



Document title	Draft policy message on progress towards nutrient input targets
Code	3-9
Category	DEC
Agenda Item	3- Matters arising from the HELCOM Groups
Submission date	21.11.2017
Submitted by	Executive Secretary
Reference	

Background

PRESSURE 7-2017 acknowledged that the new scientific data on the input time series since 1994 substantially differ from previous assessments of nutrient inputs, which includes also values for the reference period 1997-2003. The Meeting agreed that the policy message should be focused on the achievement of the GES for the Baltic Sea, which is reflected by the national input ceilings. The Meeting also requested RedCore DG to elaborate a supplementary paper to the policy message containing detailed analysis of the data updates (section 3 and 4) and discussion on their consequences for the HELCOM nutrient reduction scheme follow-up (section 5 and 6).

PRESSURE 7-2017 set a commenting round for the policy messages and supplementary paper. Comments have been received from Denmark, Finland, Germany and Lithuania. Most of the comments were a matter of clarification or editorial changes. A clause on revision of time series was included into the policy message by the request of Denmark.

Non-parametric trend analysis and slope estimation were used to estimate the most recent progress towards fulfilment of the CARTs as well as variability/uncertainty in these estimates. Suitability of the monotonic linear trend model was tested using a cumulative sum evaluation of residuals. This method identified possible change points in several of the time series. Contracting Parties attempted to find explanations for the apparent changes. In some cases this was possible, however in others changes appeared to be connected with individual years of extremely high or low discharge, where flow-normalisation may have created artificial residuals. Questions arising from the trend analysis will be a focus of PLC work in 2018.

The document contains two options for the policy messages: with and without reallocation of extra reduction, and supplementary paper containing details of the assessment and discussion on the need to revise the current nutrients reduction scheme in the light of establishing a comprehensive, consistent and updated time series of inputs of nutrients ([Outcome of PRESSURE 7-2017](#)).

Action requested

The Meeting is invited to:

- approve an appropriate option for the CART policy message taking into account the decision on reallocation of extra reduction (document 3-8);
- discuss the consequences of the updates of the input time series to the HELCOM nutrient reduction scheme.

Progress towards national targets for input of nutrients achieved by 2014

How much is left to reach the HELCOM nutrient input targets set for a clean Baltic Sea?

These are the key results of the assessment of progress towards the [national targets for nitrogen input](#) adopted by the 2013 Copenhagen HELCOM Ministerial Declaration. ***The evaluation does not take into account reallocation of achieved extra reduction.***

National targets for nitrogen and phosphorus inputs have been expressed as nutrient input ceilings for each country by sub-basin.¹

Reductions still needed

Table 1. Total Nitrogen. Evaluation of input ceilings fulfillment

Based on statistically estimated inputs (*scroll down for full legend*).

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark	↓	↓	↓	↓	↓	↓	↓
Estonia	↓	↓	↓			↓	↓
Finland			↓		↓	↓	↓
Germany	↓	↓	↓	↓	↓	↓	↓
Latvia	↓	↓				↓	↓
Lithuania	↓	↓		↓		↓	↓
Poland	↓	↓	↓	↓	↓	↓	↓
Russia	↓	↓	↑			↓	↓
Sweden	↓	↓	↓	↓	↓		↓
Belarus							
Czech Republic							
Ukraine			↑				
Baltic Sea shipping							
Other countries	↓	↓	↓	↓	↓	↓	↓
MAI	↓	↓	↓			↓	↓









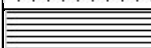
¹ Poland accepts the Polish Country Allocated Reduction Targets as indicative due to the ongoing national consultations. Ref. [Ministerial Declaration 2013, page 6, footnote 2](#).

Table 2. Total Phosphorus. Evaluation of input ceilings fulfillment

Based on statistically estimated inputs.

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark			↓				↓
Estonia			↓	↓			
Finland	↓			↓			
Germany							
Latvia							
Lithuania			↓		↓		
Poland							
Russia			↑	↓			
Sweden		↓	↓			↓	
Belarus							
Czech Republic							
Ukraine			↑				
Baltic Sea shipping							
Other countries							
MAI				↓			↓

Colour legend

	Reduction still left to the target* is less than 10%
	between 10 and 30%
	between 30% and 50%
	50% or more
	Within statistical certainty, the fulfillment of CART cannot be justified
	CART is with 95 % statistical certainty fulfilled; inputs ceiling not exceeded
	Classification is not relevant
	only airborne inputs to the sub-basin
	only transboundary waterborne inputs to the sub-basin

Arrows: statistically significant changes of nutrient inputs since the reference period, taking into account 95% confidence interval for both latest inputs and reference values.

↓ significant decrease

↑ significant increase

* Yellow, orange and red shades: input ceiling is exceeded with 95 % statistical certainty. The legend illustrates the percentage which reduction left to the target constitutes in the corresponding input ceiling value.

“Other countries” includes sources for atmospheric nitrogen deposition as the 20 EU countries not being HELCOM Contracting Parties, countries outside EU including Belarus, Ukraine, North Sea shipping etc.

MAI is the maximum allowable inputs, according to the 2013 HELCOM Ministerial Declaration.

For reviewing the input data used to evaluate fulfillment of CART and the amount of remaining reductions, please see the data page.

Key messages

Based on [estimation of normalized inputs of nitrogen](#) and phosphorus from 1995 to 2014 (Tables 1 and 2) the following conclusion can be made with high statistical certainty:

Progress towards nitrogen input targets

Fulfillment of input ceilings:

- Denmark is the only country that have fulfilled nitrogen ceilings to all HELCOM sub-basins.
- Finland and Sweden met their nitrogen ceilings to all HELCOM basins except to the Baltic Proper and the Gulf of Finland where missing reduction is less than 10% of the input ceilings for these countries.
- Russia exceeded their ceilings to all sub-basins.
- Total nitrogen inputs to Bothnian Sea, Bothnian Bay, Danish Straits and Kattegat were below the MAIs for these sub-basins. The countries which did not fulfilled their ceilings for these sub-basins have only minor airborne inputs.
- Atmospheric nitrogen inputs from Baltic Sea shipping and Non-HELCOM countries exceeded their target values to all sub-basins.

Changes of inputs:

- The assessment indicates statistically significant reduction of nitrogen inputs into all sub-basins since the reference period (1997-2003) except the Gulf of Finland and Gulf of Riga where changes are not statistically significant.
- Denmark, Germany and Poland reduced their total nitrogen inputs to all HELCOM sub-basins.
- Estonia, Finland, Latvia, Lithuania and Sweden reduced their total nitrogen inputs to several sub-basins and had no statistical changes of inputs to the remaining ones.
- Russia and Ukraine increased inputs to the Baltic Proper.
- Non-HELCOM countries demonstrate reduction of airborne total nitrogen inputs to all HELCOM sub-basins.

Progress towards phosphorus input targets

Fulfillment of input ceilings:

- There was not a single country fulfilling input ceiling for phosphorus to all HELCOM sub-basins.
- All HELCOM countries and non-HELCOM countries with waterborne inputs exceeded input ceilings for the Baltic Proper.
- Two of three countries, which contribute to the input to the Gulf of Finland, also exceeded their ceilings. Fulfilment of the input ceiling by Russia cannot be judged unambiguously due to uncertainty caused by variability of the assessment data. This also holds true for the Russian P inputs to Gulf of Riga.
- Latvia, Poland, Czech Republic and Ukraine exceeded their ceilings to the sub-basins to which they have inputs.
- All countries fulfilled national ceilings for total phosphorus inputs to Danish Straits and Kattegat.

Changes of inputs:

- High uncertainty due to large variability of the data prevents identification of statistically significant changes of phosphorus input since the reference period (1997-2003) for more than 50% of the sub-basins. Most of the sub-basins do not demonstrate any significant changes.
- Russia and Ukraine increased inputs to the Baltic Proper.
- Lithuania was the only country that reduced total phosphorus inputs to all sub-basins to which it contributes.

