

Nitrogen emissions to the air in the Baltic Sea area

Authors: Jerzy Bartnicki and Anna Benedictow, EMEP MSC-W

Key message

In all HELCOM Contracting Parties, nitrogen oxides emissions are 14-61% lower in 2014 than in 1995 with the most significant drop of nitrogen oxides emissions in Denmark (61%) followed by Finland(46%), Sweden (45%) and Germany (44%). Also, for all HELCOM Contracting Parties the reductions of total nitrogen emissions can be observed in the period 1995 – 2014, ranging from 3% in Estonia to 47% in Denmark. Only ammonia, annual emissions increase in three out of nine HELCOM Contracting Parties in the period 1995-2014. These are: Estonia (10%), Germany (9%) and Finland (2%). In the remaining countries a decline (2-33%) of the ammonia emissions can be noticed.

Results and Assessment

Relevance of the indicator for describing the developments in the environment

This indicator shows the levels and trends of annual nitrogen oxides and ammonia emissions from anthropogenic sources in HELCOM Contracting Parties into the air. The emissions of nitrogen oxides and ammonia represent the pressure of emission sources on the atmosphere of the Baltic Sea basin and catchment.

Policy relevance and policy reference

The HELCOM Ministerial Declaration of 1988 called for a 50 % reduction in discharges of nutrients to air and water by 1995 with 1987 as a base year. The 1992 Helsinki Convention and the 1998 Ministerial Declaration reaffirmed the need to further reduce discharges; leading to the adoption of several relevant Recommendations concerning measures to reduce emissions from point sources and diffuse sources. In 1990 HELCOM adopted its first Recommendation on Monitoring of Airborne Pollution Load (HELCOM Recommendation 11/1), which was later superseded by the Recommendations 14/1 and 24/1.

On the European level the relevant policy to the control of emissions of nitrogen oxides and ammonia to the atmosphere is being taken in the framework of UN ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) and in the EU NEC Directive. The Executive Body of CLRTAP adopted the Protocol to Abate Acidification, Eutrophication and Ground Level Ozone in Gothenburg (Sweden) on 30 November 1999. The 1999 Protocol set emission ceilings for 2010 for four pollutants: sulphur oxides, nitrogen oxides, ammonia and Volatile Organic Compounds (VOCs). These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties whose emissions had a more severe environmental or health impact and whose emissions were relatively cheap to reduce had to make the biggest cuts. The original 1999 Protocol was amended in 2012 to include national emission reduction commitments to be achieved in 2020 and beyond. Following the revised Gothenburg Protocol, nitrogen oxides emissions in 2020 will be reduced between 18% and 56% in 31 countries, compared to 2005 annual emissions. The largest relative reductions will be in Denmark (56%), United Kingdom (55%) and France (50%). Ammonia emissions will be also reduced in the same 31 countries, but in the lower range 1-24%. The largest relative reductions of ammonia emissions will be in Denmark (24%), Finland (20%) and Sweden (15%).

Assessment

Time series of nitrogen oxides, ammonia and total nitrogen annual emissions in the period 1995 – 2014 are shown, for all HELCOM Contracting Parties, in **Figure 1**. Time series of nitrogen oxides, ammonia and total nitrogen annual emissions for the same period, in percent of 1995 emissions, are shown in **Figure 2**.

