HELCOM

REDUCING NUTRIENT INPUTS TO THE BALTIC SEA

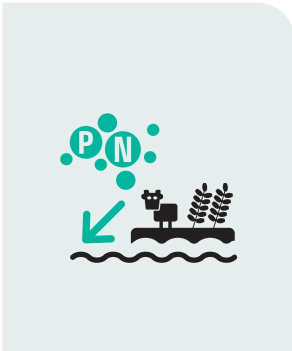
Key messages from the 2025 HELCOM reports *Effectiveness of measures to reduce nutrient inputs* and *Assessment of achieving NICs in 2030 and the effectiveness of measures*

KEY MESSAGES

Despite achieved and expected reductions, targets will not be reached by 2030

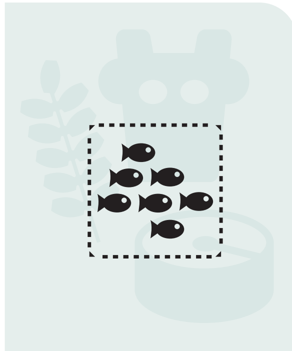
Nutrient inputs have decreased significantly since 1997–2003

However, most HELCOM countries will not meet 2030 reduction targets; only Denmark is on course

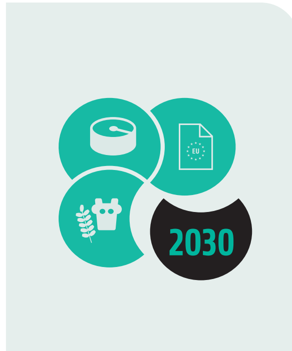


Agriculture remains the dominant source of nutrients and offers the largest potential for further reduction

Nutrient inputs from wastewater treatment have been reduced but further reduction potential remains



Marine aquaculture is a minor source of nutrient inputs



Stronger agricultural measures, improved wastewater efficiency, and coordinated HELCOM–EU implementation are essential to close the gap by 2030

Substantial nutrient input reductions have been achieved

A significant reduction in nutrient inputs has been achieved for the whole Baltic Sea. The normalized total input of nitrogen was reduced by 11% and phosphorus by 30% between the reference period (1997-2003) and 2021.

Clean air policies have successfully reduced atmospheric nitrogen deposition and contributed with 71 % to the overall reduction in nitrogen inputs. Also, the implementation of policies in the catchment such as the EU Water Framework Directive and especially policies targeting point sources such as the HELCOM Recommendation 28E/5 on municipal wastewater treatment and the EU Urban Wastewater Treatment Directive have contributed to the reduction of nutrient inputs to the Baltic Sea.

Reduction targets will not be reached by 2030

All HELCOM Contracting Parties will undertake further efforts to reduce nutrient inputs to the Baltic Sea by 2030. The targets were agreed in the 2021 Baltic Sea Action Plan (BSAP).

Despite committing to achieve nutrient input reductions to meet the nutrient input ceilings (NIC), many countries will not be able to fulfill the NICs for Baltic Poper, Gulf of Finland and Gulf of Riga by 2030 (table 1 and 2). Only Denmark will fulfil its obligations under the BSAP by 2030 for both nitrogen and phosphorus.

Of the nine transboundary rivers, only Daugava River will achieve its NIC for nitrogen and

Table 1. Status towards fulfilling total nitrogen NIC by 2030 (in tonnes) taking into account extra reduction in neighboring basins. Reductions related to measures reducing atmospheric deposition during 2021–2030 are also considered. Negative values in the tables indicate remaining reduction to fulfil NIC (numbers in table in tonnes), positive numbers indicate extra reductions. n.i. = no information. Transboundary countries (Belarus, Czech Republic and Ukraine) were not requested making Action E1 reporting. BOB = Bothnian Bay; BOS = Bothnian Sea; BAP = Baltic Proper; GUF = Gulf of Finland; GUR = Gulf of Riga; DS = Danish Straits and KAT = Kattegat.