Revision of time series.

The whole time series (1995-2014) of nitrogen and phosphorus input have been reviewed since the last assessment (2015). It resulted in an overall increase of estimated inputs to the Baltic Sea and to some sub-basins in the reference period. One of the consequences is that the commitment to reach good environmental status of the Baltic Sea requires a larger reduction than the CART agreed on in MD 2013.

Progress towards national targets for input of nutrients achieved by 2014

How much is left to reach the HELCOM nutrient input targets set for a clean Baltic Sea?

These are the key results of the assessment of progress towards the [national targets for nitrogen input](#) adopted by the 2013 Copenhagen HELCOM Ministerial Declaration. **The evaluation takes into account reallocation of achieved [extra reduction](#).**

National targets for nitrogen and phosphorus inputs have been expressed as nutrient input ceilings for each country by sub-basin.²

Reductions still needed

Table 1. Total Nitrogen. Evaluation of input ceilings fulfillment

Based on statistically estimated inputs (*scroll down for full legend*).

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark	↓	↓	↓	↓	↓	↓	↓
Estonia	↓	↓	↓			↓	↓
Finland			↓		↓	↓	↓
Germany	↓	↓	↓	↓	↓	↓	↓
Latvia	↓	↓				↓	↓
Lithuania		↓		↓			↓
Poland	↓	↓	↓	↓	↓	↓	↓
Russia	↓	↓	↑			↓	↓
Sweden	↓	↓	↓	↓	↓		↓
Belarus							
Czech Republic							
Ukraine			↑				
Baltic Sea shipping							
Other countries	↓	↓	↓	↓	↓	↓	↓
MAI	↓	↓	↓			↓	↓






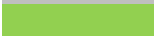



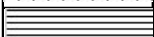
² Poland accepts the Polish Country Allocated Reduction Targets as indicative due to the ongoing national consultations. Ref. [Ministerial Declaration 2013, page 6, footnote 2](#).

Table 2. Total Phosphorus. Evaluation of input ceilings fulfillment

Based on statistically estimated inputs.

Country/basin	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark			↓				↓
Estonia				↓			
Finland	↓						
Germany							
Latvia							
Lithuania			↓		↓		
Poland							
Russia			↑	↓			
Sweden		↓	↓			↓	
Belarus							
Czech Republic							
Ukraine			↑				
Baltic Sea shipping							
Other countries							
MAI				↓			↓

Colour legend

	Reduction still left to the target* is less than 10%
	between 10 and 30%
	between 30% and 50%
	50% or more
	Within statistical certainty, the fulfillment of CART cannot be justified
	CART is with 95 % statistical certainty fulfilled; inputs ceiling not exceeded
	Classification is not relevant
	Sub-basins where extra reduction was reallocated to
	only airborne inputs to the sub-basin
	only transboundary waterborne inputs to the sub-basin

Arrows: statistically significant changes of nutrient inputs since the reference period, taking into account 95% confidence interval for both latest inputs and reference values.

- ↓ significant decrease
↑ significant increase

* Yellow, orange and red shades: input ceiling is exceeded with 95 % statistical certainty. The legend illustrates the percentage which reduction left to the target constitutes in the corresponding input ceiling value.

“Other countries” includes sources for atmospheric nitrogen deposition as the 20 EU countries not being HELCOM Contracting Parties, countries outside EU including Belarus, Ukraine, North Sea shipping etc.

MAI is the maximum allowable inputs, according to the 2013 HELCOM Ministerial Declaration.

For reviewing the input data used to evaluate fulfillment of CART and the amount of remaining reductions, please see the data page.

Key messages

Based on [estimation of normalized inputs of nitrogen](#) and phosphorus from 1995 to 2014 (Tables 1 and 2) the following conclusion can be made with high statistical certainty:

Progress towards nitrogen input targets

Fulfillment of input ceilings:

- Denmark is the only country that have fulfilled nitrogen ceilings to all HELCOM sub-basins.
- Finland, Germany and Sweden met their nitrogen ceilings to all HELCOM basins except to the Baltic Proper and the Gulf of Finland where remaining reduction for Finland and Sweden is less than 10% of the input ceilings for these countries.
- Russia exceeded their ceilings to all sub-basins.
- Total nitrogen inputs to Bothnian Sea, Bothnian Bay, Danish Straits and Kattegat were below the MAIs for these sub-basins. The countries which did not fulfilled their ceilings for these sub-basins have only minor airborne inputs.
- Atmospheric nitrogen inputs from Baltic Sea shipping and Non-HELCOM countries exceeded their target values to all sub-basins.

Changes of inputs:

- The assessment indicates statistically significant reduction of nitrogen inputs into all sub-basins since the reference period (1997-2003) except the Gulf of Finland and Gulf of Riga where changes are not statistically significant.
- Denmark, Germany and Poland have reduced their total nitrogen inputs to all HELCOM sub-basins.
- Estonia, Finland, Latvia, Lithuania and Sweden reduced their total nitrogen inputs to several sub-basins and had no statistical changes of inputs to the remaining ones.
- Russia and Ukraine increased inputs to the Baltic Proper.
- Non-HELCOM countries demonstrate reduction of airborne total nitrogen inputs to all HELCOM sub-basins.

Reallocation of extra reduction.

- Reallocation of extra reduction of nitrogen inputs achieved in neighbouring sub-basins was applied to evaluate fulfilment of national targets of Estonia, Finland, Germany Latvia and Sweden for Baltic Proper and Germany for Kattegat. Taking extra reduction into account Estonia and Latvia met input ceilings for Baltic Proper and Germany for Kattegat.

Progress towards phosphorus input targets

Fulfillment of input ceilings:

- There was not a single country fulfilling input ceilings for phosphorus to all HELCOM sub-basins.
- Estonia is the only country which fulfilled waterborne input ceiling for the Baltic Proper.
- Two of three countries, which contribute to the input to the Gulf of Finland, also exceeded their ceilings. Fulfilment of the input ceiling by Russia cannot be judged unambiguously due to uncertainty caused by variability of the assessment data. This also holds true for the Russian P inputs to Gulf of Riga.
- Latvia, Poland, Czech Republic and Ukraine exceeded their ceilings to all sub-basins to which they have inputs.
- All countries fulfilled national ceilings for total phosphorus inputs to Danish Straits and Kattegat.

Changes of inputs:

- High uncertainty due to large variability of the data prevents identification of statistically significant changes of phosphorus input since the reference period (1997-2003) for more than 50% of the sub-basins. Most of the sub-basins do not demonstrate any significant changes.
- Russia and Ukraine increased inputs to the Baltic Proper.
- Lithuania was the only country that reduced total phosphorus inputs to all sub-basins to which it contributes.

Reallocation of extra reduction.

- Reallocation of extra reduction of phosphorus inputs achieved in neighbouring sub-basins was applied to evaluate fulfilment of national targets of Estonia, Germany, Lithuania and Sweden for the Baltic Proper, Finland for the Bothnian Sea and Sweden for the Bothnian Bay. Taking extra reduction into account, Estonia met input ceilings for the Baltic Proper.

Revision of the series.

The whole time series (1995-2014) of nitrogen and phosphorus input have been reviewed since the last assessment (2015). It resulted in an overall increase of estimated inputs to the Baltic Sea and to some sub-basins in the reference period. One of the consequences is that the commitment to reach good environmental status of the Baltic Sea requires a larger reduction than the CART agreed on in MD 2013.

Supplementary paper to the policy message

1 Introduction

The nutrient reduction scheme of the HELCOM Baltic Sea Action Plan was revised in the 2013 HELCOM Ministerial Meeting (MD2013), based on an updated dataset (PLC-5.5) as well as an improved modelling approach. The Country-Allocated Reduction Targets (CART) are a part of the HELCOM nutrient reduction scheme, indicating how much nutrient inputs the HELCOM countries need to reduce by 2021, compared to the reference period (1997–2003), to meet the BSAP objectives of a Baltic Sea unaffected by eutrophication.

