PRESSURE

HELCOM work
on hazardous substances in the Baltic Sea

Baltic Marine Environment Protection Commission

Hazardous substances

BSEP n°182

helcom.fi

Published by:

Helsinki Commission – HELCOM
Katajanokanlaituri 6 B
00160 Helsinki, Finland

www.helcom.fi

This document is part of the flagship publication series of HELCOM, the Baltic Sea Environment Proceedings (BSEP) that have been running since the entry into force of the first Helsinki Convention in 1980. Although this document has been approved for publication by the members of the Helsinki Commission, views expressed in this publication are the authors' own and might vary from those of the Helsinki Commission or its members. Any maps that are featured in this publication are intended for illustration purposes only and do not necessarily designate the exact boundaries of sovereign states and entities.

For bibliographic purposes this document should be cited as:
"Background report on an update of HELCOM work on hazardous substances in the Baltic Sea. HELCOM (2021)"

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ISSN: 0357-2994

Contents

Overview of the existing HELCOM framework on hazardous substances

The here presented overview of HELCOM activities, links to other policy processes and organizations, data collection and analysis, and suggestions for additional holistic approaches to manage chemical threats is based mainly on HELCOM documentation. It highlights a number of weaknesses that should be addressed in order to modernize HELCOMs work with hazardous substances. Mainly there are two major issues that need to be addressed by HELCOM, as recognized in several HELCOM official documents:

1) HELCOM needs a mechanism to continuously update which substances to prioritize (selection and de-selection), including a systematic follow up of implemented measures and the result of these efforts in terms of reduced inputs and improved environmental status, and mechanisms for identifying substances of emerging concern that may need to be prioritized.

2) HELCOM needs to clarify its role in relation to other policies in the Baltic Sea region, in particular EU directives and regulations, and identify the added value of HELCOM activities.

Limited resources in HELCOM CPs make fulfilling legal requirements under EU and Russian directives and regulations prioritized. The role of HELCOM as coordinating implementation of MSFD has dictated much HELCOM work in recent years. However, substances agreed by CPs to be prioritized under MSFD are in many cases global pollutants with most (economically feasible) local or regional emission reduction measures already exhausted. For management of this type of hazardous substances, EU-wide or global cooperation is often required, hence the relevance of HELCOM is in many cases limited for the MSFD indicator substances selected and agreed by the CPs. Although legacy pollutants are still a major problem in the Baltic Sea, focusing on such substances in a way hinders development of chemicals management with a stronger regional relevance. HELCOM, as well as the EU, is already moving in the direction to e.g. broad scope monitoring of chemicals and effects, and HELCOM has adopted several broad measures addressing human activities in addition to specific substances, e.g. waste handling or influence consumer behavior. The overview presented here is intended to facilitate discussions of how to modernize the HELCOM strategy for hazardous substances.

1. Background

The Helsinki Convention was agreed and signed in 1974 by Denmark, the Federal Republic of Germany (FRG), Finland, the German Democratic Republic (GDR), Poland, the Soviet Union, and Sweden in response documented severe environmental problems observed in the Baltic Sea during the 1970s, in particular related to toxic pollutants, at the time described by ICES as the main threat to the Baltic. Management of hazardous substances and other environmental problems during this time was scattered [1], [2]. Focus in environmental law was mainly on industries and point sources, and measures were stipulated on a "polluter-oriented perspective" basis, meaning management actions were a compromise between technological options and the economic situation of the polluter vs environmental objectives [3]. The Helsinki Convention was re-negotiated in 1992 in conjunction with the breakup of the Soviet Union and the reunification of Germany. The new Convention entered into force in 2000. Since then, society has gone through considerable changes with increased knowledge and awareness of risks associated with chemicals, and a more developed chemicals regulation [4] (Figure 1). Many hazardous substances have been identified and regulated. At the same time, the use of chemicals, irrespective of being counted in number of individual substances, absolute volume produced or use per capita, has increased over time. Trade and production of chemicals have become increasingly globalized. Banned substances have been substituted by other, often less studied, chemicals, as the need for their beneficial functions (to enhance materials, protect human health, combat pests, facilitate industrial processes etc.) remain. It is widely acknowledged that the single-chemical approach in risk management is insufficient, and the way forward to speed up risk assessments e.g. by grouping of chemicals and wide-scope methods to track chemicals in the environment and their adverse effects has been discussed for several years. Since 2004, eight of nine HELCOM countries are also EU member states. Chemicals regulations are largely harmonized at EU level. The need for cooperation looks different compared to the time when the Convention was negotiated. HELCOM discussions commonly return to the issue of providing added value compared to EU and other actors in the region.

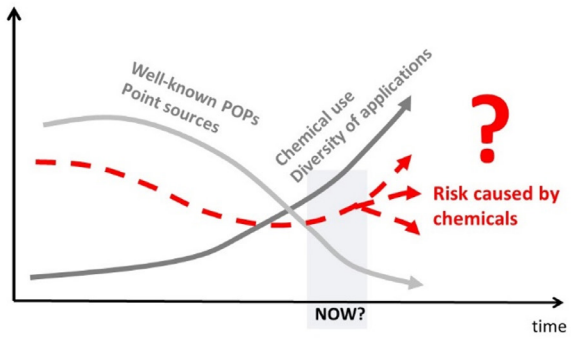

Figure 1. Emissions of well-known persistent organic pollutants (POPs) have decreased over time, whereas modern chemical use and diversity of applications increase, and with that potential risk caused by chemicals. Figure from Sobek and Undeman 2019 "Tunnel vision in current chemicals management cannot deal with the unknown risk of synthetic chemicals in aquatic systems".

1.1. Summary of Actions in the Helsinki Convention

A summary of existing HELCOM Actions, Recommendations and activities addressing hazardous substances is provided in the following, a more detailed description is presented in the Annex.

The Helsinki Convention (hereafter the Convention) focuses on industrial emissions, oil spills and dumping of dredged materials, and regional cooperation regarding technical solutions, research and monitoring:

- The Convention states that (industrial) *emissions should be quantified* (by national authorities) and emission limits defined, with a focus on in particular PCB, DDT, PCT but also a number of other substances groups. The task of the Commission is to define pollution control criteria, objectives for reduction of pollution and measures.
- Another focus of the Convention is *oils spills* (should be prevented, surveyed and mitigated) and dumping of dredged materials (only permitted if levels of listed priority substances are not significant, and the practice should be recorded).
- Finally, *technical and research cooperation* (between CPs, and also with other organizations) for assessments of pollution, pathways, exposures, risks and remedies, as well as cooperation to develop *joint monitoring* methods and programs shall be established and outlined by the Commission.

Since the Convention was signed in 1974, the geopolitical situation has changed with the fragmentation of the Soviet Union and expansion of the EU, thereby also changing the type of regional cooperation needed. The Ministerial meeting in Bremen 2003 noted that HELCOM work after 2004, when 8 of 9 Contracting states were EU members, should focus on activities *that bring added value.* The objective of EU directives WFD (year 2000) and MSFD (2009) overlaps with HELCOM objectives, and the Ministerial meeting in Krakow 2007 decided to establish HELCOM as coordinating platform for implementation of the MSFD.

1.2. Summary of Actions in the Baltic Sea Action Plan and Ministerial Declarations

In 2007, the BSAP was decided with the aim to *"achieve a Baltic Sea in Good Environmental Status by 2021"* with *"a Baltic Sea with life undisturbed by hazardous substances"* and to evaluate the progress towards this goal using indicators (specific substances and wild life health).

The hazardous substances section of the BSAP consists of actions of various types, which are more or less specific. In the Ministerial Declarations in 2010, 2013 and 2018 a number of additional actions and Recommendations have been presented and adopted.

The actions address:

- *specific substances/substance groups* (e.g. Hg, pharmaceuticals) or
- *human activities* (e.g. landfills, iron steel industry, use of consumer products), land based or sea based, that lead to emissions of
  - specific substances (e.g. dioxins and other combustion by-products from small scale combustion) or
  - chemicals in general (e.g. a wide range of chemicals can be emitted from landfills).

The actions also address

- *different stages in the chemical life cycle/chemicals management chain* (e.g. emissions during production, use, and waste phase; transport, transformation and secondary emissions in the environment; presence and effects in the marine environment) and
- are taken at different *geographical scale* (local, national, regional, global).

The actions can aim to

- *identify hazardous substances* (which chemicals should be prioritized for further action),
- *identify efficient measures* (which sources should be targeted),
- or be to *implement an already identified measure* (e.g. ban/restrict substances, change consumer behaviour to reduce use/emissions, end-of-pipe measures in industry or waste treatment).

All the actions agreed in BSAP and the MDs of these different types can also be roughly categorized as (Figure 2):

- Investigative actions – development of new knowledge that can in a next step lead to development of a concrete measure
- Development of monitoring and assessment strategies
- Limitation of production and use of hazardous chemicals – development or implementation of regulations and limits or promotion of sustainable use
- End-of-pipe actions – limit emissions from human activities by technical guidance
- Implementation of international directives, conventions and cooperation
- Offshore activities and marine traffic – of different kinds, focus of oil spills and exhausts
- Development of National and HELCOM overarching plans

1.3. National and HELCOM overarching plans

Two actions in the BSAP take a broad perspective and aim:

1) to outline the strategy for Contracting Party governments to use in the work to reach the HELCOM objective regarding hazardous substances and which substances to focus on ("Update of requirements of HELCOM Strategy for hazardous substances in Recommendation 19/5")

The **strategy Recommendation 19/5** has been updated (an action of the BSAP) and is now superseded by **Recommendation 31E/1 Implementing HELCOM's objective for hazardous substances.** It re-iterates fundamental principles from the HELCOM Convention (the precautionary principle; the polluter pays principle; best available technology and best environmental practice) and gives the following main recommendations:

- Focus on listed priority substances (11 substances/substance groups), and principles how to update the list: **hazardous properties** as specified by GHS Globally Harmonized System of classification and labelling of chemicals and **observed presence/potential for occurrence** in the Baltic Sea.
- Substances listed in the 1992 Convention, Stockholm convention and LRTAP will be (continuously) phased out, and not substituted by equally hazardous substances
- Contracting Parties are expected to inform the Commission about hazardous substances present in the Baltic Sea and cooperate to establish relevant background/reference values, monitoring data or risk assessments.
- The Commission will coordinate work to identify sources and transport pathways in order to identify relevant measures at the appropriate geographical and administrative level.
- The Commission will carry out dialogue with stakeholders to secure information, specifically mentioned is cooperation with industry.

2) for all CPs to develop national implementation programs (National programmes to reduce pollution by hazardous substances).

- The **National programmes** to reduce pollution by hazardous substances should focus on the HELCOM priority substances, identify their sources and restrict the use of these. The nations shall also enable authorities and industry to identify new hazardous substances, manage these and apply BAT/BEP to reduce industrial emissions. The HELCOM priority substances shall be taken into account in environmental permitting. In addition, raising consumer awareness and information exchange with ECHA is specifically mentioned.

Figure 2. Overview of previous and current HELCOM actions presented in the BSAP and subsequent Ministerial Declarations (2010, 2013, 2018). Colours indicate outcome of follow up activities (as performed in connection to MD 2013 or MD 2018): Blue = completed, yellow = ongoing, red = not completed, black = no follow up possible. Some Actions have been suggested for inclusion in the updated BSAP, rephrased or not rephrased.

1.4. Summary on Recommendations

Listing of Recommendations addressing hazardous substances varies in different HELCOM documents, sometimes separating Recommendations addressing offshore activities and maritime traffic from those addressing hazardous substances originating from land-based sources, and sometimes making the division depending on which working group that is responsible for the Recommendations. The evaluation of Recommendations prior to the MD 2018 divided the Recommendations in three categories:

— Reducing the input of hazardous substances
— Prevention of accidental pollution from ships
— Response to pollution incidents

Focusing here on category 1, the fourteen Recommendations issued before 2007 target mainly industrial metal emissions: emissions from industries working with fertilizers, metals, textiles, pulp/paper, glass, and also specifically mercury from dentistry and light sources & electrical equipment. There is also a recommendation on elimination of PCBs and PCTs (polychlorinated terphenyls). The Recommendations issued after 2007 also target specific point sources: dioxins and metals emitted from small-scale combustion and crematoria, metals in batteries & accumulators and also cadmium in fertilizers. Recommendation 31E/1 Implementing HELCOM's objective for hazardous substances is however broader and make the recommendation to take certain principles and methodologies into account in national legislation. There are also Recommendations that do not specifically mention hazardous substances, but will indirectly lead to reduced inputs, e.g. Recommendations regarding management of landfills, treatment in municipal WWPs, agricultural practices.

1.5. Comment

The HELCOM Actions and Recommendations constitute a mixture of concrete but narrow actions such as conducting screening campaigns for the priority substances or investigate possibilities for Cd limits in fertilizers, and broad but generally formulated actions, e.g. ambition to develop the National Implementation Programmes. The format of the BSAP makes it difficult to get the overview of which aspects of marine chemicals management that HELCOM Actions actually covers. Focus however appears to be on industrial emissions of metals and combustion products (dioxins), pharmaceuticals and implementation of international legislation/conventions regarding POPs, in particular legacy POPs which are also listed as HELCOM priority substances (the 11 substances/groups in the BSAP).

The HELCOM Recommendation 31E/1 regarding the Strategy for hazardous substances is broadly enough formulated to cover practically all elements of chemicals risk assessment and management. This strategy overlaps largely with EU principles and methodologies for risk assessment. It builds on the one-by-one assessment of chemicals, and relies on the ability to identify hazardous substances either by hazard criteria used in the EU, or by observing chemicals that have already entered the Baltic Sea in significant amounts.

Looking into the Recommendations adopted by HELCOM and the overlap with EU and Russian legislation, it can be assumed that the function of the Recommendations (as well as HELCOM) has changed over time. Previously, many CPs were not EU members, and recommending to follow specific aspects of EU legislation with relevance to the Baltic Sea was motivated as it brought added value for the region. Also, in the years prior to 2004 the Baltic States and Poland were aspiring EU-members and had an interest in aligning national legislation with EU. Since then, when Russia is the only non-EU Member State CP, recommendations overlapping with EU directives and BREFs are of relevance to harmonize with Russia. The evaluation of Recommendations against EU and Russian legislation also shows that some Recommendations have a slightly wider scope than the corresponding EU directive (i.e. including small industries in emission limits) or have stricter thresholds (few cases), and these are under consideration for updating. It can be noted that very few Recommendations with relevance to hazardous substances have been issued during the last decade. They rather address broader issues than emissions of specific hazardous substances, and make recommendations regarding handling of waste streams (31E-4 Proper handling of waste/landfilling, 38-1Sewage sludge handling, 36-2 Management of dredged material) such as following HELCOM guidelines and manuals. This mirrors the need for different Recommendations that bring added value in relation to EU legislation, e.g. leads to use of joint technical guidance, joint collection and analysis of data (recommendations that demand reporting of data, e.g. sludge recommendation).

A number of weaknesses can be identified when looking at the HELCOM Actions and Recommendations altogether, several of which are currently under discussion in HELCOM, however without an Action or Recommendation addressing these gaps yet agreed:

— It is not clear what is the added value of many Actions and Recommendations compared to EU directives and Russian law, or international conventions to which all HELCOM CPs are signatories, e.g. if other agreements are partially or fully duplicated, or if the Action/Recommendation is to implement existing agreements in other fora.
— It is not clear what effect is expected from fulfilling Actions and Recommendations, e.g. it is not stated if addressed sources are dominant, or at which scale (spatial, temporal) effects are expected etc.
— There is no clear mechanism for follow up of completed Actions, e.g. make conclusions from completed projects and plan for next steps, or provide motivation for dropping an issue. Results of projects are presented at WG meetings, but clear conclusions and decisions are commonly lacking. This results in "loose ends" left in many cases. Follow up of Actions and Recommendations is difficult as it is not clearly defined what is required to consider them completed.
    ○ Actions and Recommendations should be complemented with this information
    ○ It should be stated when formulating an Action or Recommendation how to follow up, e.g. criteria for considering it implemented, a plan for utilizing the results.
— It is stated in e.g. BSAP and Rec 31E/1 which substances to prioritize, yet work is ongoing only for a subset of these

substances[1]. There is no mechanism for regular updating of the priority list (selection and deselection), although this is required in e.g. Rec 31E/1.

- This means that there is no systematic HELCOM work to identify emerging chemical threats (specific for the Baltic Sea region).
- This also means that HELCOM work tends to take a narrow perspective in chemicals management; consideration and management of unknown and unexpected impacts is not built into the strategy. The inability of society to identify all hazardous substances, or their combined effects, is not clearly acknowledged and HELCOM is not working with "early warnings" [5] or pro-active and precautionary measures. Note that the MD Brussels 2018 (Paragraph 35) agreed "to identify the scale of problems of contaminants of emerging concern".
    - A mechanism should be developed for selecting/deselecting priority substances
    - Assessments beyond identified priority substances should be elaborated (e.g. non target/suspect screening, effect based monitoring) and activities to identify not yet addressed hazardous substances and sources of chemical mixtures (with unknown composition) with adverse effects developed
    - Pro-active and precautionary measures should be developed
- General principles for environmental/chemicals management also embraced by EU and other organs are mentioned but concrete actions to follow these principles are lacking.