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark	162	658	1751	200	269	7,418	8,663
Estonia	26	100	-164	-1,240	-4,348	7	6
Finland	69	2,226	594	-93	192	39	41
Germany	443	1,792	8,528	551	897	11,972	1,632
Latvia	1	39	-6,723	-7	-1,293	7	2
Lithuania	11	69	-26,682	15	-19	18	10
Poland	135	719	-25,159	155	496	336	203
Russia	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
Sweden	3,781	6,507	-6,097	245	309	213	5,971
Belarus			n.i.		n.i.		
Czech Republic			n.i.				
Ukraine			n.i.				
Baltic Sea Shipping	12	253	732	371	173	-16	-63
North Sea shipping	-28	-86	-316	-48	-21	-201	-186
Other Countries	-238	-1,035	-3,741	-375	-259	-816	-813

NIC is not fulfilled

Within statistical certainty, the fulfilment of NIC cannot be justified

NIC is with 95 % certainty fulfilled; input ceiling is not exceeded

Application of extra reduction achieved in neighboring sub-basin

Less than 10% from fulfilling NIC

Between 10% and 30% from fulfilling NIC

Between 30% and 50% from fulfilling NIC

50% or more from fulfilling NIC

none of the rivers will achieve their NIC for phosphorus (see table 3). It is noteworthy that quantitative information on effectiveness of planned measures in the river catchment is still missing for many countries although the EU Water Framework Directive has required designation of measures for a long time.

It is expected that implemented and planned measures will reduce 78,000 tonnes of TN up to 2030, but nearly 77,000 tonnes further TN reduction is needed in Baltic Proper (69,000 tonnes), Gulf of Finland and Gulf of Riga to fulfil all TN-NICs.

Also, for phosphorus large additional reductions are still needed. It is expected that implemented and planned measures will reduce total phosphorus (TP) by 3,150 tonnes up to 2030, but further approx. 3,650 tonnes TP reduction is needed in Baltic Proper (3,000 tonnes), Gulf of Finland, Gulf of Riga and Bothnian Sea to fulfil all TP-NICs.

The main source (38%) of nitrogen to the Baltic Sea is anthropogenic diffuse sources (agriculture, forestry, scattered dwellings and stormwater called “diff-other” in figure 1), followed by atmospheric deposition on the Baltic Sea (ATM, 24%), natural background inputs (NBL, 21%) and point sources to inland waters or discharging directly to the sea (PS, 9% including municipal wastewater treatment plants, industry and aquaculture) and transboundary inputs from upstream countries (TRL, 8%). Agricultural sources constitute nearly half of the atmospheric deposition and a major part of transboundary inputs.

Anthropogenic sources are the main sources (43 %) of total phosphorus inputs to the Baltic Sea, followed by natural background inputs

Table 2. Status towards fulfilling total phosphorus NIC by 2030 (in tonnes) taking into account extra reduction in neighboring basins. See caption and legend for table 1.

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark			0			313	125
Estonia			-7.7	-37	-35		
Finland	122	-25		-310			
Germany			-93			205	
Latvia			-111		-254		
Lithuania			-249		109		
Poland			-2,416				
Russia	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
Sweden	78	332	-92			56	152

Table 3. Status towards fulfilling total nitrogen and total phosphorus NIC by 2030 for the nine transboundary rivers with NIC. In the upper part of the tables, negative numbers represent the remaining reduction and positive numbers are extra reductions (in tonnes). In the lower part of the table, the remaining reduction is shown as percentage of the river NIC (calculated as if remaining reduction is 452 t TP and NIC is 941 t TP for Daugava, remaining reduction in percentages of NIC is 452/941 = 48%). See table 1 legend. n.i. = no information.