CART was calculated as the required reductions of nitrogen and phosphorus inputs based on the Maximum Allowable Inputs (MAI) and estimated net inputs in the reference period (1997–2003). Nutrient net input ceilings identify the allowable input for each country to each sub-basin. The sum of national input ceilings for a sub-basin is equal to MAI for this sub-basin. Meeting the national ceilings implies achieving of the good environmental status of the Sea in terms of eutrophication taking into account time lags.

The assessment made by PLC-6 project is based on the data on the net nutrient input covering the period from 1995 to 2014. During the project implementation the whole dataset has been significantly revised in addition to reporting of the new national data on inputs in 2013 and 2014. Section 4 provides information the main changes in the data set.

The update of the whole data series starting from 1995 resulted in the consequent update of the mean value for the reference period (1997–2003). The revision had different effect on reference values for different countries. It led to 6.3 % increase of the overall nitrogen inputs during the reference period to the Baltic Sea. For some country these changes in nitrogen inputs were even higher (see section 4). Updated values for phosphorus inputs in the reference period are either higher or lower than the original ones for different countries. But the updated value for the total P input to the Baltic Sea is 3.4% higher than that was used for MD2013.

The major consequence of revised reference value is that the implementation of the CART does not lead to achieving of the input ceilings hence the update of the reference value changes the reduction required to reach good environmental status of the Baltic Sea.

PRESSURE 7-2017 acknowledged that the new scientific data on the input time series since 1994 substantially differ from previous assessments of nutrient inputs, which includes also values for the reference period 1997-2003. The Meeting agreed that the policy message should be focused on the achievement of the GES for the Baltic Sea, which is reflected by the national input ceilings. The Meeting also requested RedCore DG to elaborate a supplementary paper to the policy message containing detailed analysis of the data updates (section 3 and 4) and discussion on their consequences for the HELCOM nutrient reduction scheme follow-up (section 5 and 6).

2 Targets according to Copenhagen Ministerial Declaration 2013

The 2013 Copenhagen Ministerial Declaration (MD2013) contain two tables. Table 2.1 contains the basin-wise maximum allowable inputs (MAI), reference inputs and needed reductions. The latter is simply difference between the reference inputs and the MAIs. The country-wise reduction targets (CART) are presented as totals for countries in MD2013, see Table 2.2.

Table 2.1: The MAI table from MD2013.

Baltic Sea Sub-basin	Maximum Allowable Inputs		Reference inputs 1997-2003		Needed reductions	
	TN tons	TP tons	TN tons	TP Tons	TN tons	TP tons
Kattegat	74,000	1,687	78,761	1,687	4,761	0
Danish Straits	65,998	1,601	65,998	1,601	0	0
Baltic Proper	325,000	7,360	423,921	18,320	98,921	10,960
Bothnian Sea	79,372	2,773	79,372	2,773	0	0
Bothnian Bay	57,622	2,675	57,622	2,675	0	0
Gulf of Riga	88,417	2,020	88,417	2,328	0	308
Gulf of Finland	101,800	3,600	116,252	7,509	14,452	3,909
Baltic Sea	792,209	21,716	910,344	36,894	118,134	15,178

Table 2.2: The CART table from MD2013 (tons per year)

	Nitrogen	Phosphorus
Denmark	2890	38
Estonia	1800	320
Finland	2430 +600*	330 +26*
Germany	7170 +500*	110 +60*
Latvia	1670	220
Lithuania	8970	1470
Poland ²	43610	7480
Russia	10380*	3790*
Sweden	9240	530

*Reduction requirements stemming from:

- German contribution to the river Odra inputs, based on ongoing modeling approaches with MONERIS;
- Finnish contribution to inputs from river Neva catchment (via Vuoksi river);
- these figures include Russian contribution to inputs through Daugava, Nemunas and Pregolya rivers.

² Poland accepts the Polish Country Allocated Reduction Targets as indicative due to the ongoing national consultations.

To achieve the needed reduction in Table 2.1, the national CARTs in Table 2.2 need to be complemented by a basin-wise distribution of the load reduction, and in addition be complemented by the expected reductions from atmospheric deposition and transboundary riverine nutrient inputs from non-HELCOM countries, and expected reductions from international shipping. These expected reductions were also provided as sums for all sub-basins with reduction requirements in the MD2013. The additional information, substantiating values listed in the tables 2.1 and 2.2, was

provided in a [background document for the MD2013](#) (Summary report on the development of revised Maximum Allowable Inputs (MAI) and updated Country Allocated Reduction Targets (CART) of the Baltic Sea Action Plan). Specifically, the background document contains information on input ceilings for all sub-basins and reduction requirements for the sub-basins where these requirements were set.

Calculation of nutrient input ceilings.

Nutrient input ceilings are calculated by subtracting the reduction requirements (CART) in the 2013 Ministerial Declaration from the net nutrient inputs for each country and sub-basin in the reference period 1997-2003. Following the same procedure, nutrient input ceilings can also be assigned to shipping and other sources of airborne inputs. The sum of all nutrient input ceilings for a sub-basin is equal to MAI for this sub-basin (Tables 2.3 and 2.4).

The necessary information for this calculation was included in the [background document for the 2013 Ministerial Meeting](#). For the sub-basins without reduction requirements, the nutrient input ceiling for phosphorus is equal to the net inputs in the reference period. Potential reduction of airborne nitrogen inputs due to implementation of Gothenburg protocol and regulations of ship emissions were taken into account in the 2013 Ministerial Declaration (see Background document) also for the basins without nitrogen reduction requirements. Thus, nutrient input ceiling for these sub-basins are slightly higher than reference inputs in order to keep the sum equal to MAI.

Table 2.3: Nutrient input ceilings for nitrogen for all basins and countries.

Country	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark	231	904	7910	334	381	30313	29319
Estonia	95	317	1413	11265	13029	18	20
Finland	35081	29619	1569	20653	255	64	77
Germany	817	3170	27473	1312	1465	21957	3285
Latvia	63	273	6091	183	53898	24	25
Lithuania	110	491	33093	261	5795	54	60
Poland	644	2802	160857	1166	1361	1125	1106
Russia	710	1551	9253	62522	2516	174	174
Sweden	17924	33350	30942	502	449	6224	34206
Other countries	1876	6603	33002	3455	2804	5880	5579
Baltic Sea Shipping	72	292	1434	147	112	165	149
Belarus	0	0	7322	0	6352	0	0

Czech Rep.	0	0	2693	0	0	0	0
Ukraine	0	0	1948	0	0	0	0
Sum (MAI)	57622	79372	325000	101800	88418	65998	74001

Table 2.4: Nutrient input ceilingsutri phosphorus for all basins and countries

Country	BOB	BOS	BAP	GUF	GUR	DS	KAT
Denmark	0	0	21	0	0	1040	829
Estonia	0	0	8	236	239	0	0
Finland	1668	1255	0	322	0	0	0
Germany	0	0	101	0	0	351	0
Latvia	0	0	74	0	541	0	0
Lithuania	0	0	831	0	166	0	0
Poland	0	0	4309	0	0	0	0
Russia	0	0	277	2892	185	0	0
Sweden	826	1125	308	0	0	105	740
Atm. Dep.	181	394	1046	150	93	105	118
Belarus	0	0	244	0	797	0	0
Czech Rep.	0	0	108	0	0	0	0
Ukraine	0	0	33	0	0	0	0
Sum (MAI)	2675	2773	7360	3600	2020	1601	1687

3 Results of CART assessment with reference inputs according to MD2013 and new reference inputs

In the policy message, progress towards CART is assessed by comparing recent country per basin inputs (inputs in 2014 estimated with the trend methodology) including uncertainty of these inputs with the corresponding input ceilings.

This section contains detailed information on the CART assessment for facilitating Contracting Parties country per basin evaluating achieved and remaining reduction towards fulfilling reduction targets taking into account changes in the reference inputs as compared with the MD2013 inputs.