1 HELCOM work is much focused on somehow prioritized substances. The Convention in 1992 lists DDT, PCBs and PBT in Annex I, but also a broad range of substance groups "noxious substances and materials" for which CPs shall take all appropriate measures against. The now superseded Recommendation 19/5 lists 280 hazardous substances of potential concern, of which 36 were later targeted for cessation. The Strategy in Rec 31E/1 from 2010 however states that focus shall be on Helsinki Convention, 1992, Annex I, Parts 2 and 3 (i.e. PCBs and PCTs), POPs and metals listed under the Stockholm Convention and CLRTAP, and the HELCOM List of Prioritized substances (11 substances/groups of substances, Appendix II of Rec 31E/1). In the process of developing Core Indicators, which are to be used for implementation of MSFD, the list of substances was however changed to (i.e. excluding PFOA, nonyl- and octyl phenols and ethoxylates, chlorinated paraffins and endosulfan): TBT and imposex, HBCDD, PBDEs, Benzo(a) pyrene, PAH (Anthracene, Fluoranthene), Non-dioxin like PCBs and Dioxins and dioxin-like PCBs, PFOS, Metals (Mercury, Cadmium, Lead), Cesium-137. In addition, diclofenac was introduced as a test indicator in the 2018 assessment.

2. Activities of HELCOM groups and networks

The two HELCOM working groups mainly addressing hazardous substances in the Baltic Sea are Pressure (inputs from diffuse and point sources on land) and State&Conservation (monitoring, indicators, assessments). The Maritime group addresses issues related to maritime traffic (shipping), i.e. anti-fouling systems, scrubbers, washing of cargo tanks and transportation of chemicals, mainly from a regulatory perspective. The Response group works with maritime traffic and pollution incidents (oil and chemicals). The Group on the Implementation of the Ecosystem Approach (GEAR) coordinates the implementation of MSFD for CPs that are EU members, and ensures coordination with the Maritime Doctrine of the Russian Federation.

2.1. Activities of Pressure WG and sub-groups

The Work plan for the Pressure Working Group 2019-2020 gives an overview of continuous and temporary activities[1].

The continuous activities address the following topics:

- Compilation and reporting of **waterborne inputs** of metals and EMEP atmospheric deposition estimations (PLC)
- Follow up on **sludge recommendation** and discuss limit values for hazardous substances
- Work with State&Conservation on **indicators** (loads, pathways, sources) and follow up on development of national/international legislation and conventions
- Identification of contaminants of emerging concern
- **Pharmaceuticals**
- Emissions from **off-shore sources**
- Consider **policy proposals** from PA Hazards (pharmaceuticals, PFAS)
- Deleting **hot spots** from JCP list and identify issues related to point sources
- Information on **climate change** and multiple stressors
- Regular **reporting implementation** of BSAP and Recommendations

Temporary projects during 2019-2020 address:

- Discussion of adverse environmental effects of **sludge** utilization,
- Assessment of **micropollutants in effluents** and removal technologies,
- Revision of strategy to implement **HELCOM Objective for hazardous substances** for the BSAP update,
- Develop suggestions for preparedness to respond to **climate change.**

2.2. Activities of State and Conservation WG and sub-groups

State and Conservation Working Group activities that are continuous (some of them recently started) relates to monitoring and collection of data on prioritized human activities and pressures, follow up of Recommendations (regarding assessments and indicators), develop indicators, link indicators with loads and sources, make hazardous substances assessment system operational. It is also a continuous activity to identify areas of further cooperation with OSPAR and EU technical groups related to MSFD descriptors.
More or less temporary activities in 2019-2020 include assessing cost-efficiency of joint monitoring, review if monitoring should be developed to enable follow-up of implementation and effect of BSAP measures, support to the process of updating BSAP, review of currently used core indicator, and review of data flows for each indicator suggesting how to improve these, planning the next HOLAS assessment, produce fact sheet on climate change and interactions with other stressors.

Several continuous and temporary activities of State&Conservation hence address topics discussed in this report, e.g. improving data flows and linking state in the sea with human activities/sources, development of assessment tools and improved cooperation with OSPAR and EU technical working groups.

2.3. Comment

Pressure and State and Conservation WGs have carried out an evaluation of their function, role and needs presented in 2018[2]. This evaluation highlighted the need for greater cooperation between State&Conservation and Pressure WGs, and clarity between each other. Subjects of potential interest related to hazardous substances included:

- Lack of link between issues related to the state of the marine

1 https://helcom.fi/wp-content/uploads/2019/10/Work-Plan-for-the-Pressure-Working-Group-2019-2020.pdf

2 https://portal.helcom.fi/meetings/PRESSURE%209-2018-548/MeetingDocuments/7-2%20Discussion%20document%20for%20future%20work%20on%20hazardous%20substances.pdf

environment, sources and loads.
- Improved alignment with policy initiatives (e.g. the Baltic Sea Action Plan (BSAP), pressure descriptors of the EU MSFD (MSFD)) would recreate the link between loads and status.
- Evaluation of effectiveness of implemented measures and enacting new joint action to mitigate contamination of the marine environment.
- Identification of emerging pollutants and prevention their harmful effect to the ecosystem.
- Possibility of regular and joint thematic workshops to improve common focus and communication between the two WGs. Clear and focussed discussion on specific topics.
- Increase connectivity between the WGs by merging efforts in some underlying expert networks to ensure status and loads are considered.
- Common discussion between the WGs on pressures and state, and the linkages between these.
- Reporting by expert groups to both PRESSURE and State&-Conservation WGs.

Several of these gaps are also addressed in the subsequent working plans of State&Conservation and Pressure WGs, however in many cases these activities are ongoing and results and conclusions are not finalized.

3. HELCOM in the regional policy landscape

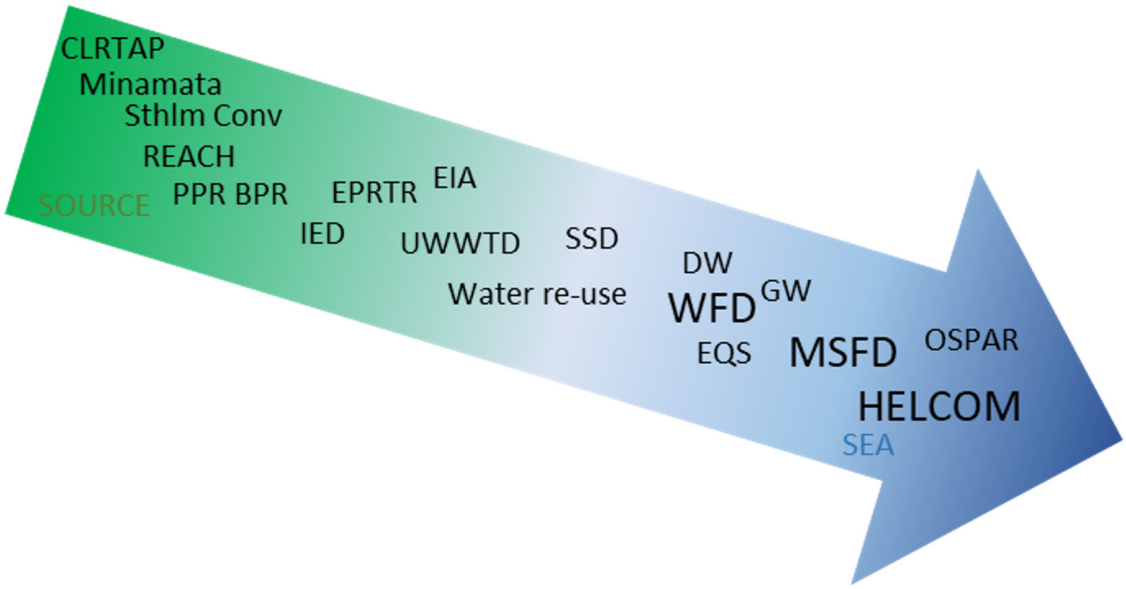

Figure 3. Overview of main EU regulations, directives and international conventions of relevance to hazardous substances in the Baltic Sea.

A multitude of EU level directives and regulations, together with national legislation in HELCOM CPs[1], directly or indirectly regulate production, use and emissions of chemicals in the Baltic Sea region. These are accompanied by international voluntary agreements focusing e.g. on management and monitoring of specific chemical pollutants, trade of chemicals and hazardous waste or cooperation in regional sea conventions. The main international policies of relevance for HELCOM are listed in Figure 3. Several actors/bodies are responsible for implementing these policies or are stakeholders in the policy processes.

REACH Registration, Evaluation, Authorisation and Restriction of Chemicals (EC) No 1907/2006
PPR Plant Protection Products Regulation (EC) No 1107/2009
BPR Biocidal Products Regulation (EU) 528/2012)
Minamata Convention on mercury
CLRTAP Convention on long-range Transboundary Air Pollution
Sthlm conv Stockholm Convention on POPs
EIA Environmental Impact Assessment 85/337/EEC
IED Industrial Emissions Directive 2010/75/EU
EPRTR European Pollutant Release and Transfer Register
UWWTD Urban Waste Water Directive 91/271/EEC
SSD Sewage Sludge Directive 86/278/EEC
Water re-use regulation (proposal) minimum requirements for water reuse 2018/0169 (COD)
WFD Water Framework Directive 2000/60/EC
DW Drinking Water Directive Council Directive 98/83/EC
GW Groundwater Directive 2006/118/EC
EQS Environmental Quality Standard Directive 2008/105/EC
MSFD Marine Strategy Framework Directive 2008/56/EC
HELCOM Helsinki Convention
OSPAR Oslo Paris Convention

1 Some information regarding Russian national legislation addressing hazardous substances can be found here: Overview of Russian chemicals and water management by UBA from 2010 https://www.umweltbundesamt.de/sites/default/files/capchemru_chemmgmntru_final.pdf . Report on development of "Eurasia REACH by Dieter Drohmann, and Dominik Kirf. "Chemical Inventory in the Eurasian Economic Union." ICRL – International Chemical Regulatory and Law Review, vol. 2020, no. 1, 2020, p. 43–50. HeinOnline. https://heinonline.org/HOL/Page?handle=hein.journals/icrl2020&div=10&g_sent=1&casa_token=&collection=journals, Information regarding transition of the Russian industry to compliance with Best Available Techniques (BAT) concept https://eipc.center/en/bat/?code=12

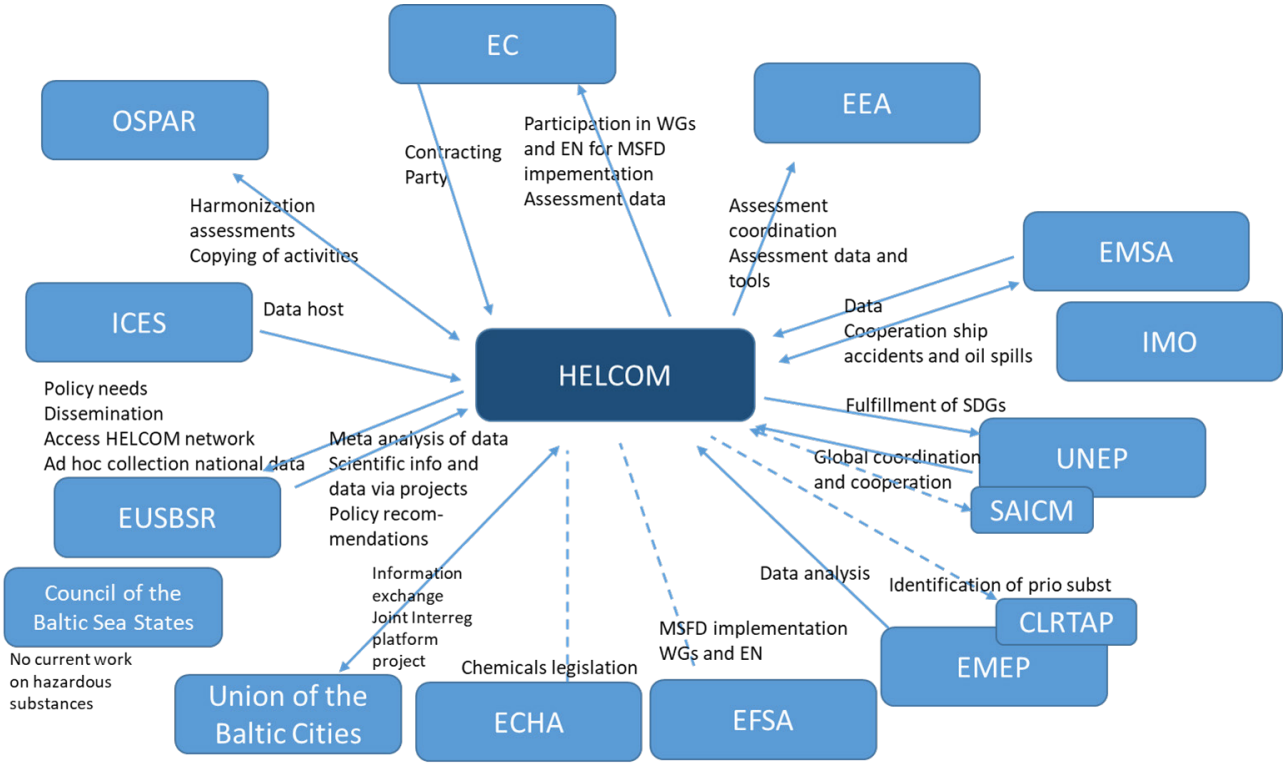

Figure 4. Links between HELCOM and other institutions, and type of information exchange / function of links.

3.1. Current cooperation between HELCOM and other institutions

The original HELCOM Convention states that "the Commission shall seek cooperation with other relevant organisations". The BSAP and subsequent MDs as well as high level HELCOM meetings[2] generally reiterate that developing cooperation and find synergies to use limited resources efficiently is a priority. HELCOM cooperates accordingly with a number of institutions, both regionally, at EU-level and globally. The role of HELCOM and nature of cooperation varies, a detailed overview is given in the Annex.

HELCOM has links to several actors in the Baltic Sea region. The interactions range from practical cooperation regarding data collection and analysis, coordination of MSFD implementation, joint projects to information exchange and alignment of policy goals. A number of possible key-functions of HELCOM can be discerned:

- **Knowledge exchange platform:** sharing of national experiences e.g. efficiency of various measures, identification of problematic chemicals etc. with relevance for the Baltic Sea.
- **Organ for synthesis and analysis of data:** Joint compilation and mapping of data (input (emissions, transport), status), analysis of monitoring data at the Baltic Sea scale. Geographical, temporal differences/similarities. Identification of major sources and pathways. Added value of data generated under other directives, or HELCOM.
- **Forerunner, arena for policy development:** Identification of new threats, development of joint action plans, new assessment methodologies, joint projects e.g. screening campaigns, regional emission inventories, development of new assessment methods. Coordinated influence of other policies.
- **Coordinating organ for MSFD:** Harmonization of assessments, knowledge exchange. Selection of indicators, thresholds, monitoring guidelines tailored for Baltic Sea conditions
- **Coordinating organ for other EU directives:** Harmonization of assessments, knowledge exchange etc.

It is clear from the analysis of dataflows in HELCOM (see section on this topic) that continuous data collection in the CPs is governed by

2 The 38th meeting of the Baltic Marine Environment Protection Commission (HELCOM) discussed, in the context of fulfilling the ocean-related SDG goals by 2030 and with particular focus on eutrophication, marine litter and climate change, the issue of how HELCOM should "enhance cooperation to reach effective results and which partnerships should be strengthened". This meeting suggested to engage other regional organizations, specifically mentioning Council of the Baltic Sea States, and use the potential of the existing initiatives within the Baltic Sea region such as the EU Strategy for the Baltic Sea Region for enhanced cooperation and coordination for strengthened BSAP implementation. The meeting suggested also the need to identify how to enhance cooperation with regional organizations also outside the Baltic Sea region, especially OSPAR and other regional seas organisations and the Arctic Council. Another point made was to continue the concrete cooperation on HELCOM hot spots, with the aim to eliminate the remaining hot spots, including further joint efforts to remedy the Krasnyi Bor toxic waste landfill with the involvement of NEFCO and other partners. https://portal.helcom.fi/meetings/HELCOM%2038-2017-401/MeetingDocuments/Outcome%20of%20HELCOM%2038-2017.pdf

requirements in EU directives or national legislation. HELCOM coordinates the implementation of MSFD and provides a forum mainly for harmonization of the status assessment (selection of indicators, thresholds, assessment methods). The HOLAS assessments can be used directly by CPs for reporting under MSFD, although it is not assessed in this report to what extent the CPs do their own data analysis (comparisons to thresholds, temporal trends) in addition to that performed by HELCOM+OSPAR+ICES, or use thresholds other than those agreed for HOLAS (although thresholds used in HOLAS are in general EQS for priority substances from the EQS directive, as no indicator is agreed for the Baltic Sea that is not already a priority substances under WFD). However, the joint assessment presented in HOLAS provides a broader picture than the sum of individual CP's MSFD reports. The HOLAS projects and related processes (e.g. HELCOM workshops on topics such as indicators or effect based monitoring) provide a mechanism for developing indicators (methods, new indicators etc.) and present progress of this aspect e.g. by applying test-indicators and evaluation of status in secondary matrices. This enables comparisons between countries and basins.