	Barta	Daugava	Lielupe	Nemunas	Neva	Oder*	Pregolya	Venta	Vistula
Total nitrogen tonnes)	-993	4,856	-7,026	-22,520	-15,027	-7,935	n.i.	-6,471	-29,414
Total phosphorus (tonnes)	-24	-452	-39	-686	-1,361	-970	n.i	-110	-3,032

	Barta	Daugava	Lielupe	Nemunas	Neva	Oder*	Pregolya	Venta	Vistula
Total nitrogen (%)	104		44	77	35	16	n.i.	107	39
Total phosphorus (%)	95	48	13	75	97	62	n.i.	104	128

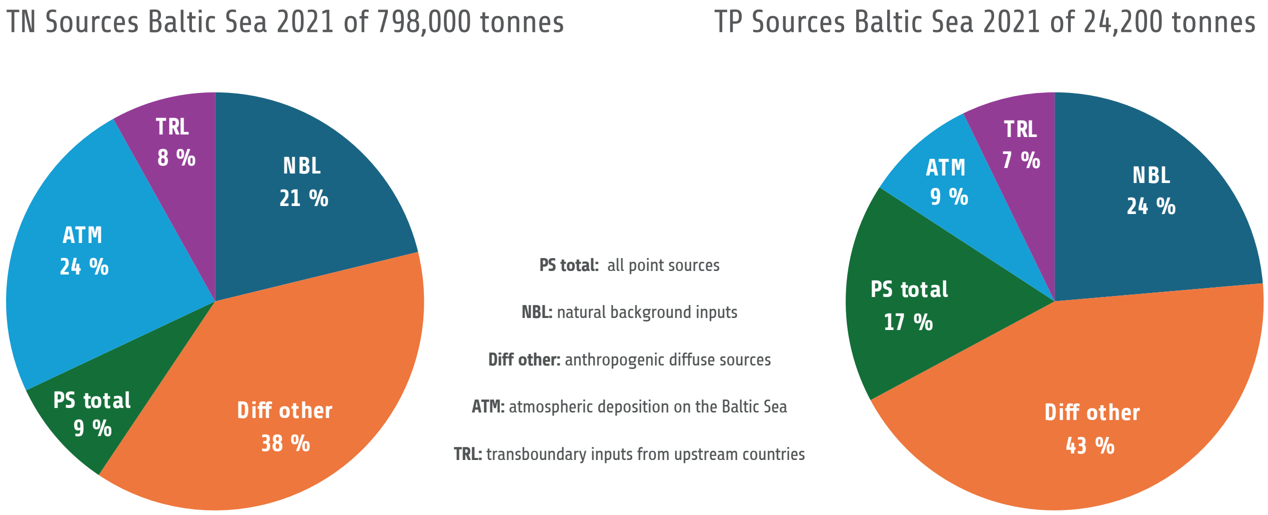


Figure 1. Sources (in percentages) in 2021 of total nitrogen (TN, left) and total phosphorus (TP, right) air- and waterborne inputs to the Baltic Sea. Total inputs amounted to 798,000 tonnes of nitrogen and 34,200 tonnes of phosphorus.

(24%), point sources (17%), atmospheric deposition (9%) and transboundary inputs (7%). The sources of atmospheric phosphorus inputs are generally not quantified and the importance of agriculture for this source remains unknown.

Of the expected TN reduction until 2030, approx. 80% will be reduced via waterborne inputs and 20% via atmospheric deposition. For TP, all reductions are expected to be achieved via waterborne inputs. Most measures reducing waterborne inputs to the Baltic Sea are directed to the agricultural sector which account for nearly 98% of TN and 57% of TP expected reduction based on the countries' quantification of sector-wise reductions. The remaining part of the reduction is expected to be achieved from wastewater, primarily wastewater treatment plants, scattered dwellings and stormwaters.