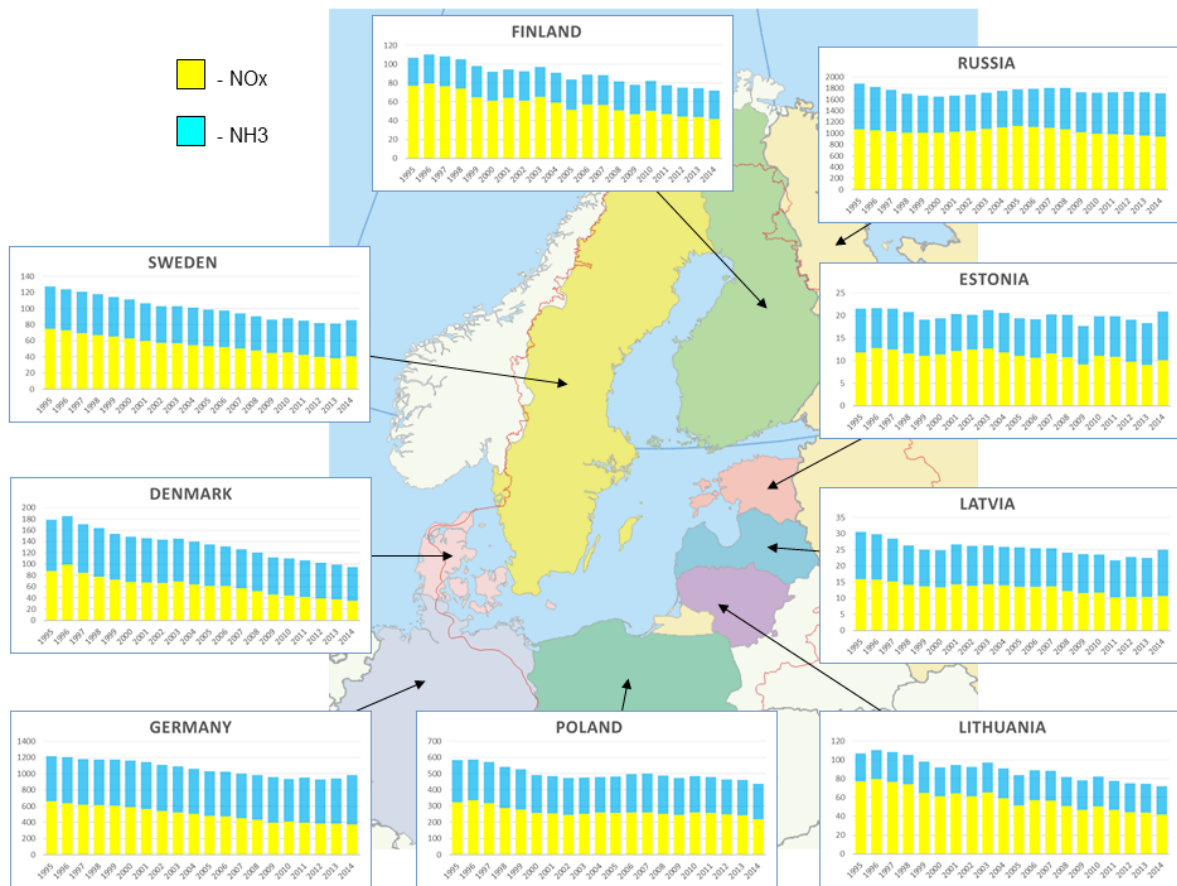


Figure 1. Map of annual atmospheric emissions of nitrogen oxides, ammonia and total nitrogen from individual HELCOM Contracting Parties in the period 1995 – 2014. Units: kt/yr.

Note: Different scales have been used for the various countries. The data cover emissions from all countries, except for Russia, where only emissions from the area covered by EMEP are included.