The role of HELCOM for implementing other aspects of MSFD is less well developed. All EU MS are required to perform a pressure analysis, i.e. identify sources of indicator substances. This enables development of Programs of Measures (PoMs) as also required under MSFD. EU implementation reports indicate that no EU MS quantify sources or assess the efficiency of suggested measures in the PoMs in terms of expected emission reductions [6]. HELCOM has previously cooperated with the Interreg BSR project COHIBA (2010-2012). This project performed a substance flow analysis for the 11 substances prioritized by HELCOM and suggested a "Palette of measures" that CPs could adopt in their national work. More recent efforts include temporary projects and input assessments by the PLC projects. HELCOM could expand the cooperation in implementing MSFD to include also pressure analysis. Local sources such as contaminated sediments or coastal point sources may be important for elevated levels of hazardous substances in limited areas (e.g. coastal zones), but of less importance for the total input the Baltic Sea for which other sources may dominate. HELCOM can provide a platform for information exchange regarding local sources that may be relevant in several CPs (rise awareness, data exchange), and also facilitate large scale pressure analysis. HELCOM has good experience of such joint entire Baltic Sea scale assessment regarding nutrient inputs, however it can be noted that this work has received financial support via the funding of the Baltic Nest Institute. Another important and well-known point to re-iterate is that the substances selected as indicators under MSFD are to a large extent legacy pollutants, banned since many years, for which it is difficult to suggest new measures. The reasons to monitor/quantify inputs and levels in marine matrices should then be clearly stated (e.g. value of tracking temporal trends, surveillance). This also calls for efforts to evaluate implementation of measures already in place, better assessments of input via long range transport and possibilities to facilitate EU-level or global cooperation (in addition to what is accomplished by individual CPs in these fora). The role for HELCOM in MSFD implementation is hence partly dictated by type of indicator substances selected (e.g. for which local sources are more prominent), and may change over time as new substances are agreed as indicators or when new types of indicators are developed (e.g. effect-based indicators, surveillance indicators).

HELCOM interaction with various EU organs for use of data on chemical properties and use has been proposed in BSAP, MDs and meetings. These links are however commonly not in place, and possibilities for utilizing data produced under EU directives and the purpose of this data exchange is not extensively discussed in HELCOM.

The Interreg BSR project HAZBREF has however recently investigated interfaces between HELCOM and the EU BAT-process, i.e. part of the exchange of information carried out in the framework of Article 13(1) of the Industrial Emissions Directive (IED, 2010/75/EU) [3]. Such a link is currently not in place. The gap identified by HAZBREF is that BREFs do not contain sufficient information on specific hazardous substances, chemicals management and abatement measures to guide permitting/supervising authorities or industries [7]. HAZBREF however finds that data collected under HELCOM Recommendations or the PLC projects is not useful in elaboration of IED BREFs regarding technical development or relevance of specific substances for various industry sectors, and that Core Indicator monitoring does not bring added value to the IED. HELCOM cannot contribute detailed information on sources of various hazardous substances, although temporary monitoring/screening campaigns can provide useful information depending on the theme of the campaign. HAZBREF proposes two ways for HELCOM to contribute to the BREF process:

— The HELCOM assessments on the status and input of specific relevant hazardous substances to the Baltic Sea could in some case be used as justification to include substances as Key Environmental Issues (KEIs) in the preparation of the BREF documents for the different sectors.
— The information relevant for IED purposes could be identified by the HELCOM Pressure Group when HELCOM assessments are published. The HELCOM secretariat could send the relevant information directly to the EIPPCB. Alternatively, information could be fed into the BREF process through national TWG members taking part in the BREF processes.

It can be noted that HELCOM Recommendation 31E/1 in fact suggests that "The Commission and the Contracting Parties will invite and encourage industry to co-operate in fulfilling the Objective of HELCOM with regard to hazardous substances /… / to provide reliable data on production volumes, use patterns, emission scenarios, exposure concentrations and properties of substances." If this action is implemented, HELCOM could contribute more to filling the information gap identified by HAZBREF.

HELCOM work could in turn benefit from the BAT-process and utilize data in the EU BREFs:

— By regularly updating the HELCOM recommendation "25/2 Reduction of emissions and discharges from industry by effective use of BAT" with information on relevant substances for the different industrial sectors by utilizing data collected and produced in the IED BREF process. The information on specific substances could be combined with possible information of concern from Baltic Sea point of view from HELCOM assessments and pollution compilations. In practice, a regular point to the HELCOM PRESSURE meeting agenda reminding on the need to look at recently published BREFs/ BAT conclusions could be introduced.

3 https://portal.helcom.fi/meetings/PRESSURE%2011-2019-628/MeetingDocuments/6-2%20Improved%20exchange%20and%20utilization%20of%20data%20on%20hazardous%20substances%20between%20EU%20legal%20frameworks%20and%20HELCOM.pdf

— To update the list of HELCOM priority hazardous substances, i.e. identify indicators of relevance to the Baltic Sea region industrial sector
— To identify efficient measures to reduce input of substances emitted from industries, both joint actions and national actions in the National Implementation Programs (of the BSAP).

In addition, the HAZBREF project assessed interfaces, links or gaps between the BREFs and different pieces of EU-legislations, which are in many cases applicable also to HELCOM. Data in REACH dossiers submitted to ECHA could potentially be used to identify hazardous substances. However, in practice this is not straightforward. The usefulness of registration dossier data has been the topic for many scientific studies, and a commonly observed hurdle is that production/use volume data is not specific enough (i.e. tonnage bands are wide) and emissions to various environmental compartments from different use categories cannot be estimated with sufficient accuracy. Also, the use descriptions might be so general, that detailed knowledge on the uses and possible sources of substances cannot be determined. The uncertainty in such emission estimations prevents meaningful ranking. Production and use data are in addition not specific for the Baltic Sea region, making the data less useful for identification of hazardous substances of relevance particularly for the Baltic Sea region. The practical way to use REACH data in HELCOM work hence has to be further investigated. Note also that HELCOM already utilizes data from E-PRTR via EMEP (see section on this topic).

HAZBREF also concludes that WFD can provide information on already prioritised substances and EQS (which are indeed already utilized in HELCOM and MSFD), but also on substances on the WatchList and river basin specific pollutants, i.e. indication of substances that are present in too high levels in inland surface water / estuaries, which could be of relevance also to HELCOM (supporting selection/deselection of priority substances). WFD could also provide use information (sources, input pathways), but in general the pressure-analysis as required under this directive is not conducted by EU MS, and in cases where pressure analysis is conducted e.g. using default emissions from various activity sectors and/or extrapolation, the accuracy of the results is uncertain. However, if these assessments are improved this information would be of value to HELCOM development of measures.

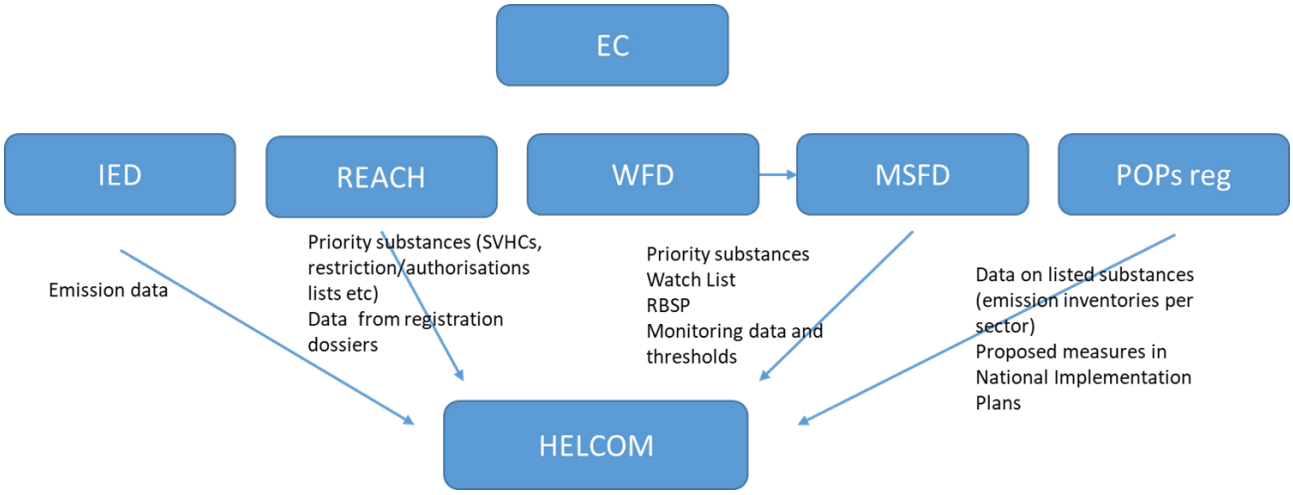

Figure 5. Information flows from EU legislations of use to HELCOM, adapted from the Interreg BSR HAZBREF project[4].

4 https://www.syke.fi/en-US/Research__Development/Research_and_development_projects/Projects/Hazardous_industrial_chemicals_in_the_IED_BREFs_HAZBREF/Work_packages/Policy_improvement_WP3

4. Analysis of HELCOM monitoring, assessments and data flows

A key function of the HELCOM cooperation is to collect and assess various types of data that support management of the Baltic Sea. For example, HELCOM has had an important role in collecting data that enables estimations of nutrient loads to the Baltic Sea, and determination of country-specific emission reduction targets necessary to reach the goal of a Baltic Sea unaffected by eutrophication. Development and maintenance of joint monitoring programs was agreed already in the first version of the Convention in 1974.

Data on hazardous substances are collected and analysed under a number of HELCOM processes. This is done either in coordinated temporary campaigns (e.g. data requests to CPs, commissioned projects or cooperation with research projects and organizations), or continuously (CPs report data with a defined frequency). The data collected specifically for hazardous substances are a) inputs, i.e. measurements or estimations of emissions and loads to the Baltic Sea, and b) status, i.e. measurements of concentrations in environmental matrices and to some extent biological effects.

The use of the data collected and analysed is more or less straightforward. Data and analyses of all types are published, presented and discussed at working group meetings and expert networks, and thereby provide CPs with general knowledge regarding the substances addressed, which can be used in HELCOM work and nationally.

Specifically, the outcomes of continuous monitoring of concentrations in different matrices (biota, water, sediment) and biological effects are used in the HELCOM Status assessment (HOLAS projects) which keeps track of the progress towards the goal of a Baltic Sea undisturbed by hazardous substances and the need for further measures. The Status assessment is repeated approximately in 6-year cycles with the ambition to align with the MSFD management cycle. The assessment is designed to help CPs implement the MSFD.

Data on inputs can be/are used as basis for development/updating of Recommendations regarding specific substances or suggestions of Actions for the working groups, however this work is commonly done ad hoc. There have been discussions in HELCOM that the Status assessments should include also assessment of temporal trends in inputs of hazardous substances from different sources.

Application of the DPSIR framework [8] for reporting on environmental issues helps describing the relations between the human system and the environment, and is recommended to apply both in e.g. WFD [9] and MSFD [10]. This framework can be applied to analyze the chain of actions in HELCOM (Figure 6).

Drivers (human activities leading to emissions) are addressed to some extent in the HOLAS II project and derivation of the Baltic Sea Pressure Index (e.g. mapping of shipping, dredging, fossil fuel energy production etc.), although not linked specifically to chemical pressure. The SOM analysis included an expert survey-based assessment of activity-pressure linkages for Hg, TBT, PFOS and diclofenac.

Analysis of Pressures (quantification of chemical inputs) is conducted in PLC-projects, including EMEP activities, and temporary data collection projects with different themes (e.g. pharmaceuticals, certain pollutants in wastewater, chemicals in certain industrial sectors).

State and Impacts are addressed in monitoring of concentrations of indicator substances and to some extent effect-based monitoring. There is however no clear link between Pressure assessment and

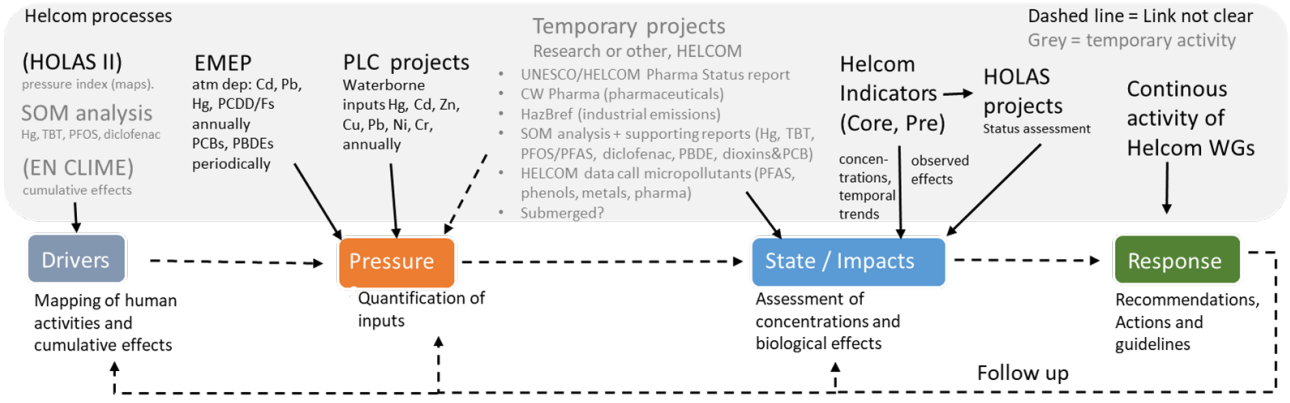

Figure 6. Overview of HELCOM data compilation and analysis. HOLAS II mapping of activities and EN CLIME currently address hazardous substances only indirectly. Temporary activities are indicated in grey.

State and Impact, i.e. the substances addressed overlap (although not completely) but information on inputs of many Core Indicators is lacking, and information from Pressure assessments is often not utilized in Core Indicator reports.

Findings of deteriorated status is not always clearly linked to development of a Response in the form of a Recommendation or other action. The 2018 Status Assessment shows that PBDEs, anthracene, Hg, Cd, Pb, TBT, Cs137 exceed thresholds in several basins in one or two matrices; concentrations of PFOS, benzo(a)pyrene, fluoranthene and dioxins&dlPCBs exceed the corresponding thresholds in one basin and matrix. However, Recommendations have been adopted that aim directly to reduce emissions of several Indicator substances causing not good status (e.g. Recommendation of measures to reduce emissions of Hg, Cd, Pb and dioxins from, as relevant, small-scale combustion, crematoria, batteries and fertilizers), which are largely reported as implemented in the CPs that have provided this information to HELCOM, sometimes as the Recommendation is covered by EU requirements. There are also older Recommendations (adopted before 2007) that have been integrated into EU and Russian legal requirements, fully or partly, mainly addressing industrial emissions. HELCOM Actions from BSAP and Ministerial Declarations also cover specific substance groups, i.e. endosulfan, PBDEs, PFOS, PFOA, nonyl/octylphenols and ethoxylates, chlorinated paraffins, Hg, Cd, pharmaceuticals and antifouling-related substances are mentioned. However, Actions suggested are in many cases investigative actions or agreements to implement international directives and conventions, which not necessarily lead to reduced emissions or may be relevant only for a few CPs (i.e. Russia in the case of EU-directives or CPs that have not ratified global conventions). In addition, HELCOM Recommendation 31E/1 suggests to develop National Implementation Programs to manage the 11 prioritized substances/groups, i.e. in this case it is up to the individual CPs to develop suitable measures. There are also Recommendations and Actions that indirectly address emissions of the substances deteriorating the environmental status, for example, recommendations regarding proper waste handling, sewage sludge handling, general wastewater treatment recommendations, marine sediment extraction etc; such recommendations can reduce emission of substances such as PBDEs, PCBs, dioxins and many metals. For upcoming Ministerial Meetings and the current update of the BSAP, HELCOM commonly performs evaluation of the implementation of adopted Recommendations and agreed Actions, usually presented as number of CPs that consider national actions fully implemented, or status of joint HELCOM actions.

4.1. Comment

It can be concluded that HELCOM work with prioritized/indicator substances more or less covers all elements of the DPSIR framework, however this work is scattered, with many information gaps, and clear linkages between the elements are missing. The lack of links between sources, loads and the state has been highlighted in HELCOM discussions. It is rarely described what results are expected from individual Recommendations or Actions, in terms of reduced emissions of specific substances or reduced risk of adverse effects, or other expected outcomes.

In other words, there are many information gaps that hinder adequate discussions regarding further measures to take, and the information that is available is not presented effectively. Potentially, the Core Indicator reports could be developed to have a structure that allows for providing, as far as possible, the full picture of available information regarding sources, transport pathways, environmental concentrations and measures for prioritized substances. The reports should in particular be developed with respect to information regarding sources, and indicate the relative importance of various sources, to what extent these are already addressed by EU/Russian legislation and/or global conventions, and which HELCOM Recommendations and Actions that are in place of relevance to the substance (and when and to which extent these have been implemented). The Core Indicator reports could state clearly which sources that are not restricted, and if reducing these is expected to have an influence on environmental concentrations in the Baltic Sea (at full Baltic Sea level, or locally). If the relative importance of various sources is unknown, which is commonly the case, this could be stated to acknowledge the knowledge gaps. Note that reports corresponding those of indicator substances are lacking for other prioritized substances, and these are therefore in many cases “left hanging” (e.g. phenolic substances, chlorinated paraffins).