Tables 3 includes information country per basin on:

- Reference inputs from MD2013 (column A in tables 3)
- CART (MD2013) (column B)
- Inputs ceilings according to table 2.3 and 2.4 (column C)
- Revised reference inputs from the PLC-6 dataset (column G)
- Changes in reference inputs since MD2013 (column H)

Further the tables includes information on:

- the estimated inputs 2014 (based on the trend methodology) (column D in tables 3)
- the estimated inputs 2014 including uncertainty (column E)

Achieved and remaining reduction are calculated based on the information mention above:

- Achieved reduction related to the reference inputs in MD2013 (column F in tables 3) calculated as column A minus column E
- Achieved reduction related to the revised reference inputs according to the PLC-6 (column I) calculated as column G minus column E
- Remaining reduction according to input ceiling (column J) calculated as column G minus column E

Table 1a and 1b in the policy message evaluate, whether the estimated inputs in 2014 including uncertainty (columns E in tables 3) have changed significantly since the reference period (based on the revised reference inputs in column G).

It is possible to compare directly the estimated inputs in 2014 with the changed reference inputs as they are based on the PLC-6 dataset. In this case both achieved (column I) and remaining reduction (J) are calculated based on the PLC-6 data set.

On the other hand, the calculated achieved reduction (column F) compared with the MD2013 n in column F are based on two different PLC datasets. The reference inputs from MD2013 were calculated from the PLC5-5- data, while the estimated inputs in 2014 is based on the PLC-6 data set. Particularly for atmospheric nitrogen there is significant changes in reference inputs from the PLC-5.5 to the PLC-6 data set – see section

4 and 5. Therefore, the calculated achieved reduction in column F should not be used without taking into account the changes in the reference inputs (as quantified in column H).

Tables 3: Detailed information used for the assessment of progress towards CART. The tables are organised pr. country (nitrogen and phosphorus) providing data per basin and where relevant for the country to the Baltic Sea (BAS). The contents in the rows are explained in the text above. The unit are in tons.

Denmark - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	226	854	10,046	376	374	28,588	30,027	70,491
B: CART (MD 2013)	0	0	2,136	42	0	0	708	2,886
C: Input ceilings	231	904	7,910	334	381	30,313	29,319	69,392
D: Input 2014	168	632	7,376	273	273	22,539	25,134	
E: Input 2014 including uncertainty estimate	174	652	7,477	283	282	24,165	26,193	
F= (A-E) Achieved reduction related to ref. inputs MD2013	52	202	2,569	93	92	4,423	3,834	
G: Revised reference inputs (PLC-6)	292	1,082	11,233	472	464	28,045	30,268	71,856
H: Changes in ref. inputs since MD2013	66	228	1,187	96	90	-543	241	1,365
I = (G-E): Achieved reduction related to revised ref. inputs	118	430	3,756	189	182	3,880	4,075	
J = (E-C): Remaining reduction according to input ceilings	-57	-252	-433	-51	-100	-6,148	-3,127	

Denmark - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			59			1,040	829	1,928
B: CART (MD 2013)			38			0	0	38
C: Input ceilings			21			1,040	829	1,890
D: Input 2014			66			1,003	692	
E: Input 2014 including uncertainty estimate			68			1,039	710	
F= (A-E) Achieved reduction related to ref. inputs MD2013			-9			1	119	
G: Revised reference inputs (PLC-6)			77			1,066	796	1,939
H: Changes in ref. inputs since MD2013			18			26	-33	11
I = (G-E): Achieved reduction related to revised ref. inputs			9			27	86	
J = (E-C): Remaining reduction according to input ceilings			46			-1	-119	

Estonia - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	93	299	1,795	12,684	12,777	17	20	27,684
B: CART (MD 2013)	0	0	382	1,419	0	0	0	1,801
C: Input ceilings	95	317	1,413	11,265	13,029	18	20	26,156

D: Input 2014	103	341	1,511	10,486	11,192	17	22	
E: Input 2014 including uncertainty estimate	106	348	1,607	12,100	12,130	18	22	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-13	-49	188	584	647	-1	-2	
G: Revised reference inputs (PLC-6)	115	371	1,907	13,529	13,002	20	24	28,967
H: Changes in ref. inputs since MD2013	22	72	112	845	225	3	4	1,283
I = (G-E): Achieved reduction related to revised ref. inputs	9	23	300	1,429	872	2	2	
J = (E-C): Remaining reduction according to input ceilings	11	31	195	836	-899	0	2	

Estonia - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			23	504	277			804
B: CART (MD 2013)			15	268	38			321
C: Input ceilings			8	236	239			483
D: Input 2014			17	319	199			
E: Input 2014 including uncertainty estimate			20	368	220			
F= (A-E) Achieved reduction related to ref. inputs MD2013			3	136	57			
G: Revised reference inputs (PLC-6)			23	543	282			848
H: Changes in ref. inputs since MD2013			0	39	5			44
I = (G-E): Achieved reduction related to revised ref. inputs			3	175	62			
J = (E-C): Remaining reduction according to input ceilings			11	132	-19			

Finland - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	34,389	27,978	1,993	23,256	250	60	79	88,005
B: CART (MD 2013)	0	0	424	2,603	0	0	2	3,029
C: Input ceilings	35,081	29,619	1,569	20,653	255	64	77	87,318
D: Input 2014	33,362	27,710	1,642	20,930	206	46	62	
E: Input 2014 including uncertainty estimate	34,752	29,034	1,692	22,253	212	47	64	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-363	-1,056	301	1,003	38	13	15	
G: Revised reference inputs (PLC-6)	35,540	28,887	2,327	24,071	291	68	92	91,278
H: Changes in ref. inputs since MD2013	1,151	909	334	815	41	8	13	3,273
I = (G-E): Achieved reduction related to revised ref. inputs	788	-147	635	1,818	79	21	28	
J = (E-C): Remaining reduction according to input ceilings	-329	-585	123	1,599	-43	-16	-13	

Finland - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	1,668	1,255		686				3,609
B: CART (MD 2013)	0	0		364				364

C: Input ceilings	1,668	1,255	322	3,245
D: Input 2014	1,483	1,248	647	
E: Input 2014 including uncertainty estimate	1,531	1,311	673	
F= (A-E) Achieved reduction related to ref. inputs MD2013	137	-56	13	
G: Revised reference inputs (PLC-6)	1,723	1,251	712	3,687
H: Changes in ref. inputs since MD2013	55	-4	26	78
I = (G-E): Achieved reduction related to revised ref. inputs	192	-60	39	
J = (E-C): Remaining reduction according to input ceilings	-137	56	351	

Germany - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	801	2,994	34,892	1,477	1,437	20,708	3,364	65,673
B: CART (MD 2013)	0	0	7,419	165	0	0	79	7,663
C: Input ceilings	817	3,170	27,473	1,312	1,465	21,957	3,285	59,480
D: Input 2014	767	2,909	33,598	1,465	1,400	18,100	3,977	
E: Input 2014 including uncertainty estimate	779	2,956	34,339	1,489	1,423	18,893	4,060	
F= (A-E) Achieved reduction related to ref. inputs MD2013	22	38	553	-12	14	1,815	-696	
G: Revised reference inputs (PLC-6)	1,001	3,785	42,552	1,905	1,799	21,514	4,726	77,283
H: Changes in ref. inputs since MD2013	200	791	7,660	428	362	806	1,362	11,610
I = (G-E): Achieved reduction related to revised ref. inputs	222	829	8,213	416	376	2,621	666	
J = (E-C): Remaining reduction according to input ceilings	-38	-213	6,866	177	-43	-3,064	775	

Germany - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			276			351		626
B: CART (MD 2013)			175			0		175
C: Input ceilings			101			351		451
D: Input 2014			250			310		
E: Input 2014 including uncertainty estimate			264			327		
F= (A-E) Achieved reduction related to ref. inputs MD2013			12			24		
G: Revised reference inputs (PLC-6)			271			348		620
H: Changes in ref. inputs since MD2013			-5			-3		-6
I = (G-E): Achieved reduction related to revised ref. inputs			7			21		
J = (E-C): Remaining reduction according to input ceilings			163			-24		