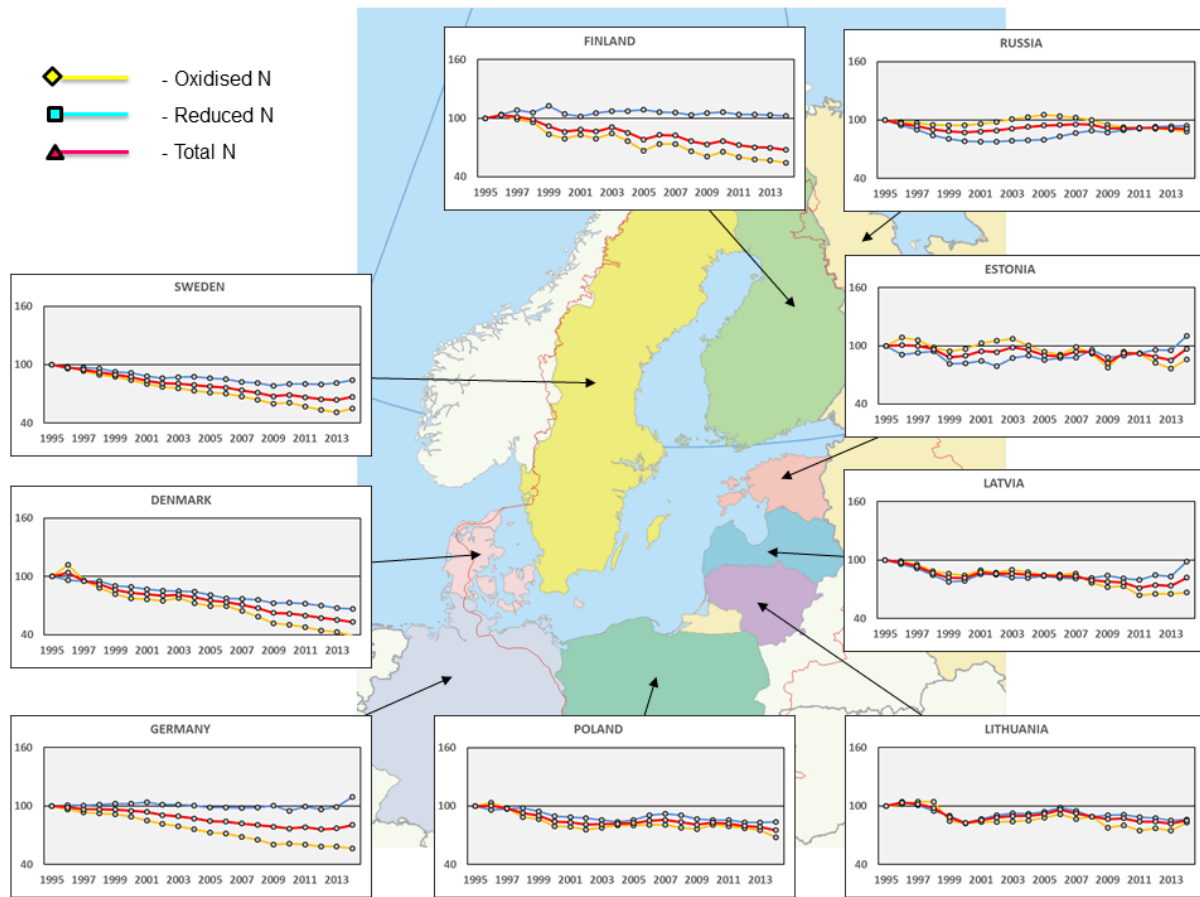


Figure 2. Map of annual atmospheric emissions of nitrogen oxides, ammonia and total nitrogen from individual HELCOM Contracting Parties in the period 1995 – 2014, in percent of 1995 emissions. **Note:** The data cover emissions from all countries, except for Russia, where only emissions from the area covered by EMEP are included.

For most of the countries, a decline in nitrogen emissions can be seen in the period 1995 – 2014. A small increase can only be noticed for ammonia emissions from Finland, Germany and Estonia. A reduction for the emissions from the Baltic Sea region in the years 1995 – 2014 is more significant for nitrogen oxides emissions than for ammonia emissions. Nitrogen oxides emissions from the international ship traffic on the Baltic Sea (not shown here) are on the same level according to CEIP inventory. According to estimates of the Finish Meteorological Institute (FMI) ship emissions from the Baltic Sea are decreasing from the year 2007 and especially for the last three years.

In all HELCOM Contracting Parties, nitrogen oxides emissions are 14-61% lower in 2014 than in 1995 with the most significant drop of nitrogen oxides emissions in Denmark (61%) followed by Finland (46%) and Sweden (45%) and Germany (44%). Large reduction, in the considered period, can be also noticed in Latvia (33%) and Poland (32%) and smaller in Lithuania (17%) and Latvia (12%).

Ammonia, emissions in six out of nine HELCOM Contracting Parties are lower in 2014 than in 1995, with the largest reduction in Denmark (33%), followed by Poland (16%), Sweden (16%) and Lithuania (14%), Russia (6%) and finally Latvia (2%). Compared to 1995, ammonia emissions in 2014 are higher in Estonia (10%), Germany (9%) and Finland (2%).

For all HELCOM Contracting Parties the reductions of total nitrogen emissions can be observed in the period 1995 – 2014, ranging from 3% in Estonia to 47% in Denmark. Besides Denmark, large reductions of total nitrogen emissions in the considered period can also be observed in Finland and Sweden – both 33%.

Emissions from outside the Baltic Sea region add to the nitrogen loads entering the Baltic, as do emissions from the ships. In 2014, nitrogen oxides (NO_x) emissions from international ship traffic on the Baltic Sea contributed 14% to oxidised nitrogen deposition to the Baltic Sea basin.