5. HELCOM current suggestions of broad scope assessment approaches

5.1. Effect based monitoring

The HELCOM assessment of environmental status with respect to hazardous substances is currently based on monitored concentrations of substances (substance groups) in the Core Indicators. These indicators cover a selection of substances and assess biota, water and/or sediment sampling matrices. Furthermore, these separate components are then integrated to provide a summary assessment of hazardous substances via the HELCOM integrated assessment of 'chemical status' (CHASE) tool. This is similar to how the environmental/ecological/chemical status is evaluated under WFD and MSFD. However, due to considerable regulatory actions of the past and better control of releases in the EU, only in very few cases "high" concentrations (defined as exceeding the toxicity threshold levels based on laboratory testing and safety factors) of any contaminant can be observed in the marine environment. Instead, "low" concentrations (below the thresholds) of a hugely increased number of "new" substances (e.g., PFAS and pharmaceuticals) are observed, adding on top to the reduced concentrations of the "old" substances. Thus, the focus is inevitably and increasingly turning towards mixture effects with the understanding that the single substance monitoring of selected "priority chemicals" cannot provide us adequate information on the true impacts of chemical contamination in the marine environment to safeguard the health of the ecosystem. Therefore, the inclusion of effect-based monitoring (EBM), intelligently integrated with chemical measurements, is considered a promising approach to tackle this problem, and discussions are ongoing at EU and regional level regarding the development of status assessment including effects of hazardous substances in the field. In HELCOM, this has also been discussed for several years. A development of the status assessment to incorporate this aspect is desirable as the monitored and assessed indicator substances are not necessarily the only substances present in the marine environment, nor the only ones responsible for negative effects (known or unknown), for example on biota or habitats. It is indeed stated in the BSAP and MSFD (Descriptor 8) that achievement and maintenance of GES via the assessment of concentrations of hazardous substances should be supported by the assessment of biological effects caused by chemical contaminants present in the environment.

HELCOM has in the latest Status Assessment included imposex & TBT concentration as an indicator that was tested (threshold value agreement not completed). TBT monitoring data (concentrations in water, biota and sediments) are available from Denmark, Sweden, Germany, Lithuania and Poland. Imposex in gastropods caused by TBT is however monitored in Denmark and Sweden only. The Status Assessment also includes White-tailed sea eagle productivity, which provides a signal of impact from contaminants, but also other environmental stressors, and this indicator was listed under "biodiversity" during the first HELCOM project that was launched to develop the Core Indicators (CORESET 2010 – 2013). A further indicator (supplementary indicator) is applied in Swedish and Finnish waters, the reproductive disorders: malformed embryos of amphipods indicator.

Some history of work on effect-based monitoring in HELCOM context is summarized in the Annex. Several EU projects have worked to develop operational effect-based monitoring tools, and the list of suggested and applied Core Indicators has evolved over time.

Table 1. Overview of effect indicators suggested in different projects.

BEAST / CORESET I	CORESET II	HOLAS II
Preliminary/Proposed Core Indicators	**Core Indicators**	**Core Indicators**
PAH and their metabolites	PAH and their metabolites	PAH and their metabolites
TBT and imposex	TBT and imposex	TBT and imposex
Lysosomal membrane stability (LMS) (a)	White-tailed eagle productivity	White-tailed eagle productivity
Malformed eelpout & amphipod embryos (b)	**Pre-Core Indicators**	**Supplementary Indicator**
Fish disease index (c)	Acetylcholinesterase inhibition	Malformed eelpout & amphipod embryos
Micronuclei test (d)	Estrogenic-like chemicals and effects	
Candidate Indicators	Lysosomal membrane stability (LMS) (d)	
Acetylcholinesterase inhibition (e)	Malformed eelpout & amphipod embryos (e)	
EROD activity (f)	**Candidate Indicators**	
Intersex/vitellogenin induction in male fish (g)	EROD activity	
	No progress during CORESET II	
	Fish disease index (f)	
	Micronuclei test (g)	

Lysosomal membrane stability (LMS) (a)	general stress caused by a range of contaminants
Malformed eelpout & amphipod embryos (b)	reproductive success impairments caused by a range of contaminants
Fish disease index (c)	index for the general health status
Micronuclei test (d)	genotoxic contaminants
Acetylcholinesterase inhibition (e)	neurotoxic effects
EROD (ethoxyresorufin-O-deethylase) activity (f)	exposure to organic compounds such as PAHs, planar PCBs and dioxins
Intersex/vitellogenin induction in male fish (g)	exposure to estrogenic substances

5.2. EN-HZ and future work on marine biological effect monitoring

Since the end of the CORESET II project (2015) the work on biological effect indicators in HELCOM has not been a major priority. However, recent work has been initiated to build a pool of relevant biological effects experts to work in close association with the HELCOM Expert Network on Hazardous Substances (EN-HZ). There is a general consensus among the experts that biological effect indicators offer important information related to hazardous substances and can support the assessment of hazardous substances under BSAP and MSFD (i.e. Descriptor 8). While progress on the specific indicators has not been extensive in recent years (e.g. since HOLAS I in 2010[1]) there is new momentum towards finding common ground and a consensus on the way forward. In autumn 2020 an Effect based monitoring workshop[2] discussed a way forward by addressing key issues including[3]:

a. What is expected from a biological effects assessment and what is the ultimate goal?

— for example, are the indicators assessing a specific substance or combined factors, do they assess populations and the ecosystem or targeted hazardous substances, what are the interaction factors and (how) can they be separated, and do different methods show similar overall assessment outcomes.

b. What to monitor and how to develop towards a regional approach?

1 https://portal.helcom.fi/meetings/EN-HZ%2012-2020-730/MeetingDocuments/Outcome%20notes%20Biological%20Effects%20Feb%202020.pdf

2 https://portal.helcom.fi/meetings/EN-HZ%2013-2020-782/MeetingDocuments/Biological%20Effects%20Workshop%2021-22%20September%20Provisional%20Annotated%20Agenda.pdf

3 https://portal.helcom.fi/meetings/EN-HZ%2012-2020-730/MeetingDocuments/Outcome%20notes%20Biological%20Effects%20Feb%202020.pdf

Table 2. Monitoring of biological effects by HELCOM Contracting Parties (CPs) as of 2020

Biological effect	Current status	# CPs with monitoring	
		regularly	project/pilot
(TBT and) imposex	Core ind.	2	1
White-tailed sea eagle productivity	Core ind.	6	1
Reproductive disorders: Malformed amphipod embryos	supplementary ind.	1	3
Acetylcholinesterase inhibition	pre-core ind.	1	2
Estrogenic-like chemicals and effects	pre-core ind.	1	0
Lysosomal membrane stability (LMS)	pre-core ind.	2	1
Fish disease index	pre-core ind.	2	0
Micronucleus test	pre-core ind.	2	2
EROD activity	candidate	2	1

— CPs have developed different national projects and regular monitoring programmes in the past and there is re-occurring discussions on how to align them. Table 2 shows is a condensed summary of the currently performed biological effects monitoring among CPs. Agreement on threshold values, in particular to address regional variation, will be a challenge and discussion on a uniform regional approach or how to align/integrate complementary approaches is needed.

c. Resources and expertise

— skilled experts are needed to carry out the monitoring/evaluation and expertise might not be available within each CP. Furthermore, funding and time cause reason for repeated concerns among CPs.

d. How to utilize synergies best with other ongoing and future processes

— continued discussion on how to use data from and for national and international monitoring programmes most efficiently to align them (for ICES, OSPAR, WFD, alignment with existing and proposed prioritised substances, REACH etc.) has repeatedly hindered agreement among CP or put decisions on hold until a next update of certain directives/priority substances was available. Furthermore, the EU aims to advance the work for D8 and D9 and include how to consider biological effects within integrated assessments, which will contribute to this important topic[4]. This latter aspect is part of the work currently considered under the MSFD Expert Network on Contaminants.

A review of the effects-based indicator approaches used in the Baltic Sea region has recently been initiated in association with the HELCOM Expert Network on Hazardous substances - EN-HZ 12-2020, EN-HZ 13-2020 and EN-HZ 14-2021.

5.3. Comment

Monitoring using effect-based methods (EBM) has been discussed within the HELCOM for many years, although mainly in the beginning of 2010's. Despite a number of BONUS, Interreg BSR, HELCOM and national projects addressing this issue and aiming to suggest operational EBM in monitoring HELCOM has not adopted these into a Recommendation of voluntary national efforts. Several factors hindering the progress in this area have been identified:

— Effect based indicators are secondary parameters in EU directives, and legal incentives for implementation are therefore lacking.
— EU is currently in the process of developing this area in the WFD and MSFD, hence CPs that are EU member states are potentially awaiting directions for future work on this issue agreed at EU level.
— In many cases, CPs already have some EBM in place, but the overlap between the applied methods and their thresholds between CPs is low, making alignment difficult as CPs are reluctant to abandon their already chosen strategy, which sometimes includes long time series that are worth continuing.
— Adding new EBM requires additional resources.
— Derivation of threshold values is in some cases difficult and some indicators may not be applicable to the whole Baltic Sea (variation in conditions and species distribution). In some cases, it is also challenging to assess how other environmental factors than HS (e.g. temperature, salinity etc.) affect the EBM results.

The same problems are encountered in WFD and MSFD CIS discussions; at the EU level it is also clear the Member States are employing a wide range of EBM. The most commonly applied

4 https://portal.helcom.fi/meetings/EN-HZ%2012-2020-730/MeetingDocuments/EN-HZ%2012-2020%20documents/Document%205.2%20Progress%20update%20on%20EU%20MSFD%20D8%20and%20D9.pdf

method amongst EU members is the monitoring of imposex in gastropods with 8 member states using this method in the latest MSFD reporting cycle[5]. This method is, however, specific only to TBT and also strongly correlated to TBT levels in sediments, which is why some countries use TBT concentrations to infer the effect aspect.

A major drawback of (non-chemical specific) EBM highlighted both in HELCOM and EU discussions is that the identity of the substances causing (the main part) of the effect is not revealed and it may not be possible to reveal them specifically. Hence, making the link to development of effective pollution reduction measures is challenging and may require further assessments (e.g., effect directed analysis). As noted by WG Chemicals [11] however, in many cases it is not necessary to know or regulate emissions of particular substances but rather the effect itself (examples from WG Chemicals report include whole effluent assessment (WEA) in permitting processes, evaluation of dredged sediments considered for sea disposal, use within broad screening of different sources such as WWTP effluents, and the Dutch effect-based alarm system in use in the Netherlands that triggers control measures e.g. closing drinking water intake, alike to the one used in the city of St. Petersburg (Russia)). WG Chemicals also concludes that if effects are observed using EBM, different strategies are needed depending on the location (type of pressures and sensitivity of the water body) and the type of EBM being used, and in their (yet unpublished) report provide a decision tree for the follow-up of observed effects in monitoring.

The "way forward" discussed in the HELCOM EN HZ highlights the following issues:

- If a CP is already using EBM, what incentives are there to change method to harmonize with other countries? HELCOM need to identify synergies, e.g. how to get more out of collected data, practical resource-saving collaborations, perform evaluation of comparability and cost-effectiveness of the different methods
- The need to agree on a short-list of recommended effect-based monitoring and guidelines how to apply them (as suggested in MSFD CIS TG GES discussions)
- The link between currently used EBM and biodiversity assessments is currently lacking[6]. Development of such links could support certain methods and provide added value, making a change of monitoring method motivated.
- Can HELCOM experts agree on a single minimum set of effect indicators? Can experts agree on clustering of indicators based on commonalities to create a 'generic' biological effects indicator?
  - The integrated approach: clustering of EBM representing different functional disorder endpoints (e.g., genotoxicity, neurotoxicity, general stress, reprotoxicity) to create an integrated 'generic' biological effects indicator
  - Scaling of several different EBM for the different endpoints followed by an integration method to provide an overview of biological effects
    - Integrated Biomarker Index (Beliaeff and Burgeot 2002 [12]; updated by Devin et al. 2013 [13])
      - widely used in local assessments and research studies
      - recent development initiatives in the OSPAR region (ICES WGBEC)
    - Weight of Evidence (WOE) approach (Piva et al. 2011 [14]; Benedetti et al. 2012 [15]; recently applied in the Baltic Sea by Lehtonen et al. 2019 [16]).
      - WOE approach combines data from different typologies of investigations (Lines of Evidence, LOEs), and typically integrates chemical results with assessment of various biological effects
- Assess comparability between effect indicators
  - review of areas and studies where multiple indicators have been applied to determine if there are commonalities in the evaluation results (discussed at Biological effects Workshop September 2020)
  - develop methods to align several different effect-based indicators
- Can HELCOM CPs agree on a common position to promote at EU-level discussions? To have larger impact on the discussions on ways forward, and also better support the discussions by having a common standpoint based on regional discussions, analysis and experiences.

5.4. Identification of contaminants of emerging concern

The currently employed system for HELCOM management of hazardous substances is based on

- use of indicators,
- a list of prioritized substances (which overlaps with indicator substances),
- ad hoc decisions to focus on specific substance groups (pharmaceuticals) or sources/pathways (e.g. wastewater, industrial emissions, dumped munitions).

The identification of problematic substances largely dictates other important management activities performed by HELCOM such as monitoring, data collection and development of Recommendations or Actions.

HELCOM has throughout the years worked with identification of hazardous substances of relevance to the Baltic Sea. Lists of individual substances, groups of substances (e.g. PCBs), chemical classes (e.g. organohalogens) or chemicals grouped by use category (e.g. pharmaceuticals) have been produced to guide prioritizations. The Convention from 1974 lists only DDT, PCBs and PCTs as "hazardous substances", but a rather broad range of substances were listed as "noxious substances and materials" which should be controlled and their emissions strictly limited. In the 1990's, as many as 280 substances were identified as of potential concern, and 36 of these targeted for cessation. After the turn of the century, the number of prioritized substances has instead decreased, with 18 substances/groups listed in the BSAP 2007 but only 8 being dubbed Core Indicators and included in the Status Assessment (HOLAS II) in 2018 together with 4 additional substances/groups, possibly as a consequence of the ambition to align this assessment with MSFD commit-

5 https://portal.helcom.fi/meetings/EN-HZ%2012-2020-730/MeetingDocuments/EN-HZ%2012-2020%20documents/Document%205.2%20Progress%20update%20on%20EU%20MSFD%20D8%20and%20D9.pdf
6 https://portal.helcom.fi/meetings/EN-HZ%2012-2020-730/MeetingDocuments/EN-HZ%2012-2020%20documents/Document%205.2%20Progress%20update%20on%20EU%20MSFD%20D8%20and%20D9.pdf

ments. A clearly defined procedure for selecting and de-selecting chemicals to prioritize in management is lacking.

The selection of priority substances / indicators is, at least in theory, key to HELCOM decisions regarding measures to reduce emissions. An indicator found to deteriorate the status should trigger implementation of adequate measures and ideally the next evaluation should show that the problem is solved and resources can be directed towards other substances. This mechanism, however, seems not to be in place, although the ambition to make Status Assessments (HOLAS projects) timely with MSFD reporting cycle should facilitate this kind of regular structured update of indicators[7]. The ambitions to keep the list of prioritized substances updated is indeed mentioned e.g. in the BSAP and Recommendation 31E/1. This Recommendation specifies which substances to focus on (selected Priority hazardous substances) to reach the HELCOM objective regarding hazardous substances, and recommends to update the list based on monitoring and other scientific data. The prioritization mechanism suggested may include an intrinsic hazard or potential to reach / observed presence in the marine environment to a significant degree. The EU/OSPAR approach to risk assessment is encouraged, as well as cooperation regarding monitoring and a regular update of the priority list. Definitions of hazardous substances are to be taken from EU legislation and UN Global Harmonized System for classification and labelling of chemicals (GHS), specifically mentioning REACH criteria for identifying substances of very high concern, and also OSPAR Selection Criteria of the OSPAR Dynamic Selection and Prioritization Mechanism for Hazardous Substances.

The currently prioritized substances and indicator substances (including test and pre-indicator substances) are representing a small fraction of all potentially harmful chemicals present in the Baltic Sea, and the need to broaden the scope of HELCOM work to include contaminants of emerging concerns is well known. The MD 2018 Brussels (Paragraph 35) also states that ministers agreed "to identify the scale of problems of contaminants of emerging concern" which can refer to both understanding total impact of the chemical mixture in the sea and also identifying hazardous substances yet not recognized. Identification of emerging pollutants is indeed listed as an ongoing activity in the Pressure Working Group work plan, and the State&Conservation's self evaluation of its function, role and needs from 2018 also listed identification of emerging pollutants and prevention of their harmful effects to the ecosystem as a subject of potential interest also for this Working Group.

5.5. An indicator for emerging contaminants

Future work on HELCOM indicators was discussed during 2019-2020 in dedicated Indicator workshops. These workshops have however mainly addressed issues with the currently applied indicators and improvement in their operationalization: A need to in the short-term review spatial coverage and regionally agreed lists was mentioned as a good starting point. Thresholds for the indicator substances indicating safe levels for the environment and human health should be derived. Also highlighted as needed in the short term was a better linkage between sources, pathways and status, a general need to consider temporal trends and an integrated assessment for hazardous substances. In the long term however, ways to address emerging substances for example using a screening indicator was mentioned (alongside development of indicators that address foodstuffs and follow up of acute pollution events), although not elaborated in more detail in the meeting notes[8].

The draft Indicator Manual under development in HELCOM however presents the idea of how to incorporate emerging substances in the Indicator system. New indicators may be proposed by experts in Expert Groups (EN-HZ, CG Pharma) and then lifted to State&Conservation WG and considered for approval as candidate indicators. CPs may also suggest new indicators at WG or HOD meetings, potentially tasking the Expert Groups to compile information needed for the indicator development process, which is done using a lead country approach. This is hence an ad hoc process. The draft indicator manual (under review in HELCOM fall 2020) suggests that new types of indicators can be used such as a surveillance indicator acting as an early warning system. The assessment could include initial overviews and screening activities, e.g. regional surveys of substances of potential concern, screening campaigns in the field or at waste outlets. The idea of surveying use and sources to find chemicals with high emission rates in the region points back to actions agreed (but not progressed since 2007) in the BSAP, namely to establish national chemical products registers and to use information from REACH to decrease pollution, i.e. utilize production/import/use data to identify chemicals potentially emitted in the Baltic Sea region. This action is suggested to be updated and transferred to the updated BSAP.