Latvia - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	62	258	7,736	206	52,853	23	26	61,164
B: CART (MD 2013)	0	0	1,645	23	0	0	1	1,669
C: Input ceilings	63	273	6,091	183	53,898	24	25	60,558
D: Input 2014	67	284	10,489	248	43,228	24	29	
E: Input 2014 including uncertainty estimate	69	292	11,390	254	46,680	25	30	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-7	-34	-3,654	-48	6,173	-2	-4	
G: Revised reference inputs (PLC-6)	80	331	9,139	282	42,824	29	35	52,720
H: Changes in ref. inputs since MD2013	18	73	1,403	76	-10,029	6	9	-8,444
I = (G-E): Achieved reduction related to revised ref. inputs	11	39	-2,251	28	-3,856	4	5	
J = (E-C): Remaining reduction according to input ceilings	6	19	5,299	71	-7,219	1	5	

Latvia - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			203		627			830
B: CART (MD 2013)			129		86			215
C: Input ceilings			74		541			615
D: Input 2014			295		1,018			
E: Input 2014 including uncertainty estimate			340		1,119			
F= (A-E) Achieved reduction related to ref. inputs MD2013			-137		-492			
G: Revised reference inputs (PLC-6)			259		994			1,253
H: Changes in ref. inputs since MD2013			56		367			423
I = (G-E): Achieved reduction related to revised ref. inputs			-81		-125			
J = (E-C): Remaining reduction according to input ceilings			267		578			

Lithuania - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	108	464	42,028	294	5,682	51	61	48,689
B: CART (MD 2013)	0	0	8,935	33	0	0	1	8,969
C: Input ceilings	110	491	33,093	261	5,795	54	60	39,864
D: Input 2014	105	443	44,178	314	7,360	53	70	
E: Input 2014 including uncertainty estimate	108	457	48,786	325	8,535	55	72	
F= (A-E) Achieved reduction related to ref. inputs MD2013	0	7	-6,758	-31	-2,853	-4	-11	
G: Revised reference inputs (PLC-6)	119	500	38,932	355	6,159	60	79	46,204
H: Changes in ref. inputs since MD2013	11	36	-3,096	61	477	9	18	-2,485
I = (G-E): Achieved reduction related to revised ref. inputs	11	43	-9,854	30	-2,376	5	7	

J = (E-C): Remaining reduction according to input ceilings	-2	-34	15,693	64	2,741	1	12
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Lithuania - Phosphorus

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			2,272		192			2,463
B: CART (MD 2013)			1,441		26			1,467
C: Input ceilings			831		166			996
D: Input 2014			1,109		51			
E: Input 2014 including uncertainty estimate			1,258		84			
F= (A-E) Achieved reduction related to ref. inputs MD2013			1,014		108			
G: Revised reference inputs (PLC-6)			2,166		287			2,453
H: Changes in ref. inputs since MD2013			-106		95			-10
I = (G-E): Achieved reduction related to revised ref. inputs			908		203			
J = (E-C): Remaining reduction according to input ceilings			428		-82			

Poland - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	631	2,647	204,293	1,313	1,335	1,061	1,133	212,413
B: CART (MD 2013)	0	0	43,436	147	0	0	27	43,610
C: Input ceilings	644	2,802	160,857	1,166	1,361	1,125	1,106	169,062
D: Input 2014	625	2,667	178,377	1,408	1,417	1,119	1,270	
E: Input 2014 including uncertainty estimate	636	2,715	187,847	1,434	1,442	1,141	1,293	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-5	-68	16,446	-121	-107	-80	-160	
G: Revised reference inputs (PLC-6)	712	3,039	205,876	1,605	1,613	1,277	1,447	215,569
H: Changes in ref. inputs since MD2013	81	392	1,583	292	278	216	314	3,156
I = (G-E): Achieved reduction related to revised ref. inputs	76	324	18,029	171	171	136	154	
J = (E-C): Remaining reduction according to input ceilings	-8	-87	26,990	268	80	16	187	

Poland - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			11,786					11,786
B: CART (MD 2013)			7,477					7,477
C: Input ceilings			4,309					4,309
D: Input 2014			10,267					
E: Input 2014 including uncertainty estimate			11,010					
F= (A-E) Achieved reduction related to ref. inputs MD2013			776					
G: Revised reference inputs (PLC-6)			11,750					11,750
H: Changes in ref. inputs since MD2013			-36					-36
I = (G-E): Achieved reduction related to revised ref. inputs			740					
J = (E-C): Remaining reduction according to input ceilings			6,701					

Russia - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	696	1,465	11,751	70,401	2,467	164	178	87,123
B: CART (MD 2013)	0	0	2,498	7,879	0	0	4	10,381
C: Input ceilings	710	1,551	9,253	62,522	2,516	174	174	76,900
D: Input 2014	836	1,806	14,688	72,124	4,214	192	227	
E: Input 2014 including uncertainty estimate	844	1,825	14,922	79,092	4,513	194	229	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-148	-360	-3,171	-8,691	-2,046	-30	-51	
G: Revised reference inputs (PLC-6)	864	1,869	13,296	76,814	5,088	201	237	98,368
H: Changes in ref. inputs since MD2013	168	404	1,545	6,413	2,621	37	59	11,245

I = (G-E): Achieved reduction related to revised ref. inputs	20	44	-1,626	-2,278	575	7	8
J = (E-C): Remaining reduction according to input ceilings	134	274	5,669	16,570	1,997	20	55

Russia - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			758	6,169	215			7,142
B: CART (MD 2013)			481	3,277	30			3,788
C: Input ceilings			277	2,892	185			3,354
D: Input 2014			749	2,522	165			
E: Input 2014 including uncertainty estimate			808	3,649	194			
F= (A-E) Achieved reduction related to ref. inputs MD2013			-50	2,520	21			
G: Revised reference inputs (PLC-6)			567	7,497	135			8,199
H: Changes in ref. inputs since MD2013			-191	1,328	-80			1,057
I = (G-E): Achieved reduction related to revised ref. inputs			-241	3,848	-59			
J = (E-C): Remaining reduction according to input ceilings			531	757	9			

Sweden - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	17,571	31,501	39,298	565	440	5,869	35,032	130,277
B: CART (MD 2013)	0	0	8,356	63	0	0	826	9,245
C: Input ceilings	17,924	33,350	30,942	502	449	6,224	34,206	123,597
D: Input 2014	14,190	27,784	32,254	519	405	4,875	26,268	
E: Input 2014 including uncertainty estimate	14,602	28,612	32,775	535	417	5,280	27,451	
F= (A-E) Achieved reduction related to ref. inputs MD2013	2,969	2,889	6,523	30	23	589	7,581	
G: Revised reference inputs (PLC-6)	18,229	32,526	39,961	701	533	5,791	35,406	133,148
H: Changes in ref. inputs since MD2013	658	1,025	663	136	93	-78	374	2,871
I = (G-E): Achieved reduction related to revised ref. inputs	3,627	3,914	7,186	166	116	511	7,955	
J = (E-C): Remaining reduction according to input ceilings	-3,322	-4,738	1,832	33	-32	-943	-6,755	

Sweden - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	826	1,125	843			105	740	3,639
B: CART (MD 2013)	0	0	535			0	0	535
C: Input ceilings	826	1,125	308			105	740	3,104
D: Input 2014	902	812	706			83	679	
E: Input 2014 including uncertainty estimate	999	874	724			86	717	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-173	252	119			19	23	
G: Revised reference inputs (PLC-6)	856	1,184	839			103	750	3,732
H: Changes in ref. inputs since MD2013	30	59	-4			-2	10	93
I = (G-E): Achieved reduction related to revised ref. inputs	-143	311	115			17	33	
J = (E-C): Remaining reduction according to input ceilings	173	-251	417			-19	-23	

