84	0 %	39 %	-65 %
Poland	508	325	468	8 %	36 %	-44 %
Russia	1191	600	1179	1 %	50 %	-97 %
Sweden	61	55	57	7 %	10 %	-4 %
Total	2833	1789	2511	11 %	37 %	-40 %

* Estonia is not a Party to the Gothenburg Protocol

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