5.6. Wide-scope target screening and non-target/suspect screening

Wide scope screening has not been an activity in HELCOM (although the BSAP contains an agreement to assess the presence of the 11 priority substances and their sources, these studies were conducted in 2009-2010). Based on discussions in EN-HZ, a proposal for the development of regular wide-scope of screening of hazardous substances in the field was submitted by the Secretariat to Pressure WG meeting 12-2020[9]. To summarize this proposal, the idea is to identify substances previously unknown in the marine environment but occurring in elevated concentrations by applying wide scope target screening analysis (>2400 substances) and suspect screening (>40000 substances, only semi-quantification possible) to samples in most appropriate location and matrices, accompanied by retrospective screening for identification of unknowns. This would follow the Norman network screening methodologies. The results would be compiled and analyzed by EN-HZ, PLC and CG Pharma and presented as

7 https://portal.helcom.fi/meetings/STATE%20-%20CONSERVATION%2012-2020-740/MeetingDocuments/4J-5%20Draft%20HELCOM%20Indicator%20Manual%20Version%201.0.pdf

8 https://portal.helcom.fi/meetings/HOD%2056-2019-597/MeetingDocuments/3-20%20Future%20work%20on%20HELCOM%20indicators%20%E2%80%93%20progress%20and%20planned%20work.pdf

9 https://portal.helcom.fi/meetings/PRESSURE%2012-2020-734/MeetingDocuments/10-5%20Proposal%20for%20development%20of%20regular%20wide-scope%20screening%20of%20HS.pdf

a surveillance or early warning indicator (form of this needs to be elaborated). These groups are also suggested to develop trigger criteria for further investigation of a substance and raising the findings with HELCOM Working Groups Pressure and State and Conservation. The regular joint screening campaigns are suggested to be carried out every 3 or 6 years, and be aligned with HELCOM PLC periodic data compilation and Holistic Assessments. A similar approach for screening is being explored within OSPAR (OSPAR MIME Group and being handled via OSPAR HASEC), with a semi-quantitative regional approach being explored. The outline of the HELCOM proposal was sketched based on information currently available from the OSPAR process. The Pressure Working Group meeting 12-2020[10] considered the proposal as a useful initiative and in general supported it, highlighting cooperation with OSPAR as important. It was suggested to broadening the scope of the screening to include land-based sources and pathways of contaminants but at the same time the meeting expressed concern regarding additional funds needed for this initiative. The Meeting also acknowledged that there might be differences between contamination of North Sea and Baltic Sea but pointed out that coordinated screening campaign would help to identify and proof these differences and also reveal common challenges.

5.7. De-selection of prioritized substances and indicators

It can be noted that procedures and criteria for removal of substances as indicators or as prioritized are not clearly defined in HELCOM documents. However, this is an issue discussed in the MSFD Expert Network on Contaminants and OSPAR. MSFD points out that according to the MSFD Com. Dec. (EU) 2017/848, Member States shall consider for MSFD D8C1 assessments the WFD priority substances and River Basin Specific Pollutants (RBSP) within coastal and territorial waters and also beyond territorial waters if these still may give rise to pollution effects. According to a discussion paper [17] authored by MSFD Expert Network on Contaminants, excluding assessment beyond territorial waters of those priority substances for which there is clear evidence that they do not pose a risk or harm to the marine environment would free resources that can be used for monitoring of other (emerging) substances not currently on the priority list. It is however notable that member states can (and do) exclude substances if they motivate the decision. The discussion paper points out that for prioritized chemicals considered for exclusion, very low concentrations in rivers is for example an indication of even lower concentrations in sea water (unless major sea-based sources exist). In the WFD, there are also mechanisms for exclusion of priority substances in subsequent River Basin Management Plans if they are not found in the environment, although substances may for various reasons re-appear, as sometimes observed in monitoring. Substances can also be excluded if they are not used anymore and emissions are expected to have ceased. The discussion paper considers REACH PBT criteria, information on use from REACH dossiers and ban status (EU and Stockholm Convention), presence of potential sea-based sources and inclusion of the WFD priority substances in regional sea convention lists (HELCOM, OSPAR) and if the substance was considered in MSFD reporting in 2018, and finally the status in the environment (WFD and/or MSFD). The list of substances[11] with a low likelihood of being of relevance in the open sea produced using these criteria does not contain any substances included in the HELCOM Status assessment. However, it illustrates an effort to introduce systematic revision of priority lists.

10 https://portal.helcom.fi/meetings/PRESSURE%2012-2020-734/MeetingDocuments/Outcome%20of%20PRESSURE%2012-2020.pdf

11 1,2-dichloroethane, Aclonifen, Alachlor, Atrazine, Benzene, Bifenox, Chlorfenvinphos, Chlorpyrifos, Cypermethrin, Dichloromethane, Dichlorvos, Dicofol, Isoproturon, Quinoxyfen, Simazine, Terbutryn, Carbon-tetrachloride, Trichloro-ethylene

6. ANNEX Summary of existing commitments related to hazardous substances

6.1. The Convention and Ministerial Declarations until 2007

The HELCOM Contracting Parties (CPs) agreed in 1974 to take measures to prevent and abate pollution of the Baltic Sea. Specifically, the convention mentions counteracting introduction of PCBs and DDT (and later PCTs) into the Baltic Sea, and in addition take appropriate measures to limit pollution by different substance groups including a number of metals, phenolic substances, phthalates, persistent halogenated hydrocarbons, polycyclic aromatic hydrocarbons, persistent toxic organosilicons and persistent pesticides including organophosphates and organotin compounds (Convention 1974, Convention re-negotiated in 1992). The Convention states that National Authorities will inform the Commission if significant quantities of the listed substances are emitted, and will adopt criteria for issuing emission permits. Loads of industrial waste shall be minimized to reduce the amount of hazardous substances. The Commission shall define pollution control criteria, objectives for reduction of pollution and measures.

Pollution from ships and pleasure boats shall be prevented. The ability to combat spillage of oil and other harmful substances shall be maintained, surveillance activities shall be developed, and CPs shall cooperate to combat spillages. CPs shall prohibit dumping, and dumping of dredged spoils shall be subject to a prior special permit by national authorities. A permit can be issues if the dredged spoils do not contain significant quantities or concentrations of the listed hazardous substances. National authorities shall keep record of quantities, location, time, method of dumping and report to the Commission.

The Commission shall promote cooperation with governmental bodies to protect the marine environment and therefore receive, process, summarize and disseminate relevant scientific, technical and statistical information, as well as promote research. The Commission shall also seek cooperation with other relevant organisations. Article 16 specifies that technical and research cooperation for assessments of pollution, pathways, exposures, risks and remedies. Cooperation to develop joint monitoring methods and programs shall be established and outlined by the Commission.

Selin and VanDeveer 2004 [18] summarizes HELCOM work on hazardous substances until 2002 as follows: HELCOM Recommendations during the 1980s targeted DDT, PCBs, PCTs, mercury, cadmium and lead. The 1988 Ministerial Declaration (MD) set the goal to reduce emissions of the most hazardous substances by 50% by 1995. During the early 1990s, 47 substances were targeted for this reduction goal, but data for baseline emissions and assessments of emission reductions were lacking. HELCOM continued to work for the 50% reduction with a postponed deadline (i.e. 2005). In 1998, Recommendation 19/5 was issued, recalling the 1996 Kalmar Communique with the goal of cessation of hazardous substances emissions by 2020 to achieve concentrations in the environment near background levels for naturally occurring substances and close to zero for synthetic substances. The Recommendation lists 280 hazardous substances of potential concern, of these 36 were later targeted for cessation, a goal judged to be "largely reached" in 2001.

The Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) was approved in 1992, In this programme, 132 especially polluting sites and areas within the Baltic Sea catchment area were identified and included in an official "List of Hot Spots" to be managed by 2020. The pollution load reductions reported from these hot spots up until 2003 were mainly numbers for BOD, COD, nutrients, air pollutants like nitrogen and sulphur compounds (e.g. NOx, SOx), carbon monoxide, chlorine, fluoride, dust, metals (Fe, Cr, Zn, Pb, Cd, Cu, As) and AOX (Adsorbable Organic Halides) as an indicator for halogenated compounds e.g. dioxins, PCB and DDT [19]. These hot spots were in particular pulp and paper industries in Sweden and Finland, occasionally in Latvia, Estonia and Poland and Russia (Kaliningrad), and chemical industry releasing heavy metals in e.g. Poland and Latvia.

The Ministerial meeting in Bremen 2003 noted that HELCOM work after 2004, when 8 of 9 Contracting states were EU members, should focus on activities that bring added value [20].

6.2. BSAP in 2007 and Ministerial Declarations thereafter

The Ministerial meeting in Krakow 2007 adopted the Baltic Sea Action Plan [21] to "achieve a Baltic Sea in Good Environmental Status by 2021". The hazardous substances segment of BSAP sets the overall goal "to achieve a Baltic Sea with life undisturbed by hazardous substances".

The goal is described by four ecological objectives:

- Concentrations of hazardous substances close to natural levels,
- All fish safe to eat,
- Healthy wildlife,
- Radioactivity at pre-Chernobyl level.

Indicators with targets reflecting good ecological and environmental status in the Baltic Sea were specified in the BSAP (see Annex). Decreasing concentration trends were set as primary target for Cd, Hg, PCDD/Fs and dioxin –like PCBs, TBT and PFOS in fish, mussels or sediment. Intermediate target concentrations in fish muscle

were defined for Hg, Cd, dioxins (WHO PCDD/F TEQ) and dioxins+dioxin-like PCBs (WHO PCDD/F-PCB TEQ). Indicators of wildlife health were defined for predatory birds (white tailed sea eagle and/or osprey), fish and seals with quantitative targets to be defined. Primary target for Cs-137 in fish muscle (herring, plaice and flounder), sea water and sediment was decreasing concentration trends and ultimately below specified pre-Chernobyl levels in these matrices.

In addition to the indicators and targets for these, the BSAP lists substances of specific concern to the Baltic Sea marine environment: dioxins, TBT and TPhT, penta-, octa- and decaBDE, PFOS and PFOA, HBCDD, NP+NPE and OP+OPE, short and medium chained chlorinated paraffins (SSCPs, MCCPs), endosulfan, Hg and Cd.

The BSAP mentions a number of HELCOM Recommendations that will enable HELCOM to reach the goal of a Baltic Sea with life undisturbed by hazardous substances:

- **Recommendation 28E/8 Environmentally friendly practices for the reduction and prevention of emissions of dioxins and other hazardous substances from small-scale combustion addresses emissions of dioxins from small-scale combustion:** 1) promotion of environmentally sound combustion appliances and make suppliers aware of best environmental practices 2) enhance public awareness of environmentally friendly practices when operating combustion appliances and when installing new ones 3) CPs develop efficiency requirements and emission limit values, and report on the implementation.
- **Recommendation 24/4 Reduction of Emissions and Discharges from the Iron Steel Industry** recommends measures for CPs to take to avoid discharges of chemicals and suspendable solids to water and air, and disposal of sludge. Quantitative limits for suspendable solids, oil and cyanide emissions from specific processes to water, and particulate matter content of filtered gases are specified. Recommendations are given to monitor emissions and to report total air emissions, and to avoid Cd, Hg and chlorinated compounds.

The BSAP also stated that, in addition to the Recommendations, further requirements for energy production and industrial combustion plants should be evaluated.

A number of Recommendations were agreed to be updated:

- Recommendation 19/5 which has later been superseded by **Recommendation 31E/1 Implementing HELCOM's objective for hazardous substances:** This updated version of the Recommendation specifies a strategy for CP governments to use in the work to reach the HELCOM objective regarding hazardous substances and which substances to focus on (Priority hazardous substances), and recommends to update the list based on monitoring and other scientific data. The strategy recommends to use EU guiding principles (precautionary principle, polluter pays, BAT and BEP) and sustainable chemistry principles. Definitions of hazardous substances are taken from EU legislation and UN Global Harmonized System for classification and labelling of chemicals (GHS). The prioritization mechanism may include an intrinsic hazard or potential to reach / observed presence in the marine environment to a significant degree. The EU/OSPAR approach to risk assessment is encouraged, as well as cooperation regarding monitoring and a regular update of the priority list. It is also stated that substances listed in the 1992 Convention, Stockholm convention and LRTAP will be (continuously) phased out, and not substituted by equally hazardous substances. The Commission will coordinate work to identify sources and transport pathways in order to identify relevant measures at the appropriate geographical and administrative level. Also, the Commission will carry out dialogue with stakeholders to secure information, specifically mentioned is cooperation with industry to implement BAT/BEP and provide data on production volumes, use pattern, emission scenarios, exposure concentrations and substance properties. Contracting parties shall bring measures and information to the Commissions' attention.
- Recommendation 24/5 was superseded by **31E/4 2011 Proper handling of waste/landfilling.** The Recommendation is for CPs to enforce national legislation, i.e. close or restore existing landfills that do not meet obligations for a permit or do not implement proper handling of waste as stated in a permit based on national legislation. It is also to minimize amount of landfilled waste, upgrade and enforce national legislation in accordance with EU directive (1999/31/EC)

In addition to the Recommendations mentioned, the BSAP required CPs to develop national implementation programs (by 2010) and evaluate these at the MD 2013. These programs should identify sources of the priority substances, substitute, ban or restrict the use of these, and develop technical guidance documents for environmental permitting. In addition, these programmes should include activities that build capacity within authorities and industry to identify and eliminate hazardous substances and apply BAT/BEP, and raise awareness among consumers.

In the BSAP, CPs also agreed to focus on emissions from specified sectors and uses, and consider these in the national implementation programs and programs of measures under WFD. It was also mentioned that the 11 prioritized substances/groups will be taken into account in establishment/renewal of environmental permits if relevant, and BAT and BEP are to be applied where hazardous substances might be released, and that information exchange with ECHA on hazardous substances will be initiated.

The BSAP also mentions a number of specific activities: A screening study for a "subset of the selected hazardous substances" and their occurrence in the marine environment in cooperation with the Nordic Council of Ministers (which was conducted in 2008/2009 for TBT, TPhT, PBDEs, HBCDD, PFOS, PFOA, NP, NPE, OP, OPE, SCCP, MCCP, endosulfan [22]). In addition, a screening campaign for these substances in wastewater, landfill effluents and storm waters was planned by 2009.

The CPs agreed in the BSAP to by 2009 "if relevant assessments show the need" to take measures for MCCPs, OP/OPEs, PFOA and decaBDE. CPs also agreed to ban the use, production and marketing of endosulfan, penta and octaBDE by 2010, and in 2008 start working for "strict restrictions on the use" of PFOS, NP/NPEs and SCCPs. The possibility to restrict Cd in fertilizers was to be assessed by 2009. Strict restrictions on Hg should be applied and CPs should work towards further limitations.

The BSAP also mentions evaluation of practical introduction of Whole Effluent Assessment as monitoring approach for wastewater, i.e. a pilot project, and start in 2008 to develop biological effects monitoring. The CPs also agreed to (by 2010) establish chemical products registers, and to use information from REACH to decrease pollution.

CPs also agreed to implement the GHS, participate in the implementation of SAICM, and ratify the Stockholm convention, Aarhus protocol and LRTAP and support inclusion of new substances in these conventions. The BSAP emphasizes the importance of coher-

ent input by CPs in international fora, specifically in development of EU BAT Reference documents (BREFs), updating of WFD priority list and placing pesticides on the market.

6.3. Moscow MD 2010

In this MD, the CPs agree to further strengthen cooperation with other Regional Sea Conventions. HELCOM CPs that are EU members also decide to establish HELCOM as coordinating platform for implementation of the MSFD, with a shared scientific understanding building on the Holistic Assessment and common understanding of good environmental status, goals and ecological objectives as well as jointly constructed quantitative targets and indicators, and using this in international, regional and national policy making. The CPs decided to use the Holistic and thematic assessments to support reporting under international legislative frameworks and processes. It was further decided that the Core Indicators were to be developed and designed in such way to enable use in other international monitoring and reporting, e.g. MSFD. It was also decided to finish the revision of HELCOM monitoring programs by 2013, in line with other international monitoring and reporting requirements.

The ministerial meeting agreed specifically to take account of the COHIBA project[1] and look for need of measures, to strengthen control of imported consumer products and articles, to prioritize waste and contaminated areas to target with measures and investments, to check feasibility in reducing/avoiding Hg in products and processes by 2011/2012, and to take into account the need to strictly control dredging and dumping of dredged materials when revising HELCOM Guidelines for this activity. Finally, the MD reconfirms the decision to develop efficiency requirements and emission limits for small scale combustion plant appliances that complement Rec 28E/8, now taking into account upcoming EU legislation including agricultural installations and small scale industrial combustion sources.

The MD also adopted the updated recommendations, and in addition **Recommendation 31E/2 Batteries and waste batteries containing mercury, cadmium or lead** and **Recommendation 31E/3 Cadmium in fertilizers.**

6.4. Copenhagen MD 2013

CP ministers and EU Commissioner assembled to assess the progress towards reaching the common goal of the Baltic Sea in a good environmental status by 2021. An overview of the accomplishments of BSAP actions was provided[2], indicating that most actions were ongoing and yet only partly accomplished. Two actions were accomplished: Ratification of the Stockholm Convention, and continuation of HELCOM work with regard to radioactivity. Not accomplished were the actions related to pharmaceuticals, other non-monitored substances and their occurrence and effect in the Baltic Sea. The action "Evaluation of need to develop further requirements for reduction of heavy metal and other hazardous substances emissions from energy production and industrial combustion plants" was postponed due to ongoing EU processes on this subject.