Belarus - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			9,299		6,228			15,527
B: CART (MD 2013)			1,977		0			1,977
C: Input ceilings			7,322		6,352			13,673
D: Input 2014			8,012		11,230			
E: Input 2014 including uncertainty estimate			8,926		12,164			
F= (A-E) Achieved reduction related to ref. inputs MD2013			373		-5,936			
G: Revised reference inputs (PLC-6)			9,563		14,020			23,583
H: Changes in ref. inputs since MD2013			264		7,792			8,056

I = (G-E): Achieved reduction related to revised ref. inputs	637	1,856
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J = (E-C): Remaining reduction according to input ceilings	1,604	5,812
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Belarus - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			668		925			1,593
B: CART (MD 2013)			424		128			552
C: Input ceilings			244		797			1,041
D: Input 2014			664		704			
E: Input 2014 including uncertainty estimate			707		835			
F= (A-E) Achieved reduction related to ref. inputs MD2013			-39		90			
G: Revised reference inputs (PLC-6)			668		575			1,243
H: Changes in ref. inputs since MD2013			0		-350			-350
I = (G-E): Achieved reduction related to revised ref. inputs			-39		-260			
J = (E-C): Remaining reduction according to input ceilings			463		38			

Czech Republic - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			3,420					3,420
B: CART (MD 2013)			727					727
C: Input ceilings			2,693					2,693
D: Input 2014			3,221					
E: Input 2014 including uncertainty estimate			3,340					
F= (A-E) Achieved reduction related to ref. inputs MD2013			80					
G: Revised reference inputs (PLC-6)			3,102					3,102
H: Changes in ref. inputs since MD2013			-318					-318
I = (G-E): Achieved reduction related to revised ref. inputs			-238					
J = (E-C): Remaining reduction according to input ceilings			647					

Czech Republic - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			295					295
B: CART (MD 2013)			187					187
C: Input ceilings			108					108
D: Input 2014			225					
E: Input 2014 including uncertainty estimate			251					

F= (A-E) Achieved reduction related to ref. inputs MD2013	44	
G: Revised reference inputs (PLC-6)	267	267
H: Changes in ref. inputs since MD2013	-28	-28
I = (G-E): Achieved reduction related to revised ref. inputs	16	
J = (E-C): Remaining reduction according to input ceilings	142	

Ukraine - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			2,474					2,474
B: CART (MD 2013)			526					526
C: Input ceilings			1,948					1,948
D: Input 2014			4,827					
E: Input 2014 including uncertainty estimate			4,991					
F= (A-E) Achieved reduction related to ref. inputs MD2013			-2,517					
G: Revised reference inputs (PLC-6)			2,099					2,099
H: Changes in ref. inputs since MD2013			-375					-375
I = (G-E): Achieved reduction related to revised ref. inputs			-2,892					
J = (E-C): Remaining reduction according to input ceilings			3,042					

Ukraine - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)			91					91
B: CART (MD 2013)			58					58
C: Input ceilings			33					33
D: Input 2014			305					
E: Input 2014 including uncertainty estimate			319					
F= (A-E) Achieved reduction related to ref. inputs MD2013			-228					
G: Revised reference inputs (PLC-6)			76					76
H: Changes in ref. inputs since MD2013			-15					-15
I = (G-E): Achieved reduction related to revised ref. inputs			-243					
J = (E-C): Remaining reduction according to input ceilings			285					

Baltic Sea Shipping - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	361	1,461	7,169	739	561	826	751	11,868
B: CART (MD 2013)	0	0	5,735	592	0	0	602	6,929
C: Input ceilings	72	292	1,434	147	112	165	149	2,372
D: Input 2014	494	1,838	8,687	950	689	953	960	
E: Input 2014 including uncertainty estimate	500	1,860	8,791	961	697	965	971	
F= (A-E) Achieved reduction related to ref. inputs MD2013	-139	-399	-1,622	-222	-136	-139	-220	
G: Revised reference inputs (PLC-6)	519	1,929	9,115	996	723	1,000	1,007	15,289
H: Changes in ref. inputs since MD2013	158	468	1,946	257	162	174	256	3,421
I = (G-E): Achieved reduction related to revised ref. inputs	19	69	324	35	26	35	36	
J = (E-C): Remaining reduction according to input ceilings	428	1,568	7,357	814	585	800	822	

Baltic Sea Shipping – Phosphorus*	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)								
B: CART (MD 2013)								
C: Input ceilings								
D: Input 2014								
E: Input 2014 including uncertainty estimate								
F= (A-E) Achieved reduction related to ref. inputs MD2013								
G: Revised reference inputs (PLC-6)								
H: Changes in ref. inputs since MD2013								
I = (G-E): Achieved reduction related to revised ref. inputs								
J = (E-C): Remaining reduction according to input ceilings								

- No phosphorus deposition quantifies and assigned to Baltic Sea shipping

Other Countries* - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	2,685	9,451	47,727	4,941	4,013	8,631	8,090	85,538
B: CART (MD 2013)	0	0	14,725	1,486	0	0	2,511	18,722
C: Input ceilings	1,876	6,603	33,002	3,455	2,804	5,880	5,579	59,199
D: Input 2014	2,368	8,220	44,136	4,421	3,553	7,489	7,863	
E: Input 2014 including uncertainty estimate	2,396	8,312	44,638	4,465	3,587	7,592	7,976	
F= (A-E) Achieved reduction related to ref. inputs MD2013	289	1,139	3,089	476	426	1,039	114	
G: Revised reference inputs (PLC-6)	3,225	11,149	61,287	5,858	4,735	10,855	11,276	108,386
H: Changes in ref. inputs since MD2013	540	1,698	13,560	917	722	2,224	3,186	22,848

I = (G-E): Achieved reduction related to revised ref. inputs	829	2,837	16,649	1,393	1,148	3,263	3,300
J = (E-C): Remaining reduction according to input ceilings	520	1,709	11,636	1,010	783	1,712	2,397

Other Countries* - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	181	394	1,046	150	93	105	118	2,087
B: CART (MD 2013)	0	0	0	0	0	0	0	0
C: Input ceilings	181	394	1,046	150	93	105	118	2,087
D: Input 2014	181	394	1,046	150	93	105	118	
E: Input 2014 including uncertainty estimate	181	394	1,046	150	93	105	118	
F= (A-E) Achieved reduction related to ref. inputs MD2013	0	0	0	0	0	0	0	
G: Revised reference inputs (PLC-6)	181	394	1,046	150	93	105	118	2,087
H: Changes in ref. inputs since MD2013	0	0	0	0	0	0	0	0
I = (G-E): Achieved reduction related to revised ref. inputs	0	0	0	0	0	0	0	
J = (E-C): Remaining reduction according to input ceilings	0	0	0	0	0	0	0	

* Other countries are the 20 EU members not members of HELCOM, other countries outside EU and HELCOM, and North Sea shipping. It is not possible to allocated phosphorus deposition on the Baltic Sea on sources, and it is allocated as a background inputs from other countries

MAI - Nitrogen	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	57,622	79,372	423,922	116,252	88,418	65,998	78,762	910,346
B: CART (MD 2013)	0	0	98,921	14,452	0	0	4,761	118,134
C: Input ceilings	57,622	79,372	325,001	101,800	88,418	65,998	74,001	792,212
D: Input 2014	52,948	71,623	393,280	114,922	90,436	54,524	65,170	
E: Input 2014 including uncertainty estimate	54,737	74,212	405,521	122,599	94,455	56,393	66,106	
F= (A-E) Achieved reduction related to ref. inputs MD2013	2,885	5,160	18,401	-6,347	-6,037	9,605	12,656	
G: Revised reference inputs (PLC-6)	60,695	85,468	450,389	126,589	91,252	68,861	84,597	967,850
H: Changes in ref. inputs since MD2013	3,073	6,096	26,467	10,337	2,834	2,863	5,835	57,504
I = (G-E): Achieved reduction related to revised ref. inputs	5,958	11,256	44,868	3,990	-3,203	12,468	18,491	
J = (E-C): Remaining reduction according to input ceilings	-2,886	-5,160	80,521	20,798	6,038	-9,605	-7,895	