Data

Table 1. National total emissions of nitrogen oxides from individual HELCOM Contracting Parties in the period 1995 – 2014. Units: kt N/yr.

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	HELCOM
1995	88.1	11.8	77.4	659.5	15.9	18.8	323.6	1068.8	74.7	2338.7
1996	98.6	12.8	79.7	637.7	15.7	19.2	335.0	1048.9	73.1	2320.7
1997	84.5	12.5	76.5	617.6	15.2	19.6	317.6	1036.4	69.8	2249.6
1998	77.8	11.6	74.1	610.4	14.1	19.7	287.0	1014.1	67.1	2175.9
1999	72.1	11.1	64.8	603.0	13.7	15.9	280.2	1008.6	65.4	2134.8
2000	68.3	11.4	61.3	586.0	13.4	15.4	256.9	1009.1	63.1	2084.8
2001	67.3	12.1	64.3	562.4	14.2	15.8	255.3	1028.3	60.1	2079.9
2002	66.1	12.4	61.2	538.7	13.8	15.7	245.4	1047.4	57.8	2058.5
2003	68.7	12.7	65.3	522.0	14.3	15.8	252.1	1078.2	56.7	2085.8
2004	63.9	11.9	59.3	501.7	14.0	16.0	260.1	1103.1	54.8	2084.7
2005	61.3	11.1	51.6	478.8	13.5	16.5	259.0	1127.3	53.4	2072.6
2006	61.2	10.7	57.1	473.9	13.5	17.2	260.4	1109.5	52.4	2056.0
2007	57.0	11.7	56.8	451.5	13.7	16.3	261.9	1094.0	50.4	2013.3
2008	51.8	10.8	51.1	429.4	12.2	16.8	252.4	1071.8	47.8	1944.0
2009	45.8	9.1	47.1	398.7	11.5	14.6	246.2	1014.6	45.0	1832.6
2010	44.2	11.1	50.7	405.9	11.7	15.1	261.9	990.1	45.5	1836.3
2011	42.0	10.8	46.7	398.9	10.2	14.0	256.4	983.5	42.4	1805.0
2012	39.0	9.8	44.6	386.6	10.4	14.5	249.3	975.1	40.0	1769.2
2013	37.7	9.0	44.1	386.3	10.4	14.1	242.9	961.0	38.3	1743.8
2014	34.5	10.1	41.8	372.6	10.7	15.6	220.1	945.0	41.1	1691.6

Table 2. National total emissions of ammonia from individual HELCOM Contracting Parties in the period 1995 – 2014. Units: kt N/yr.

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	HELCOM
1995	90.4	9.8	29.7	558.7	14.6	39.1	260.6	816.6	52.9	1872.3
1996	86.9	8.9	30.7	563.8	14.0	40.8	250.7	771.9	50.8	1818.5
1997	85.9	9.1	32.0	560.1	13.4	39.5	253.3	735.6	51.4	1780.3
1998	86.1	9.2	31.4	565.7	12.4	37.2	255.9	688.2	50.7	1736.9
1999	81.8	7.9	33.4	570.8	11.3	35.3	246.9	659.7	49.0	1696.1
2000	80.5	8.0	30.9	573.1	11.5	32.4	233.6	637.8	48.5	1656.2
2001	78.6	8.2	30.2	579.3	12.5	33.8	230.7	637.1	46.5	1656.9
2002	77.2	7.7	31.3	566.7	12.4	35.4	228.5	636.3	45.5	1641.0
2003	76.5	8.5	31.8	566.8	12.0	36.2	223.1	642.6	46.1	1643.7
2004	76.3	8.8	31.8	559.9	12.0	36.1	218.6	648.3	46.2	1637.9
2005	73.1	8.3	32.2	550.0	12.2	36.8	223.7	653.2	45.6	1635.2
2006	70.0	8.5	31.6	550.4	12.0	38.6	236.3	679.5	45.0	1671.9
2007	69.7	8.6	31.4	546.0	11.8	37.2	239.5	708.5	43.5	1696.3
2008	68.7	9.3	30.7	550.9	11.9	34.9	235.8	729.9	43.0	1715.1
2009	65.7	8.6	31.2	560.1	12.3	35.5	225.7	712.2	41.3	1692.5
2010	65.9	8.8	31.5	529.2	11.9	35.6	223.6	731.1	42.5	1679.9
2011	64.9	9.0	30.8	555.7	11.6	34.6	222.8	745.8	42.5	1717.8
2012	63.5	9.3	30.7	539.4	12.3	34.2	216.2	758.6	42.2	1706.4
2013	61.2	9.3	30.7	552.5	12.1	33.3	216.9	765.0	43.0	1724.0
2014	60.4	10.7	30.4	609.2	14.4	33.7	218.3	769.3	44.4	1790.9