Some new ambitions and actions were presented in the MD. The MD calls for consideration of the impact of current and future climate change on the Baltic Sea environment. It is further decided to use the limited resources more effectively by drawing on synergies between HELCOM, MSFD and other Regional Sea Conventions (e.g. OSPAR), and support regional cooperation and coherence by joint "Baltic Sea roof reports"

The CPs endorse "the Palette of Measures on management options to reduce discharges, emissions, and losses of hazardous substances from various sources"[3], to be used by HELCOM nations in their national work and by industry. The Palette is the outcome of the COHIBA project and addresses the 11 priority substances/groups of substances in the BSAP.

The revised HELCOM Monitoring and Assessment Strategy implying a six-year monitoring and assessment cycle is also adopted. It is stated that further research on the Whole Effluent Assessment is needed before any recommendation can be made.

Ratification of the Minamata convention on mercury is encouraged.

The agreement to establish combustion efficiency requirements and/or emission limit values for dioxins from small-scale combustion sources according to HELCOM Recommendation 28E/8 by 2016 is re-iterated, as well as the agreement to develop measures targeting large scale industrial sources.

It is further decided to collect more information on pharmaceuticals and resistant microorganisms, also to support the development on the EUs strategic approach on pharmaceuticals.

It is also agreed to promote a "greener" consumer behaviour.

The MD supports that inputs of hazardous substances should be reduced by:

- monitoring and measures to reduce airborne inputs,
- continue research on interactions and cumulative effects of hazardous substances, and development of both source-reduction and end-of-pipe solutions. Collaboration with BONUS and EUSBSR is encouraged,
- assessing the need for joint measures,
- making use of information generated by the REACH Regulation, EU WFD and EU MSFD, and exchange information with other legal frameworks and the IPCheM exposure knowledge database.

6.5. Brussels MD 2018

A concern regarding climate change is again expressed, and it is stated that contamination is one of the most widely-distributed pressures. It is noted that coastal areas see the highest cumulative pressures and impacts (Holas II, Pressure Index). Sea dumped chemical weapons and munitions are mentioned as a continuing concern.

CPs agree to operationalize the set of indicators for status assessment and advance mapping and assessment of human activities in the Baltic Sea region and improve understanding of their impacts and cumulative effects on the ecosystem.

1 https://helcom.fi/helcom-at-work/projects/cohiba/

2 https://helcom.fi/media/documents/BSAP_Overview_with-cover.pdf

3 https://helcom.fi/media/documents/Palette-of-cost-effective-management-options-to-reduce-pollution-by-hazardous-substances.pdf

It is agreed to re-examine the effectiveness of measures and recommendations for legacy pollutants, and identify the scale of the problem of contaminants of emerging concern including micropollutants in coastal and marine waters. Based on this knowledge consider cost-effective measures. The Pharmaceutical Status report [23] (HELCOM/UNESCO/EUSBSR) is mentioned as information basis for developing measures targeting pharmaceuticals.

It is also agreed to assess hazardous substances released from off-shore sources and develop mitigation measures.

The CPs commit to enhance cooperation, policy coherence and coordination to fulfil Agenda 2030 SDGs, and mentions specifically cooperation on hazardous substances in anti-fouling systems, synergies of HELCOM monitoring system and other monitoring activities, OSPAR (although not specifically hazardous substances), and in general Regional Sea Conventions and River Basin authorities.

6.6. Follow up on implementation – assessment of the BSAP and MD Actions in 2018

As background information for the 2018 Ministerial Meeting in Brussels, HELCOM made an overview of the implementation of agreements in BSAP and MDs in 2010 and 2013[4]. The assessment separated "joint" and "national" actions, i.e. implemented via HELCOM cooperation and projects, or separately implemented by the individual CPs. The implementation status of joint actions were graded as "accomplished", "partly accomplished" (activity ongoing) or "not accomplished" (no ongoing activity). For national measures, the same scale was used with accomplished, partly or not accomplished meaning all, some or no CPs had implemented the action, respectively, with national reporting based on a self-evaluation made in 2016. The Actions were also categorized as:

1. Measures - directly aimed at reducing pressures or improving the state of the environment
   - Reduction of pressures
   - HELCOM Recommendations that require implementation through measures
   - Joint actions with the aim of influencing international regulations
2. Management coordination - aimed at establishing joint HELCOM principles for management of the marine environment
   - HELCOM Recommendations not included under Measures
   - Plans, guidelines and manuals
   - Assessment tools
   - Classification systems, reporting systems
   - Follow-up/assessments of agreed actions and plans
3. Monitoring and assessment
   - implementation of monitoring and surveillance, and assessments
4. Data, databases and information
5. Knowledge
   - promotion of research
   - reviews and evaluations
   - development of supporting information [e.g. modelling]

"Hazardous substances" includes pollution from land-based sources, and also from offshore activities (mainly accidental pollution by shipping).

The joint actions categorized as measures or management coordination that were accomplished were:

- Update of requirements of HELCOM Strategy for hazardous substances (HELCOM Recommendation 19/5)
- Update of HELCOM requirements concerning proper handling of waste/landfilling (HELCOM Recommendation 24/5)
- To assess the possibility of introducing restrictions on cadmium content in fertilisers. (Assessed as accomplished in 2013. Results of a more recent follow-up of Recommendation 31E/3 'Cadmium in fertilizers' is presented below.)
- Strictly control the dredging and disposal of sediments when revising the HELCOM Guidelines for disposal of dredged spoils
- Establish an ad hoc HELCOM Expert Group on dumped chemical munitions in the Baltic Sea
- Joint submissions to IMO to tighten regulations concerning SOx emissions from ships within the revision of Annex VI to MARPOL 73/78

Not accomplished joint actions were:

- Update of HELCOM requirements for iron/steel industry (HELCOM Recommendation 24/4) (Target year: not specified)
- Enhance co-operation between Paris MoU (Memorandum of Understanding) and HELCOM by applying for advisor status of HELCOM to Paris MoU on Port State Control (Target year: not specified)
- Update the Action Plan for the protection of the environment from offshore platforms; put into practice the "zero-discharge" principle for all chemicals and substances used and produced during the operation of offshore platforms (Target year: 2013)

Accomplished national actions were:

- Introduction of ban on the use, production and marketing of endosulfan, pentabromodiphenylether (pentaBDE) and octabromodiphenylether (octaBDE)
- Implementation of the Globally Harmonised System (GHS) on classification and labelling of chemicals and to take into account guidelines for preparing safety data sheets
- Ratification of the Stockholm POPs Convention
- Ratification of the AFS Convention (International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2009)

Partly accomplished national actions were (number of CPs / total CPs):

- National programmes to eliminate hazardous substances (6 / 9)
- Evaluation of effectiveness of national programmes to eliminate hazardous substance (5 / 9)
- Ratification of the UNEP 2013 Minamata Convention on Mercury (7 / 9)
- Develop specific efficiency requirements and emission limit values for small scale combustion appliances in relation to HELCOM Recommendation 28E-8 (3 / 9)

4 https://helcom.fi/wp-content/uploads/2019/06/Implementation-of-the-BSAP-2018.pdf

6.7. HELCOM Recommendations

6.7.1 The implementation status of Recommendations issued before 2007

HELCOM Recommendations on measures to address pollution sources are to be implemented by the CPs through their national legislation. In many cases, the provisions of the Recommendations have subsequently been integrated into common legal requirements for the EU member states and Russian national BREFs; these Recommendations are considered fully implemented (i.e. needed no follow up)[5]. In 2019, HELCOM national experts and the Secretariat evaluated Recommendations adopted before 2007 against BREFs and other EU legislation (and Russian national legal requirements, however this was not included in the document produced) and provided suggestions on Recommendations on industrial emissions that are to be followed up to support the BSAP update (excerpt from HELCOM report on implementation, Recommendations directly addressing hazardous substances[6]):

1. Industrial Connections and Point Sources other than Household Connected to **Municipal Sewerage Systems** 13-2/1992.
   - No follow up recommended All provisions of the Recommendation are covered by Urban Waste Water Treatment Directive 271/91/EEC
2. Reduction of Emissions and Discharges from the **Iron Steel Industry** 24-4/2003
   - To decide to follow up the recommendation in relation to minor industries. Provisions of the Recommendation have been included to the BREF 2012/135/EU Commission Implementing Decision of 28 February 2012, except minor industries.
3. Reduction of discharges and emissions from the **metal surface treatment** 23-7/2002
   - To decide to follow up the recommendation in relation to minor industries. Provisions of the Recommendation have been included to the BREF Surface Treatment of Metals and Plastics August 2006.
4. Reduction of Discharges and emissions from **production of textiles** 23-12/2002
   - Most of the actions are included to Reference Document on Best Available Techniques for the Textiles Industry July 2003 but some limit values for waste water and air emissions in the Recommendation are stricter than in BREF.
5. Elimination of **PCBs and PCTs** 25-1/2004
   - No follow up recommended for most actions. Provisions are largely included to Regulation (EC) No 850/2004; Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006
6. Basic Principles in Waste Water Management in the **Leather Industry** 16-7/1995
   - No follow up recommended: All provisions of the Recommendation have been included to the directives: Directive 2010/75/EU of the European Parliament and of the Council of the 24 November 2010 on industrial emissions (IED); Commission Implementing Decision no 2016/902 of 30 May 2016; Commission Implementing Decision no 2013/84/EU of 11 February 2013
7. Requirements for discharging of **waste water from the chemical industry** 23-11/2002
   - No follow up recommended All provisions of the Recommendation have been included to the directives: 2010/75/EU of the European Parliament and of the Council of the 24 November 2010 on industrial emissions (IED); Commission Implementing Decision no 2016/902 of 30 May 2016; Regulation no 2017/852 of the European Parliament and of the Council of 17 May 2017 on mercury.
8. **Approval of pesticides** ("Plant protection products") for use in the catchment area of the Baltic Sea 20-2/1999
   - No follow up recommended. All provisions of the Recommendation have been included into REGULATION (EC) No 1107/2009
9. Reduction of discharges and emissions from **production and formulation of pesticides** 23-10/2002
   - Provisions of the Recommendation to large extent covered by BREF for the Production of Large Volume Organic Chemicals. Nonetheless, some limit values in the HELCOM Recommendation are stricter than in BREF
10. Reduction of discharges from **oil refineries** 23-8/2002
    - No follow up recommended All provisions of the Recommendation have been included to the BREF for Mineral Oil and Gas Refineries
11. Limitation of emissions into atmosphere and discharges into water from **incineration of waste** 27-1/2006
    - No follow up recommended All provisions of the Recommendation have been included to the directive 2010/75/EU of the European Parliament and of the Council and Reference Document on the Best Available Techniques for Waste Incineration and in Industrial Emissions
12. Limitation of Emissions to the Atmosphere and Discharges into Water from **Glass Industry** 14-3/1993
    - Almost all provisions of the Recommendation are included to the BREF for the Manufacture of Glass. Only the limit value for NOx emissions in the HELCOM Recommendation is stricter than in BREF
13. Measures Aimed at the Reduction of **Mercury Resulting from Dentistry** 6-4/1985
    - To decide whether follow up is needed. Provisions are largely included to 2017/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017 and HELCOM PRESSURE 1-2014, item 7.10 The Meeting considered the proposal to revise HELCOM Recommendation 6/4 and was of the opinion that it is not necessary to update the Recommendation as most countries no longer use mercury in dentistry.
14. Measures aimed at the reduction of **mercury pollution resulting from light sources and electrical equipment** 23-4/2002
    - No follow up recommended for most actions. Provisions are largely included to DIRECTIVE 2011/65/EU; DIRECTIVE 2012/19/EU (WEE); 2017/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017 on mercury
15. Reduction of emissions and discharges of **mercury from chloralkali industry** 23-6/2002
    - No follow up recommended 2013/732/EU establishing the

5 https://portal.helcom.fi/meetings/HOD%2057-2019-620/MeetingDocuments/3-10-Rev.1%20Reporting%20on%20implementation%20of%20HELCOM%20Recommendations.pdf

6 https://portal.helcom.fi/meetings/PRESSURE%2010-2019-549/MeetingDocuments/DS-1-Rev.1%20Reporting%20on%20HELCOM%20Recommendations%20adopted%20before%202007.pdf

best available techniques (BAT) conclusions for the production of chlor-alkali products.

16. Restriction of atmospheric emissions and waste water discharges from **hard coal cokeries** 23-9/2002
    - Not evaluated.

Unclear status:

- **Antifouling paints** containing organotin compounds 20-4/1999 (under revision at the time of evaluation)
- Reduction of Emissions of Lead from Combustion of **Leaded Gasoline** 9-4/1988 (implemented in 2011)
- Reduction of **Emissions and Discharges from Industry by effective use of BAT** 25-2/2004 (Cd, Pb and also nutrient inputs) (to be followed up later by the Secretariat)
- Reduction of discharges from urban areas by the proper management of **storm water systems** 23-5/2002 To decide on the follow-up after discussion on the update of the Recommendation The suggestion to update the Recommendation was submitted to PRESSURE 10-2019

For these Recommendations directly addressing industrial emissions of hazardous substances and adopted before 2007, 9 of 16 Recommendations are nowadays covered by EU legislation and have no longer additional value for CPs that are EU member states. In 3 Recommendations there are some limit values recommended that are stricter than those in EU legislation, it is not clear to what extent the stricter values are hence applied in the CPs. The Recommendations on "Reduction of Emissions and Discharges from the Iron Steel Industry 24-4/2003" and "Reduction of discharges and emissions from the metal surface treatment 23-7/2002" are covered by EU BREFs, however not for sites with production volumes below the IED threshold. Russian experts later evaluated actions from Recommendations adopted before 2007 against the requirements of related national legislation and found that most of the provisions of the HELCOM Recommendations had been already included into national BREFs enacted since 1 January 2019. Exceptions were some specific requirements for sewage water discharges from the Iron Steel Industry (Recommendation 24-4) and HELCOM requirements beyond Stockholm Convention for elimination of PCBs and PCT (Recommendation 25-1)[7]. The Recommendations that were later covered by EU and Russian legislation were issued before all CPs except Russia became also EU Member States. It is hence conceivable that the Recommendations were relevant because not all CPs were EU members, but also directed by e.g. legally binding emission limits for those CPs that were already EU members.

In 2019, the Pressure WG followed-up the implementation of the Recommendations that were not fully covered by EU/Russian legislation, i.e. contributed additional restrictions on emissions, divided as recommendations adopted before and after 2007[8].

The implementation status of Recommendations issued before 2007 have so far been self-evaluated by Estonia, Finland, Germany, Lithuania and Poland, information is lacking for Denmark, Latvia, Russia and Sweden. The evaluation addressed the following Recommendations of direct relevance to hazardous substances[9]:

- 17-6 Reduction of Pollution from Discharges into Water, Emissions into the Atmosphere and Phosphogypsum out of the **Production of Fertilizers** (including limit values for some **metals**)
- 24-4 Reduction of Emissions and Discharges from the **Iron Steel Industry**
- 23-7 Reduction of discharges and emissions from the **metal surface treatment**
- 23-12 Reduction of Discharges and emissions from **production of textiles**
- 25-1 Elimination of **PCBs** and **PCTs**
- 6-4 Measures Aimed at the Reduction of **Mercury** Resulting from **Dentistry**
- 23-10 Reduction of discharges and emissions from **production and formulation** of **pesticides**
- 14-3 Limitation of Emissions to the Atmosphere and Discharges into Water from **Glass Industry**
- 23-4 Measures aimed at the reduction of mercury pollution resulting from light sources and electrical equipment
- 23-9 Restriction of atmospheric emissions and waste water discharges from **hard coal cookeries** (limit values for **PAH and phenol**)

These recommendations target mainly industrial metal emissions: emissions from industries working with fertilizers, metals, textiles, pulp/paper, glass, and also specifically mercury from dentistry and light sources & electrical equipment. There is also a recommendation on elimination of PCBs and PCTs (polychlorinated terphenyls).

In Estonia and Lithuania, the implementation of several Recommendations is "not applicable" because the industries targeted in the recommendations do not exist in these CPs (e.g. there is no fertilizer production, textile production, pesticide production/formulation, hard coal cookeries or iron steel industry in Estonia). In all other cases, the implementation of recommended actions is complete or ongoing, with the exception of "23-4 Measures aimed at the reduction of mercury pollution resulting from light sources and electrical equipment" which is not implemented in Germany or Lithuania, (as there is, according to the German answer, no general EU mercury ban in electrical equipment or requirement for mercury labelling, and exemptions from the RoSH directive are adopted in Germany).

"Ongoing" implementation could be e.g.: implementation of stricter limit values when the permits for facilities are renewed; substitution of certain substances (metals, sequestering agents, nonylphenolethoxylates, chlorinated organics) used in metal surface treatment occurs "continuously" depending on market forces and availability of alternatives; it is stated that a BAT document will be prepared; mercury waste from dental clinics is collected at the pace of removal of mercury filled teeth.

7 https://portal.helcom.fi/meetings/PRESSURE%2010-2019-549/MeetingDocuments/DS-1-Rev.1%20Reporting%20on%20HELCOM%20Recommendations%20adopted%20before%202007.pdf

8 https://portal.helcom.fi/meetings/HOD%2057-2019-620/MeetingDocuments/3-10-Att.1%20Reporting%20on%20implementation%20of%20HELCOM%20Recommendations.pdf

9 https://portal.helcom.fi/meetings/PRESSURE%2012-2020-734/MeetingDocuments/6-5%20Reporting%20on%20HELCOM%20Recommendations%20adopted%20before%202007.pdf

Full implementation in several cases means the requirement is transposed into national law, EU directives are in place overlapping with the recommendation, BAT/BREFs set lower emission limits, or it means that limits are complied with only when technically and economically feasible.