MAI - Phosphorus	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
A: Input 1997-2003 (MD 2013) (ref. inputs)	2,675	2,773	18,320	7,509	2,328	1,601	1,687	36,894
B: CART (MD 2013)	0	0	10,960	3,909	308	0	0	15,177
C: Input ceilings	2,675	2,773	7,360	3,600	2,020	1,601	1,687	21,717
D: Input 2014	2,582	2,483	18,072	3,543	2,208	1,516	1,460	
E: Input 2014 including uncertainty estimate	2,740	2,631	19,132	5,227	2,442	1,567	1,506	

F= (A-E) Achieved reduction related to ref. inputs MD2013	-65	142	-812	2,282	-114	34	181	
G: Revised reference inputs (PLC-6)	2,761	2,829	18,010	8,902	2,367	1,622	1,665	38,156
H: Changes in ref. inputs since MD2013	86	56	-310	1,393	39	21	-22	1,262
I = (G-E): Achieved reduction related to revised ref. inputs	21	198	-1,122	3,675	-75	55	159	
J = (E-C): Remaining reduction according to input ceilings	65	-142	11,772	1,626	421	-34	-181	

4 Changes in reference inputs

The inputs of nitrogen and phosphorus in the reference period is calculated as the average of normalized annual air- and waterborne net inputs during 1997-2003. The PLC-5.5 assessment data set was used to calculate the reference inputs for the Copenhagen Ministerial Declaration 2013 (MD2013).

For the latest assessment on progress towards CART Contracting Parties an updated data set for annual nitrogen and phosphorus inputs was established covering 1995-2014 – the PLC-6 data set. Data during 1997 to 2003 was also updated as seen by column A, G and H in tables 3 (section 3). Table 4.1 and 4.2 show the percentage changes between reference inputs MD2013 and the revised reference inputs.

Table 4.1. Change (in %) in the revised reference inputs of nitrogen as compared with the MD2013 reference inputs.

TN	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	25	26	22	29	25	3.9	40	18
DK	29	27	12	26	24	-1.9	0.8	1.9
EE	24	24	6.2	6.7	2	18	20	4.6
FI	3.3	3.2	17	3.5	16	13	16	3.7
LT	10	7.8	-7.4	21	8	18	30	-5.1
LV	29	28	18	37	-19	26	35	-14
PL	13	15	0.8	22	21	20	28	1.5
RU	24	28	13	9.1	106	23	33	13
SE	3.7	3.3	1.7	24	21	-1.3	1.1	2.2
BY			2.8		125			52
CZ			-9.3					-9.3
UA			-15					-15
BSS	44	32	27	35	29	21	34	29
OC	20	18	28	19	18	26	39	27
All	5.3	7.7	6.2	8.9	3.2	4.3	7.4	6.3

Table 4.2. As tables 4.1 but for phosphorus.

TP	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			-1.8			-0.9		-1.0
DK			31			2.5	-4.0	0.6

EE			0.0	7.7	1.8			5.5
FI	3.3	-0.3		3.8				2.2
LT			-4.7		49			-0.4
LV			28		59			51
PL			0					-0.3
RU			-25	22	-37			15
SE	3.6	5.2	-0.5			-1.9	1.4	2.6
BY			0.0		-38			-22
CZ			-9.5					-9.5
UA			-16					-16
BSS								
OC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All	3.2	2.0	-1.7	19	1.7	1.3	-1.3	3.4

As a result of the update of the input time series, the total reference input of nitrogen to the Baltic Sea increased with 6.3%, varying from and 3% for GUR to 9% for GUF. For the countries with significant airborne input the reference values grew even higher (table 4.1).

The reference inputs of phosphorus increased with 3.4% to the Baltic Sea mainly because of a 19% increase of the reference inputs to GUF primarily from Russia.

The growth of the reference values was caused by using more consistent and complete dataset compared to the PLC-5.5. The following updates of the data were made for the PLC-6 assessment:

- EMEP has changed models for calculation of atmospheric nitrogen deposition and Contracting Parties have re-reported the annual emission data used to calculate atmospheric deposition.
- Some contracting parties have re-reported old riverine input data partly or for the whole 1995-2014 period including updated/new emissions for point sources having inputs directly to the Baltic Sea. Some countries also have recalculated the estimated inputs for some unmonitored areas e.g. for Kaliningrad region (to BAP) and unmonitored areas to GUF.
- In the PLC-6 assessment annual nitrogen and phosphorus inputs are flow-normalized by river. For the MD2013 nitrogen and phosphorus input were aggregated per sub-basin before flow-normalization. This led to minor increases or decreases in the normalized riverine TN and TP inputs as compared with MD2013 inputs, and the revised method provides data that are more consistent.
- Extending the input time series with extra years will also slightly changes (increases or decreases) the normalized inputs in the complete time series as compared with MD2013 due to the normalization procedure.
- New validation and data gaps filling have been performed and some assumptions have been modified based on new knowledge and a longer time series

Modernization of the EMEP deposition model and updating of air emission increased the annual atmospheric inputs to the Baltic Sea with more than 52,000 tons TN in the reference period (23 %). In absolute values the growth was from approximately 227,000 tons TN in the MD2013 to nearly 280,000 tons TN in the current PLC-6 assessment. The increase of atmospheric deposition constitutes more than 90 % of the total increase (57,500 tons) of TN in the MD2013 reference inputs. The highest change of atmospheric inputs in the reference period to Kattegat (in average 27%) and lowest to the Danish Straits (13%). For Denmark, the atmospheric deposition only increased with 7% compare to MD2013 while for Latvia it is 31% (tables 4.3).

The changes in waterborne nitrogen inputs (in tons, table 4.4) are rather low besides for Russia to GUF where the increase is more than 5,700 tons TN (7.7 % or from 74,000 tons TN to 79,700 tons TN). This is primarily caused by reassessment of inputs from unmonitored areas. Transboundary inputs were revised due to new monitored data at the border which were used in the assessment instead of proportion-based estimation used in MD2013. Revision of retention values also effected time series (se section 5).

Table 4.3. Changes (in %) in total nitrogen deposition in the reference period compared with the corresponding MD2013 deposition.

TN (%)	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	25	26	30	29	25	11	40	27
DK	29	27	13	26	24	-8	4	7
EE	24	24	18	25	17	15	17	21
FI	23	21	17	23	16	14	17	20
LT	10	8	10	21	13	18	30	11
LV	30	28	31	37	29	25	35	31
PL	13	15	21	22	21	20	28	20
RU	24	28	31	29	29	23	33	30
SE	28	22	10	24	21	11	12	14
BSS	44	32	27	35	29	21	34	29
OC	20	18	28	19	18	26	39	27
All	23	21	25	24	21	13	27	23

Table 4.4. Changes (in tons) in total waterborne nitrogen inputs in the reference period compared with the corresponding MD2013 inputs.

TN (tons)	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	0	0	180	0	0	-72	0	108
DK	0	0	91	0	0	-128	12	-26
EE	0	0	-9	677	185	0	0	854
FI	747	427	0	757	0	0	0	1,931
LT	0	0	-2,502	0	0	0	0	-2,502
LV	0	0	1,000	0	521	0	0	1,521
PL	0	0	-3,865	0	0	0	0	-3,865
RU	0	0	355	5,728	0	0	0	6,083
SE	447	474	-156	0	0	-119	262	907
All	1,195	901	-4,906	7,161	706	-319	273	5,011

For phosphorus, changes in the reference inputs are caused only by revision of waterborne inputs. Atmospheric deposition of phosphorus remains unchanged and equal to 5 kg/km².

The largest relative changes of reference values for phosphorus inputs are from Denmark to BAP (increased 30% or from 59 tons TP to 77 tons TP). It was caused by revision of modelling and updating of point source emission data. Inputs from Russia to GUF increased with more than 21% due to revised modelled inputs from unmonitored areas – see table 4.5.