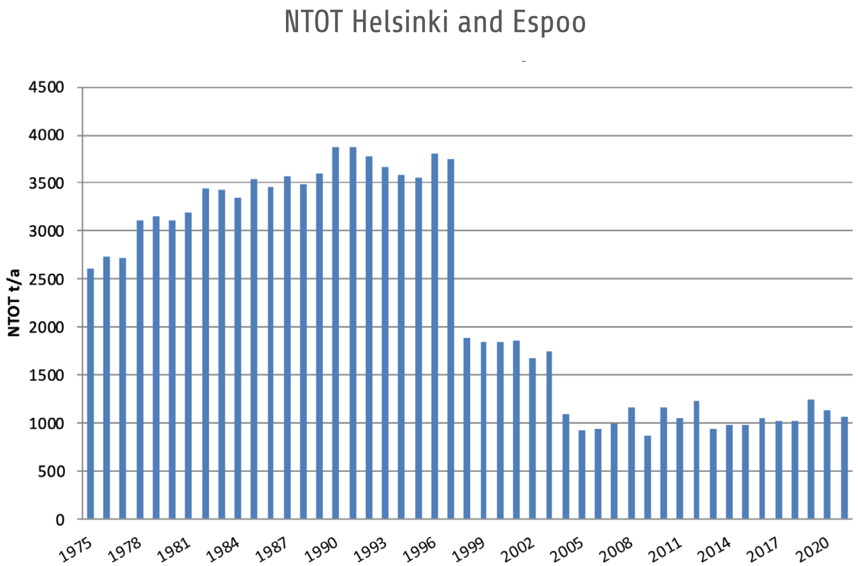
Nutrient inputs from wastewater treatment have been reduced but further reduction potential remains

Direct municipal total nitrogen (NTOT) loads decreased between the reference period and 2021 by 5480 tonnes, which is equal to a 19% decrease. N loads were reduced by over 1000 t in four countries: Finland, Germany, Latvia, and Sweden. The reductions could be attributed to large investments in wastewater treatment in the biggest cities. Municipal N inputs into inland waters increased by 7030 t (20%). Part of the increases might be due to the increased connectivity, i.e. an effort to decrease loads originating from scattered dwellings by increasing the number of people being connected to municipal treatment plants.

The direct municipal phosphorus (P) loads decreased since the reference period until 2021 by 1130 t. With 56 %, this decrease of direct municipal phosphorus load was more than factor two larger than the respective N decrease. The biggest reduction in municipal P loads was detected in Russia (593 t) followed by Latvia (180 t) and Denmark (89 t). The reduction of the Russian load was mainly due to enhanced P removal from wastewaters in St. Petersburg. It is noteworthy that in Sweden and Finland P removal percentage from municipal wastewaters was at a high level already before the year 2000, but both countries have been able to further reduce their PTOT loads. There was a slight decrease of P inputs from indirect municipal wastewater treatment plants into inland waters.

The improvements of nutrient removal by municipal wastewater treatment plants in the past decades becomes easily visible in the time series of nutrient loads from Helsinki and Espoo wastewater treatment plants 1975-2021 (Figure 2). In 2021 over 97 percent of PTOT and 91 percent of NTOT was removed from the wastewater in Helsinki and Espoo.

While there have been good developments all around the Baltic Sea region, there is still room



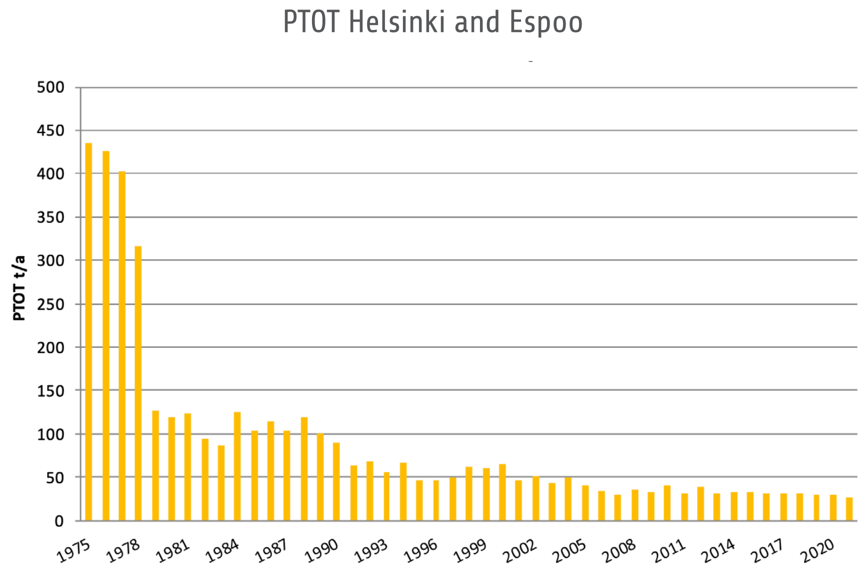


Figure 2. Nitrogen and phosphorus loads from Helsinki and Espoo WWTPs 1975–2021 as an example of improved nutrient removal efficiency in the last decades. Note: The scales of the y-axis differ.