6.7.2 Implementation status for HELCOM Recommendations adopted after 2007

Implementation status for HELCOM Recommendations adopted after 2007 were reported by Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden[10].

These Recommendations target specific point sources: dioxins and metals emitted from small-scale combustion and crematoria, metals in batteries & accumulators and also cadmium in fertilizers (see the grey boxes). Recommendation 31E/1 Implementing HELCOM's objective for hazardous substances is however broader and make the recommendation to take certain principles and methodologies into account in national legislation.

The implementation of these recommendations is variable. Several CPs have worked to introduce low-emission combustion appliances and launched information campaigns regarding environmentally friendly combustion. It is noted that CPs however interpret emission limit values in 28E/8 differently (i.e. limits are not always set for dioxins although that is the target substance of the recommendation). Enforcing recommended requirements on crematoria is completed or ongoing in all CPs but two. The Recommendation regarding Batteries & accumulators is well implemented, with the exception that only Sweden has implemented limitations on transport of these items at sea. Most CPs have set national limit values for Cd in fertilizers at the time of evaluation, and in addition the new EU fertilizer product legislation (1009/2019) nowadays sets limits to Cd content in fertilizers.

Regarding 31E/1 Implementing HELCOM's objective for hazardous substances, all CPs report full implementation except Denmark, that grade this as an on-going action and mentions that further reduction of emissions for some prioritized substances is very difficult and that "guidance etc." is constantly updated. Also Russia defines this action as ongoing and refers to a "new technical guideline of Eurasian Economic Union is going to come in force" in 2018, however the link to the Recommendation is not clearly described.

Stating a simple implementation status for this broad recommendation is not straightforward. It is notable that 31E/1 in most parts overlaps with EU management of chemicals and water quality e.g. environmental principles (precaution, polluters pay, sustainable chemistry), BAT (a concept at the core of the Industrial Emissions Directive[11]), substitution (REACH), sustainable/green chemistry. It is stated that "precautionary risk management measures based on the intrinsic properties of chemicals should be applied using internationally agreed systems for classification and labelling", referring to REACH criteria for identifying substances of very high concern, or OSPAR Selection Criteria of the OSPAR Dynamic Selection and Prioritisation Mechanism for Hazardous Substances. CPs that are EU member states and signatories of the Stockholm Convention (implemented in EU legislation) and CLRTAP should by these commitments already implement large parts of 31E/1. Some aspects of 31E/1 are also hard to imagine a CP not doing, e.g. when implementing as a priority the most cost-effective measures also "take into account advantages and disadvantages of proposed measures". Other parts of the Recommendation 31E/1 cannot entirely be regarded as completed by HELCOM, e.g. the coordination in "identifying the sources of hazardous substances and their pathways to the marine environment, using, inter alia, information derived from monitor-

Evaluated Recommendations adopted after 2007 explicitly addressing hazardous substances. Numbers indicate how many CPs report full implementation:

- 28E/8, Environmentally friendly practices for the reduction and prevention of emissions of dioxins and other hazardous substances from **small-scale combustion** (4/9)
- 29/1, Reduction of Emissions from **Crematoria** (3/9)
- 31E/1, Implementing **HELCOM's objective** for hazardous substances (7/9)
- 31E/2, **Batteries and accumulators** and waste batteries and accumulators containing mercury, cadmium or lead (1/9)
- 31E/3, Cadmium in **fertilizers** (7/9)

Note that the following Recommendations addressing specific hazardous substances are also issued in recent years (but implementation is not evaluated):

- HELCOM Recommendation 38/1 Sewage Sludge Handling
- HELCOM Recommendation 37-38/2 superseding HELCOM Recommendation 24/1 Monitoring of airborne pollution input
- HELCOM Recommendation 37-38/1 superseding HELCOM Recommendation 26/2 Waterborne pollution input assessment (PLC-Water)

In addition, the implementation of the following Recommendations that have only indirect impact on emissions of hazardous substances were evaluated:

- 19/1, Marine Sediment Extraction in the Baltic Sea Area
- 28E/5, Municipal wastewater treatment
- 28E/6, On-site wastewater treatment of single-family homes, small businesses and settlements up to 300 Person Equivalents (P.E.)
- 31E/4, Proper handling of waste/landfilling

10 https://portal.helcom.fi/meetings/HOD%2057-2019-620/MeetingDocuments/3-10-Rev.1%20Reporting%20on%20implementation%20of%20HELCOM%20Recommendations.pdf

11 https://portal.helcom.fi/meetings/CG%20Aquaculture%202-2018-574/MeetingDocuments/4-2%20Att.%20Definitions%20of%20BATBEP%20Analysis.pdf

ing, research, specific surveys and assessment activities;" which must be considered an ongoing activity of HELCOM and CPs as sources and pathways are not well described for many of the prioritized substances listed in 31E/1. Another action of 31E/1 that is not clearly implemented is that "The Commission and the Contracting Parties will invite and encourage industry to co-operate in fulfilling the Objective of HELCOM with regard to hazardous substances /… / to provide reliable data on production volumes, use patterns, emission scenarios, exposure concentrations and properties of substances." This kind of information is currently not provided to HELCOM. Producers and importers in EU member states are obliged to provide such information during registration under REACH, however this information is not provided to HELCOM and is not tailored for the Baltic Sea region. For Nordic countries, data on chemical products are available in the SPIN register. How to exploit such data sources e.g. to develop measures or identify priority substances is not described.

6.8. Activities of Pressure WG and sub-groups

Activities relating to hazardous substances are summarized below:

Action 1

Guide Pollution Load Compilations (PLCs) and prepare related reports meeting policy needs, including core indicators

1.1. Annual compilation of air- and waterborne inputs (continuous)
   - Produce annual report and BSEFS Baltic Sea Environment Fact Sheet
   - Consider inclusion of new and/or rotation of already covered substances in accordance with the HELCOM priorities and data availability

1.2. Compilation of PLC 7 data reporting. (2020)
   Producing assessment reports:
   Update of the PLC-water Guidelines and statistic report
   - assessment of input of selected hazardous substances, their sources and pathways;

1.3. Regular update of the HELCOM information resources (e.g. GIS map service) (continuous)

Action 3

Pollution prevention from waste water treatment, including sustainable handling of sewage sludge

3.2. Follow up implementation of the HELCOM Recommendation on sustainable handling of sewage sludge in terms of compilation of the reported data and discuss on opportunities to set regional limit values for hazardous substances. (continuous)

3.3. Discussion on the best available solution to utilize nutrients and other valuable properties of sewage sludge minimising a potential adverse environmental effect. (according to BSR Water plan in 2020)

3.4. Implementation of the new HELCOM action on Micropollutants in effluents from wastewater treatment plants. (2019)

Action 4

Solutions for limiting emissions and losses of hazardous substances

4.1. Revision of the strategy to implement the HELCOM objective for hazardous substances priorities outlined by the HELCOM Recommendation 31E/1 "Implementing HELCOM's objective for hazardous substances" as a part of the BSAP update (2020)

4.2. Cooperate with State&Conservation to further advance HELCOM indicators on hazardous substances integrating into them information on loads, pathways and sources of the pollutants. As a part of policy relevance of indicators also follow up development of relevant national and international legislation (e.g. UNEP 2013 Minamata Convention, Gothenburg protocol, etc.) (continuous from 2020)

4.3. Identification of emerging pollutants, evaluation of the scale of problems and suggestion of mitigation measures. (continuous)

4.4. Assessing the state of threat to the Baltic Sea marine environment posed by input of pharmaceuticals, filling in data and knowledge gaps, prioritization of measures with aim to elaborate regional policy in terms of pharmaceuticals in the region. (continuous from 2020)

4.5. Identify and assess further hazardous substances and contaminants from offshore sources, which may give rise to pollution effects, and develop appropriate mitigation measures. (2019)

4.6. Consider policy relevant proposals raised by PA Hazards of EUSBSR (continuous)

Action 7

Assess individual or newly identified point sources of pollution

7.1. Consider, and where applicable agree on deletion of remaining hot spots from the JCP list in accordance with HELCOM procedures. (continuous)

7.2. Identify current and emerging issues related to point sources of land based and other pollution and assess the effectiveness of the measures being adopted and the need for any additional or different measures (on-going)

Action 8

Climate change

8.1. Contribute to scientific understanding of the impacts of climate change together with multiple other stressors on the Baltic Sea marine environment and environmental pressures in cooperation with State&Conservation (continuous)

8.2. Develop suggestions, within the group's mandate, to increase HELCOM's preparedness to respond to climate change impacts by taking foreseen climate change impacts into account when updating the BSAP and by adaptation of relevant policies and recommendations. (2020)

Action 9

Reporting on implementation of BSAP and HELCOM Recommendations in the remit of PRESSURE

9.1. Regular reviewing the state of implementation of the HELCOM agreements; follow up implementation of national actions; reviewing of the existing Recommendations Further contribute to the HELCOM Explorer (indicator-based follow up system for BSAP) as may be decided (continuous)

6.9. Activities of WG Pressure and sub-groups –

details

Action 1
Guide Pollution Load Compilations (PLCs) and prepare related reports meeting policy needs, including core indicators

Air and waterborne inputs. The Pressure group continuously compiles and analyses information regarding air-and waterborne inputs of pollutants, mainly nutrients but also some hazardous substances. The main activity is the Pollution Load Compilation projects (PLC7 is to be finished in 2020), which are carried out as separate projects but are a continuous activity of the Pressure group. The PLC work is carried out by the Reduction Scheme Core Drafting Group (RedCore DG), a sub-group to Pressure. The PLC projects compile national data, provide technical guidelines and statistic reports. The PLC utilizes monitoring data obtained in accordance with the requirements of the HELCOM Recommendation 37-38/1 "Waterborne pollution input assessment (PLC-WATER)", i.e. metal inputs from point sources (municipal and industrial effluents) and monitored rivers. Atmospheric deposition of nitrogen, cadmium, lead and mercury to the Baltic Sea is assessed and reported to HELCOM regularly by EMEP (Co-operative Programme for Monitoring and Evaluation of Long-Range Transmission of Air Pollutants in Europe). (EMEP also estimates atmospheric deposition of other hazardous substances for which waterborne transport is not estimated.) Based on the PLC information, annual reports and Baltic Sea Environmental Fact Sheets are produced. The Pressure group also update the online HELCOM information resources (map-service).

Action 3
Pollution prevention from waste water treatment, including sustainable handling of sewage sludge

Sewage sludge. Pressure is also continuously following up the implementation of the HELCOM Recommendation regarding handling of sewage sludge, based on reporting from CPs. This follow up is carried out by Lead countries (unclear which CP is leading this). Discussions of opportunities to set regional limit values for hazardous substances in sludge is also listed as a continuous activity.

Action 4
Solutions for limiting emissions and losses of hazardous substances

Loads, pathways, sources of indicator substances. A continuous activity which is new and will continue from 2020 and onwards is for Pressure to cooperate with State&Conservation to advance the HELCOM indicators by including assessments of loads, pathways and sources, and also to start following up (national and international) legislation for indicator substances. This is to be carried out by a Lead country (unclear which CP is leading this) with involvement of temporary projects, RedCore, CG Pharma, EN-hz, State&Conservation, and EMEP+PLC7.

Action 7
Assess individual or newly identified point sources of pollution

Identify emerging pollutants. In 2020 and thereafter onwards, Pressure will also identify emerging pollutants, scale of the problem and possible measures for these. Responsible are State&Conservation, PA Hazard and also temporary projects CW Pharma, HAZBREF, BEST, and BSR Water. Unclear which CP is leading this.

Pharmaceuticals. The CG Pharma (together with Sweden, other countries willing to take lead and temporary projects) is responsible for continuously assessing pollution by pharmaceuticals and elaborate on the regional policy regarding this substances group.

Policy proposals. Sweden continuously ensure that policy proposals raised by PA Hazards are considered by the Pressure group.

Action 7
Assess individual or newly identified point sources of pollution

Hotspots. The CPs are responsible for a continuous process where hot spots at the JCP list are deleted when applicable.

Point sources. Another action described as ongoing is identification of emerging issues related to point sources, effectiveness of measures for these and need for additional/other measures. Unclear which CP is leading this.

Action 8
Climate change

Multiple stressors. Another action is to contribute to scientific understanding of the cumulative impacts of climate change and other stressors. This is lead by EN-CLIME and is in cooperation with State&Conservation and temporary projects.

Action 9
Reporting on implementation of BSAP and HELCOM Recommendations in the remit of PRESSURE

Follow up BSAP and Recommendations. CPs continuously report (as agreed on the implementation of national actions and review the existing Recommendations. (Unclear mechanism who initiates a revision of Recommendations.)

Temporary actions: In addition to the continuous tasks performed by Pressure, temporary actions are carried out. During 2019-2020 these actions addressed re-use of sludge (BSR Water project), inventory of micropollutants in wastewater and advanced treatment technologies, revision of Recommendation 31E/1 "Implementing HELCOM's objective for hazardous substances" as a part of the BSAP update (CG Pharma, Projects HAZBREF and BSR Water), identify and assess hazardous substances emitted from off-shore sources (CPs provide info, Maritime group), develop suggestions for preparedness of HELCOM to respond to climate change (EN-CLIME, State&Conservation)

6.10. Activities of State and Conservation Working Group and sub-groups

Activities of State&Conservation WG with relevance specifically for hazardous substances are summarized in the following and link to tasks from terms of reference for the group[12]:

ToR Task 1:
Implementation of the HELCOM Monitoring and Assessment Strategy, including development of necessary manuals and guidelines i.a. related to quality assurance, taking into ac-

12 https://portal.helcom.fi/meetings/STATE%20-%20CONSERVATION%2011-2019-662/MeetingDocuments/2N-1%20work%20plan%20for%20the%20State%20and%20Conservation%20Working%20Group%202019-2020.pdf

count the existing international guidance documents

— BSAP 1, Analyse cost-efficiency of joint monitoring. State and Conservation, Spring 2019

ToR Task 2:

Functioning of the HELCOM Joint Coordinated Monitoring system covering all aspects from flora and fauna of the Baltic Sea to water quality and human pressures

— 2.2 Develop a reporting system on prioritized human activities and pressures, building on the existing HELCOM reporting, to regularly collect harmonized data for HELCOM assessments, State and Conservation, Other WGs, Secretariat. Link to MSP needs. Need to find functioning working structure. Exchange with Pressure and HELCOM_VASAB MSP. Identification of priorities for regular reporting using HOLAS II BSPI BSII information

— BSAP 2 Review and if needed further develop monitoring to follow-up implementation and effect of measures under the Baltic Sea Action Plan. State and Conservation. Possible link to BONUS FUMARI and BONUS SEAM. Start in 2020

Link to ToR Duties:

B. Provide technical and scientific support for the implementation of the HELCOM Baltic Sea Action Plan, Ministerial Declarations and HELCOM Recommendations as well as propose strategies, guidelines and recommendations in the area of its expertise according to the existing priorities as well as requests by the Heads of Delegations and subsidiary bodies;

C. Coordinate and implement the monitoring and assessment activities of HELCOM related to biodiversity, and status of and effects on the marine environment with regards to eutrophication, hazardous substances, including radioactive substances, marine litter and underwater noise, as well as assessment of human pressures and their impacts affecting the sea state, thereby implementing the HELCOM Monitoring and Assessment Strategy;

— Follow up on implementation of and reporting on HELCOM Recommendations under the Assessment and indicator section of State and Conservation. State and Conservation. Continuous

— Develop follow up systems and reporting schemes for those HELCOM Recommendations under the Assessment and indicator section of State and Conservation for which such are not yet available. State and Conservation. Continuous

Update of the Baltic Sea Action Plan

— BSAP UP 7. Review of ongoing work on synthesis of existing knowledge to support the analysis of sufficiency of measures and identification of potential new measures. State and Conservation. 2019-mid 2020

— BSAP UP 8. Develop and consider and proposals on new measures, including based on syntheses of knowledge. State and Conservation. Consider the timeframe for the MSFD PoMs, initial consideration could start in fall 2019. spring 2020

— BSAP UP 9. Further elaboration of possible actions, including an evaluation of effect of proposed new measures (at WG meetings or HELCOM workshops to be decided). State and Conservation. autumn 2020

ToR Task 3:

Development of operational HELCOM core indicators, with associated targets to serve e.g. holistic assessments according to the goals and objectives of the Baltic Sea Action Plan, HELCOM Ministerial Declarations, and the EU Marine Strategy Framework Directive for those Contracting Parties also being EU Member States

— 3.1 Review the current state of core indicators, policy relevance, integration methods and identify gaps. State and Conservation, Gear. Link Pressure and Fish to the work. 2019

— 3.2 Review the data flows for each indicator and consider how these could be improved. State and Conservation to provide thematic guidance to the work and provide initial prioritization on how to fill the identified gaps. State and Conservation. EG MAMA, ZEN-ZIIM, PEG, EN-HAZ, FISH-PRO III, JWG BIRD, EN BENTIC, EN LITTER, EN NOISE, EG MORS, Secretariat. 2019-2020

— 3.3 Development new HELCOM core, pre-core and candidate indicators, based on gaps identified under the review process. State and Conservation, Pressure, EG MAMA, ZEN-ZIIM, PEG, EN-HAZ, FISH-PRO III, JWG BIRD, EN BENTIC, EN LITTER, EN NOISE, EG MORS, Secretariat. Ongoing.

— 3.4 Link indicators with loads and sources. State and Conservation, Pressure. Relevant EG's under State and Conservation and Pressure. Chairs of State and Conservation and and Pressure to attend the relevant sessions of the respective meetings to support information exchange. Starting in 2019

— 3.5 Operationalization of hazardous substances assessment system. State and Conservation, EN HAZ. Ongoing activity under EN-HAZ.