Some of the transboundary TP reference input values were also significantly changed due to new monitoring data.

Table 4.5. Change (%) in total waterborne phosphorus inputs in the reference period compared with the corresponding MD2013 inputs.

TP (%)	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			2.9			-0.7		0.5
DK			29.9			2.5	-4.0	0.6
EE			-0.1	7.7	1.9			5.5
FI	3.3	-0.3		3.6				2.1
LT			-2.4					-2.4
LV			17.5		1.7			3.6
PL			-1.0					-1.0
RU			-19.6	21.4				15.9
SE	3.6	5.3	-0.4			-2.1	1.3	2.6
All	3.4	2.3	-1.8	18.9	1.7	1.4	-1.4	3.6

5 Discussion – implications of change reference inputs

Consequences on MAI

The MAI were computed by finding the combination of nutrient inputs to the sub-basins that:

- i) ensure a development where environmental targets eventually are reached
- ii) minimize the reduction requirement.

This calculation is relatively insensitive to the reference inputs because the model was calibrated to reproduce the temporal development of the Baltic Sea eutrophication during the 20th Century and not for a static nutrient input situation. There could be an impact if the reference inputs to the basins without reduction requirements were significantly different:

- If they were higher potentially reduction requirements could be needed in those basins or additional reduction requirements could be needed in other basins.
- If they were lower less reduction requirements could be needed.

A rough view of these sensitivities can be analysed using available model results, but this has not been done. So far this has not been considered necessary as the changes in nutrient inputs in the reference period due to updated data – besides for GUF - is really modest to these basins (3-8% for TN and 1-3% for TP). *Conclusively, there are no reasons to reconsider MAI on the basis of new information of nutrient inputs.*

Consequences on the determination of CART and national input ceilings

The reference inputs were used in three ways in the calculation of CART:

- i) to distribute the input reductions between CPs (all CPs are to reduce in proportion to their share of the total CPs input to the basin)
- ii) to quantify the total needed reduction per basin
- iii) to estimate the expected reduction of nitrogen deposition from Baltic Sea shipping (80% reduction was assumed).

Separate data was provided by EMEP that gave the expected reductions from implementation of Gothenburg protocol relative to inputs 2005 and these were recalculated to be relative 1997-2003 by BNI.

As described above, the input ceiling is the difference between the reference net inputs and the CART from a given country to a given basin, and that ensures that the sum of all contributions will lead up to MAI when ceilings reached. For modest changes in the input data set, it is relevant to keep the nutrient input ceilings unchanged and evaluate progress according to these. However, at some point, there might be so much new information that the basis for the allocation was so off that an adjustment of CART and nutrient input ceiling is needed.

Adjustment of CARTs and nutrient input ceilings can be more or less complicated from a political perspective and we can identify a few cases that are relevant concerning the present PLC-6 assessment data set:

1. *New data on transboundary waterborne inputs:*

This case will be the most common since the basis for the sharing of inputs between countries contributing to a river catchment was quite uncertain in the PLC5.5. There is in fact a case in the present assessment, i.e. the contribution from countries upstream Latvia (Lithuania, Russia and Belarus), where new data is used which calls for an adjustment of the input ceilings. There is also new information on retention becoming available soon for other countries. Reallocation among contributing countries do not affect the total input to the basin, and hence do not affect the fulfilment of MAI. In addition, several countries have specific remarks in MD2013 on that they are aware that CART will change when new information on transboundary inputs become available.

2. *Updated time-series for a single country:*

Denmark has re-reported all waterborne inputs using new modelling for unmonitored areas and revised point source emissions, which made significant change, primarily on phosphorus inputs to Baltic proper. In addition, there are new reconstruction and information used for Russia in the earlier part of the data set that significantly changed their inputs to GUF (higher TP inputs) and BAP (lower TP inputs) compared to the PLC-5.5 data set. There are some minor changes for other countries as well. In the case of Denmark and BAP, the Danish contribution is so small that it would be possible to adjust the Danish CART only according to the new data without any other country being significantly affected. This is not the case with Russia to GUF, where the new reference inputs are about 1,300 tons TP higher, which significantly would change the overall needed reductions for the basin and consequently both Finland and Estonia would get larger reduction requirements as well.

3. *New data on atmospheric deposition:*

EMEP has reported significantly increased atmospheric nitrogen deposition for most country-basin combinations. Especially for the combinations where nitrogen deposition is the only source from a country, this leads to significant changes all the way through the time-series. Adjusting CART and nutrient input ceilings to this change will affect all countries and basins for nitrogen. However, in most cases, the magnitude of the change is small compared to riverine inputs and therefore the change in CART will be rather modest on land inputs.

4. *Basins without reduction requirement:*

If revising allocation, there need to be an agreement on how to treat that the reference inputs to the basins without reduction requirements change. One should be aware of that if one sticks to the MAI inputs following MD2013, there might be some small reduction requirements necessary for some country and basin combinations, although they will be small.

6 Summary and Recommendations

To meet the BSAP objective of a Baltic Sea unaffected by eutrophication, Contracting Parties need to reduce their nutrient inputs to the levels indicated by the Maximum Allowable Inputs (MAI) of each sub-basin. The MAI were calculated using a biogeochemical oceanographic model which described the response of the sea to more than a century of nutrient inputs, showing how eutrophication has developed as nutrient inputs increased. The same model was then run to find the smallest nutrient load reduction in each sub-basin necessary to meet the requirements of the BSAP for eutrophication. The MAI are independent of recent inputs and are overall unaffected by changes reported by the Contracting Parties during PLC-6 (see section 5).

Based on the MAI, the Country Allocated Reduction Targets (CART) were developed to share the burden of inputs reductions equally among Contracting Parties, proportional to their inputs during the reference period (1997-2003). Several Contracting Parties already had one or more basins where their inputs were already below the levels required to meet their share of the MAI. For these combinations of basin and Contracting Party, the CART as agreed at the Ministerial Meeting 2013 was zero. However, a CART of zero still requires the Contracting Party to maintain their nutrient inputs to that basin below the level of their share of MAI, otherwise MAI will be exceeded. Therefore, to follow Contracting Parties' respective progress towards the BSAP Objectives, Contracting Parties should follow-up progress relative to their respective net input ceilings in each basin, where the input ceiling is defined as their proportion of the MAI during the reference period.

The net input ceiling is the same as a Contracting Parties' original reference period input minus any CART country per basin, so is the direct result of the commitment made in the Ministerial Declaration. Using the net input ceilings allows Contracting Parties to monitor progress even in basins where they were not explicitly allocated a CART. In addition, net input ceilings are directly related to MAI and the objective of a Baltic Sea unaffected by eutrophication. Future follow-up of the HELCOM Nutrient Reduction Scheme agreed at the Ministerial Meeting 2013 should present Contracting Parties' progress towards their respective net input ceilings in each basin.

Work in PLC-6 project has led to improvements in establishing a comprehensive, consistent and updated data set for nutrient inputs country per basin to the Baltic Sea. Models quantifying atmospheric deposition, and waterborne inputs from unmonitored are and modelling nutrient retention have been further developed, estimates of nutrient flows across borders have been improved, and older data have been reassessed. This has led to changes in the estimated loads during the reference period. In addition, more recent data added to the time series have led to the relationships between flow and nutrient load being refined, which in turn further revises the estimates of net inputs during the reference period. These changes in nutrient inputs in the reference period inputs give no reason to reconsider MAI. They could however affect Contracting Parties input ceilings to each basin, as the proportion of the net inputs from each Contracting Party during the reference period has changed.

A future revision of the BSAP Nutrient Reduction Scheme should consider the most recent estimates of inputs during the reference period (1997 – 2003). Should significant changes in the distribution of net nutrient input among Contracting Parties be found, then it could be appropriate to revise the share of the net input ceilings to the basins as indicated in section 5.