for improvement. In different scenarios within the PLC-8 project it was calculated that moving all reported wastewater treatment plants to the next higher purification class (e.g. from 80%-<85% to 85%-<90%) including a 10% retention would result in a reduction of more than 23,000 tonnes NTOT and 3,400 tonnes PTOT. Although the scenario includes for several WWTPs higher reduction requirements than the HELCOM Recommendation 28E/5 on municipal wastewater treatment demands, the scenario indicates a high nutrient reduction potential. Compared to the required reductions according to the MAI (HELCOM 2024), more efficient wastewater treatment can provide a 26 % and 64 % reduction potential of the corresponding 90,000 tonnes NTOT and 5,300 tonnes PTOT that still remain to be reduced.

The EU Urban Wastewater Treatment Directive was revised in 2024 increasing nutrient removal requirements for some plants and the revision of HELCOM Recommendation 28E/5 provides an opportunity to consider increasing removal requirements.

There has been a steady increase in the percentage of the population connected to secondary and tertiary wastewater treatment systems. In 2021, the connectivity was highest in Denmark and Germany where it was over 90%. Since 2004, connectivity to wastewater systems has especially increased in Lithuania, Poland and Russia, which has been reflected in a decreased nutrient load from scattered dwellings. In 2021, the number of scattered dwellings in the Baltic Sea catchment area was nearly 17 million, but over 60% of them were connected to wastewater system. There is a potential for further reduction of inputs from scattered dwellings and stormwaters but relevant data to provide quantitative estimates of the reduction potential is missing.

Some Contracting Parties struggle to estimate the effectiveness of measures to reduce nutrient load from agriculture

In 2021, agriculture contributed approx. 45 % of TN inputs and approx. 30 % of TP inputs to the Baltic Sea taking into account the share of agriculture in the atmospheric deposition of NTOT and the share of agriculture for NTOT and PTOT of transboundary inputs. The share of agriculture of the load has increased as the inputs from point sources have been more effectively reduced. A wide range of general and targeted measures have been quite successful in markedly reducing nitrogen inputs from agriculture since the 1990'ties in some countries, like Denmark, but as only some HELCOM countries have quantified inputs from agriculture separately in the PLC source apportionment it prevents an overall estimation of the effectiveness of agricultural measures.

Based on the reporting by countries, nearly 98% of TN and 57% of TP reduction of waterborne inputs to the Baltic Sea is expected to result from measures targeting agriculture or agriculture and forestry. Four countries provided information on expected load reduction in waterborne inputs per implemented measure which suggests that the majority of countries have difficulties in making quantitative estimates of the effectiveness of individual measures, especially for diffuse sources such as agriculture.

HELCOM has recently adopted two Recommendations aiming at reducing nutrient inputs from agriculture: HELCOM Recommendation 42-43/5 on mitigating ammonia emissions from agriculture and HELCOM Recommendation 42-43/7 on Best Available Technology (BAT) and Best Environmental Practice (BEP) to Reduce Nutrient Inputs and Greenhouse Gas Emissions from Manure.

Marine aquaculture

Currently marine aquaculture is a minor source of nutrient inputs to the Baltic Sea. In 2021, direct N input from aquaculture was 711 tonnes and direct P input was 71 tonnes. For NTOT aquaculture amounts to 3% of direct point source inputs and 0.1% of the total nitrogen inputs to the Baltic Sea. Corresponding numbers for PTOT are 6% and 0.3%, respectively

HELCOM has recently adopted BAT/BEP descriptions of sustainable aquaculture in the Baltic Sea region and revised the HELCOM Recommendation on Sustainable Aquaculture in the Baltic Sea Region.

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