Table 3. National total emissions of total nitrogen from individual HELCOM Contracting Parties in the period 1995 – 2014. Units: kt N/yr.

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	HELCOM
1995	178,5	21,6	107,1	1218,2	30,5	58,0	584,2	1885,4	127,6	4211,0
1996	185,5	21,7	110,5	1201,5	29,8	60,0	585,7	1820,8	123,9	4139,2
1997	170,4	21,5	108,5	1177,7	28,6	59,1	570,9	1772,0	121,2	4029,9
1998	163,9	20,8	105,5	1176,1	26,4	56,9	542,9	1702,3	117,8	3912,7
1999	153,9	19,1	98,1	1173,7	25,0	51,3	527,1	1668,3	114,4	3830,9
2000	148,8	19,4	92,2	1159,1	24,9	47,8	490,5	1646,8	111,6	3741,0
2001	145,9	20,4	94,5	1141,7	26,7	49,6	486,0	1665,4	106,6	3736,8
2002	143,3	20,1	92,4	1105,4	26,3	51,1	473,9	1683,6	103,3	3699,5
2003	145,3	21,2	97,1	1088,8	26,3	52,0	475,2	1720,9	102,8	3729,5
2004	140,1	20,6	91,1	1061,6	25,9	52,1	478,8	1751,4	101,0	3722,7
2005	134,5	19,4	83,8	1028,8	25,7	53,3	482,7	1780,5	99,1	3707,8
2006	131,3	19,2	88,7	1024,3	25,5	55,8	496,7	1789,0	97,4	3727,9
2007	126,7	20,2	88,2	997,5	25,5	53,5	501,5	1802,5	93,9	3709,6
2008	120,4	20,1	81,8	980,3	24,2	51,7	488,2	1801,7	90,7	3659,1
2009	111,5	17,7	78,3	958,8	23,8	50,1	471,9	1726,8	86,2	3525,1
2010	110,1	19,9	82,2	935,1	23,5	50,7	485,5	1721,2	88,1	3516,2
2011	106,9	19,8	77,6	954,7	21,8	48,6	479,2	1729,3	84,9	3522,9
2012	102,5	19,1	75,3	925,9	22,7	48,7	465,5	1733,7	82,2	3475,7
2013	98,9	18,4	74,8	938,7	22,5	47,3	459,9	1726,0	81,3	3467,7
2014	94,9	20,9	72,2	981,8	25,0	49,4	438,4	1714,3	85,5	3482,4

Metadata

Technical information

1. Source: EMEP/MSC-W, UMWELTBUNDESAMT – Austria, UN ECE Secretariat.
2. Description of data: Annual total emissions of nitrogen oxides and ammonia were officially reported to the UN ECE Secretariat by the HELCOM Contracting Parties.
3. Geographical coverage: European region.
4. Temporal coverage: Data on nitrogen oxides and ammonia emissions are available for the period 1995 - 2014.
5. Methodology and frequency of data collection: National data on emissions are annually submitted by countries Parties to CLRTAP Convention to the UN ECE Secretariat; the methodology is based on combination of emission measurements and emission estimates based on activity data and emission factors. Submitted data are passing through QA/QC procedure and stored in the the EMEP Centre for Emission inventories and Projections CEIP in Vienna, Austria.

Quality information

6. Strength and weakness: Strength: data on emissions are annually submitted, checked and stored in the database; Weakness: gaps in time series of national emissions which have to be corrected by experts.
7. Uncertainty. No official information about the uncertainty of provided nitrogen emission data have been sent to EMEP from both EMEP and HELCOM Contracting Parties.
8. Further work required: Further work on emission uncertainty is required.

Last updated: 12.10.2016