ToR Task 4:

Periodic assessments of:

— *biodiversity, eutrophication, hazardous substances, marine litter and underwater noise, thereby providing building blocks for HELCOM Holistic assessments;*

— *threat status of Baltic Sea species and habitats/biotopes;*

— 4.4 Planning for hazardous substances assessments, including developing methods and tools to support future assessments. State and Conservation, EN HAZ. 2019-2020

— 4.9.1 Produce a Fact sheet on Climate Change. State and Conservation with Baltic Earth, EN CLIME. 2019-mid 2020

ToR Task 8:

Cooperate with, and seek synergies with relevant work carried out in other international organizations and institutions and processes relevant for the group such as ICES, EEA, JRC, OSPAR, Convention on Biological Diversity, MSFD Common Implementation Strategy, etc.

— 8.2 Identify areas of further cooperation and operationalize cooperation with OSPAR, e.g. on issues relating to assessments, indicators and conservation. State and Conservation. Continuous

— 8.4 Identify areas of further cooperation and operationalize cooperation with EU technical groups related MSFD descriptors 1-11 and Habitats Directive. State and Conservation. Continuous

ToR Task 9:

Develop and maintain the regional data and information systems needed to carry out its tasks

— 9.1 Map and review data flows related to assessments and indicators, and further streamline and develop data flow infrastructure, as needed. State and Conservation. All EG's. Striving for INSPIRE compliance. 2019-2020

7. Overview of current cooperation between HELCOM and other institutions – description of interactions

7.1. OSPAR

Cooperation with Regional Sea Conventions (RSCs) involves, when it comes to hazardous substances, mainly involves the most direct links with OSPAR (the unification of the Oslo and Paris conventions in 1992). OSPAR is a comparable organisation to HELCOM by which 15 governments and the EU cooperate to protect the marine environment of the North-East Atlantic. HELCOM and OSPAR have collaborated for a number of years and through varying joint efforts or information exchange, often facilitated by countries (CPs) in both RSCss. A statement by OSPAR to the MD in Brussels 2018[1] describes the cooperation: "HELCOM and OSPAR have a common vision of an ecosystem approach to managing human activities impacting on the marine environment as reflected by the joint adoption of the "Statement on the Ecosystem Approach to the Management of Human Activities" at the joint Ministerial Meeting held in Bremen in June 2003 (Annex 5 to the Report of the Joint Ministerial Meeting, 2003)". Discussions in the recent years address the issue of fulfilling the UN Sustainable Development Goals, especially goal 14 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development'. Denmark, Finland, Germany and Sweden are CPs of both conventions and from that position contribute to cooperation. Kattegat, where the North Sea and the Baltic Sea connect, is a transition area shared by OSPAR and HELCOM, consequently with most opportunities for enhanced collaboration (statement in abovementioned OSPAR letter). Other records of OSPAR in official documentation include Recommendation 31E/1 Implementing HELCOM's objective for hazardous substances with a statement that the EU/OSPAR approach to risk assessment is encouraged, as well as cooperation regarding monitoring and a regular update of the priority list.

The MD 2013 in Copenhagen presents a decision to use the limited resources more effectively by drawing on synergies between HELCOM, MSFD and other Regional Sea Conventions (e.g. OSPAR), and support regional cooperation and coherence by joint "Baltic Sea roof reports". MD 2018 Brussels also mention OSPAR in the context of UN SDGs. In addition to encouraging resource use efficiency these cooperations are aimed at establishing common methodologies and approaches between the regions, a factor of increased importance for CPs in both RSCs. Both OSPAR and HELCOM aim to support CPs that are EU members to deliver to commitments under the MSFD by acting as the platform for the implementation of the MSFD.

With respect to hazardous substances specifically, HELCOM and OSPAR cooperate with respect to monitoring and assessment methodologies, e.g. data collection, monitoring guidelines, use of thresholds in assessments etc. The cooperation builds on the use of a common approach, e.g. using guidelines and methods as templates and sharing of cutting edge scientific knowledge, with necessary adaptation for the specific regions, in practice via experts active in both conventions' working groups. Experts inform about activities that may be considered or valuable in sister RSCs, some recent examples include participation in SAICM beyond 2020 and proposal of regional joint screening campaigns.

Environmental monitoring data (HELCOM Combine monitoring program) are reported annually by HELCOM countries to the DOME data portal, which is hosted by the International Council for the Exploration of the Sea (ICES). This data portal is used also by OSPAR, AMAP and ICES Expert Groups. An earlier cooperation between HELCOM and OSPAR facilitated further work on the OSPAR contaminants tool and the adaptation of the approach to be applicable in the Baltic Sea environment. Since this cooperation HELCOM utilizes the OSPAR contaminant assessment tool, the Monitoring and on Trends and Effects of Substances in the Marine Environment (MIME) indicator assessment protocol R-script, for processing the data reported to ICES. The MIME script was originally developed in the OSPAR Commission Working Group on Monitoring of trends and Effects of substances in the Marine Environment (ICG-MIME) and has been adapted to HELCOM core indicator requirements [24].

The 45th HOD meeting, Finland 2014, discussed cooperation between HELCOM and OSPAR, Bonn Agreement, Black Sea Commission and ICES. Hazardous substances were only mentioned in the context of support of HELCOM monitoring system by ICES. However, a new potential area for cooperation identified was that joint requests with OSPAR to EMEP[2] regarding atmospheric deposition of hazardous substances would possibly allow covering a wider spectrum of substances and more efficient use of resources for a common task. More generally (not specifically discussed for hazardous substances, but potentially applicable

1 https://portal.helcom.fi/meetings/HELCOM%2039-2018-504/MeetingDocuments/2-2%20OSPAR%20contribution%20to%20HELCOM%20Ministerial%20Meeting%202018.pdf

2 https://portal.helcom.fi/meetings/HOD%2045-2014-130/MeetingDocuments/3-5%20Cooperation%20between%20HELCOM%20and%20OSPAR,%20Bonn%20Agreement,%20Black%20Sea%20Commission%20and%20ICES.pdf

also to this theme), possibilities for how to better draw on synergies between HELCOM, other RSCs, ICES mentioned at his meeting include: establishment of joint groups and projects, mutual participation in the meetings and workshops, appointing liaison persons or rapporteurs, agreeing on RSC leading or pioneering specific topics, joint letters and calls, using common reporting formats, schedules and survey protocols, using compatible software and GIS tools, introducing similarities to the databases[3]

7.2. ICES

The International Council for the Exploration of the Sea (ICES) is an intergovernmental marine science organization with the goal to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. The work is accomplished by scientists working together in expert groups, workshops and committees. All HELCOM CPs are also members of ICES.

According to their web-page, the Working Group on Biological Effects of Contaminants (WGBEC) initiates transnational research and monitoring and provides guidance to international organizations and conventions such as OSPAR, HELCOM, and AMAP, including in relation to the Marine Strategy Framework Directive (MSFD). The link to OSPAR seems however more active than that to HELCOM; no collaboration with HELCOM is mentioned e.g. in the annual report [25] of this group from 2018. The Marine Chemistry Working Group (MCWG): A significant part of its effort is linked to ICES advisory process, which includes answering to requests from regional sea conventions (however, not from HELCOM, partly due to limited budget of HELCOM to pay for this service) and providing technical advice in support of the EU Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD). No activities involving HELCOM are mentioned in the latest report [26].

The Working Group on Marine Sediments in Relation to Pollution (WGMS) efforts have resulted in guidelines for monitoring and assessment tools in support of harmonized monitoring under OSPAR's Joint Assessment and Monitoring Programme, which relates to their hazardous substances strategies. No activities involving HELCOM are mentioned in the latest report [27].

However, experts in HELCOM EN-HZ who are involved in ICES working groups constitute an informal link between the networks for information transfer and data requests, e.g. as recently regarding field data on chemicals of emerging concern [4].

The ICES-HELCOM link with respect to hazardous substances involves mainly the role of ICES as data host for contaminant monitoring data. HELCOM cooperation with ICES was previously in the form of scientific advice from ICES[5] to HELCOM (however not regarding hazardous substances), but nowadays more often in joint projects or undertakings (e.g. the SPICE and TAPAS projects), in addition to ICES functioning as data host for the HELCOM Monitoring System (oceanographic data, biological data and contaminants data) (see section on OSPAR)[6]. ICES often functions as a bridge between HELCOM and OSPAR when it comes to data compilation and assessment as representatives (SWE, DE, DK) from both organization often participates in equivalent Expert and Working Group meetings in both RSCs.

7.3. European Commission (Commission expert groups and JRC)

The European Union is a Contracting Party in HELCOM, with a representative in HOD from the EC DG Environment. The EU commonly has participants in the regular HELCOM Working Groups meetings also (e.g. PRESSURE, GEAR and State and Conservation).

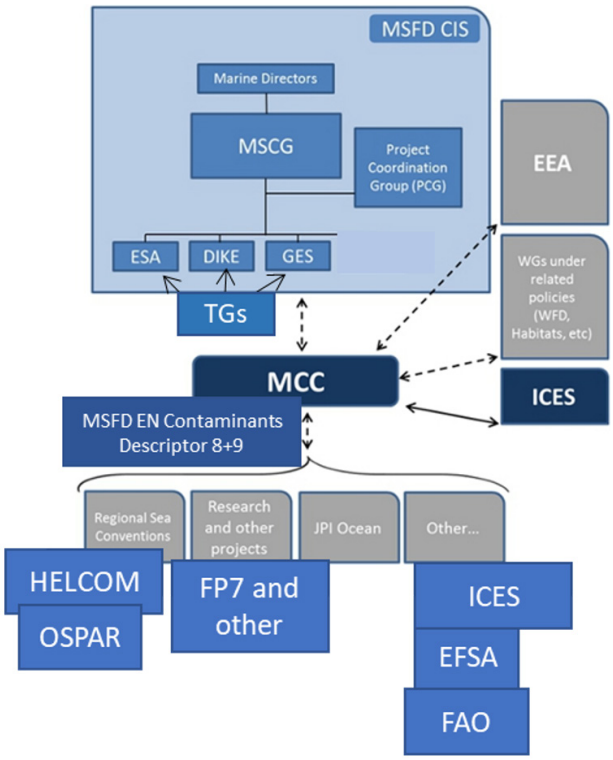

Figure 7. Overview of the Marine Strategy Framework Directive Competence Centre (MCC) interactions with other actors. MCC is hosted and supported by the Joint Research Centre (JRC), directly exchanges with all Marine Strategy Framework Directive (MSFD) Common Implementation Strategy (CIS) players: Marine Directors, Marine Strategy Coordination Group (MSCG), CIS Working Groups (Economic and Social Assessment (WG ESA); Data, Information and Knowledge Exchange (WG DIKE); Good Environmental Status (WG GES)), and other Technical Groups (TGs) related to each of the MSFD Descriptors. Adapted from MCC web-page

3 https://portal.helcom.fi/meetings/HOD%2045-2014-130/MeetingDocuments/3-5%20Cooperation%20between%20HELCOM%20and%20OSPAR,%20Bonn%20Agreement,%20Black%20Sea%20Commission%20and%20ICES.pdf

4 https://portal.helcom.fi/meetings/EN-HZ%2010-2019-608/MeetingDocuments/14-4%20ICES_request_emerging_cont.pdf

5 http://ices.dk/about-ICES/Documents/Cooperation%20agreements/HELCOM/MoU%20ICES%20and%20HELCOM%201999.pdf

6 https://portal.helcom.fi/meetings/HOD%2045-2014-130/MeetingDocuments/3-5%20Cooperation%20between%20HELCOM%20and%20OSPAR,%20Bonn%20Agreement,%20Black%20Sea%20Commission%20and%20ICES.pdf

HELCOM, similarly as other RSCs, is an observer (i.e. can take part in discussions and provide expertise, but cannot vote or take part in drawing up the expert groups' recommendations or advice) in the Commission Expert Group on Strategic Coordination for the Marine Strategy Framework Directive (MSCG) and most of its subgroups[7]. These groups are typically populated by representatives of Member State ministries of environment or environmental protection agencies and ministries, which are in many cases also national representatives in HELCOM WGs and/or other RSCs. The Secretariat staff members attend the meetings as HELCOM observers.

The Joint Research Centre is the European Commission's science and knowledge service. The JRC employs scientists to carry out research in order to provide independent scientific advice and support to EU policy. The JRC hosts the MSFD Competence Centre (MCC). The MCC aims to share harmonised marine policy and science information, and to provide the MSFD Common Implementation Strategy with scientific knowledge. The MSFD Expert Network on Contaminants deliver technical support for the implementation of MSFD Descriptors 8 and 9. The network involves scientists and experts from various national agencies and organizations including RSCs. Temporary Core Groups are formed for specific issues such as Core group- Exclusion WFD PS from MSFD open sea assessments. The HELCOM Secretariat nominates staff to attend the meetings, and representatives from HELCOM CPs are also members of this network.

Members in the EU groups mentioned above, groups of other RSCs and HELCOM groups (WGs, ENs, DGs) are often the same people, and the chair/coordinator of the MSFD Expert Network on Contaminants frequently attend HELCOM group meetings (e.g. Pressure, EN-HZ, CG PHARMA). Information regarding activities in HELCOM and in the EC work on implementing MSFD is exchanged at the meetings of the various groups, but also e.g. OSPAR and other observes/members. The MSFD groups thus have important functions to facilitate information exchange, build consensus, avoid double work, to support HELCOM in its role as the platform for MSFD implementation, to provide consolidated regional input to the MSFD groups, and thus support work of HELCOM Contracting Parties that are also EU Member States with MSFD commitments.

The EC and EEA are developing WISE-Marine, a portal for sharing information with the marine community on the marine environment at European level. The information is provided by Member States through implementation and reporting for the MSFD, but also from other EU legislation and contributions from stakeholders involved in the MSFD Common Implementation Strategy, including HELCOM, OSPAR and ICES. The cooperation involves e.g. technical discussions between HELCOM, OSPAR and WG DIKE regarding data reporting [8].

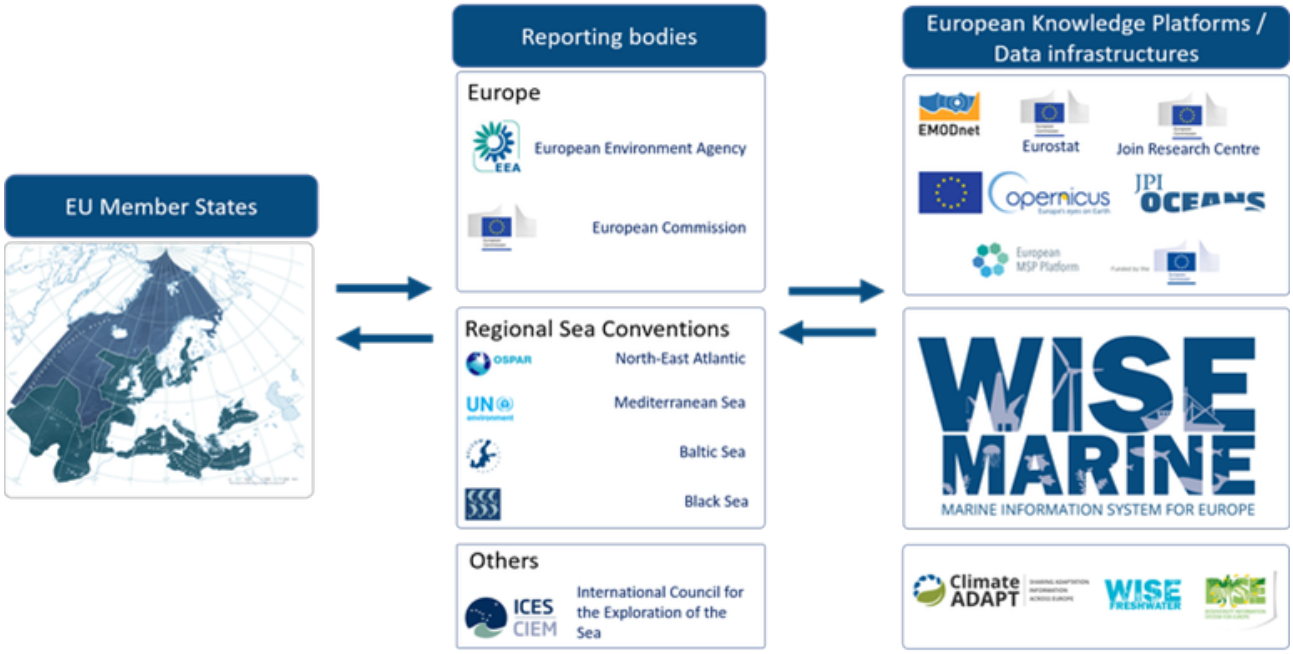

Figure 8. Overview of the WISE marine portal for data and information exchange between EU actors and the marine community in the region. Overview adapted from webpage.

7 Working group on Data Information and Knowledge Exchange (WG DIKE), Technical subgroup on Underwater Noise (TG Noise), Working group Programme of Measures, Economic and Social Analysis (WG POMESA),Working group on Good Environmental Status (WG GES), Technical Subgroup on Marine Data (TG Data), Technical Subgroup on Technical Group on seabed habitats and sea-floor integrity (TG Seabed). (HELCOM is not a member of the Technical Subgroup on Marine litter (TG Marine Litter)

https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2550&NewSearch=1&NewSearch=1).

8 WG DIKE 22nd meeting 12 March 2020, Minutes https://circabc.europa.eu/ui/#

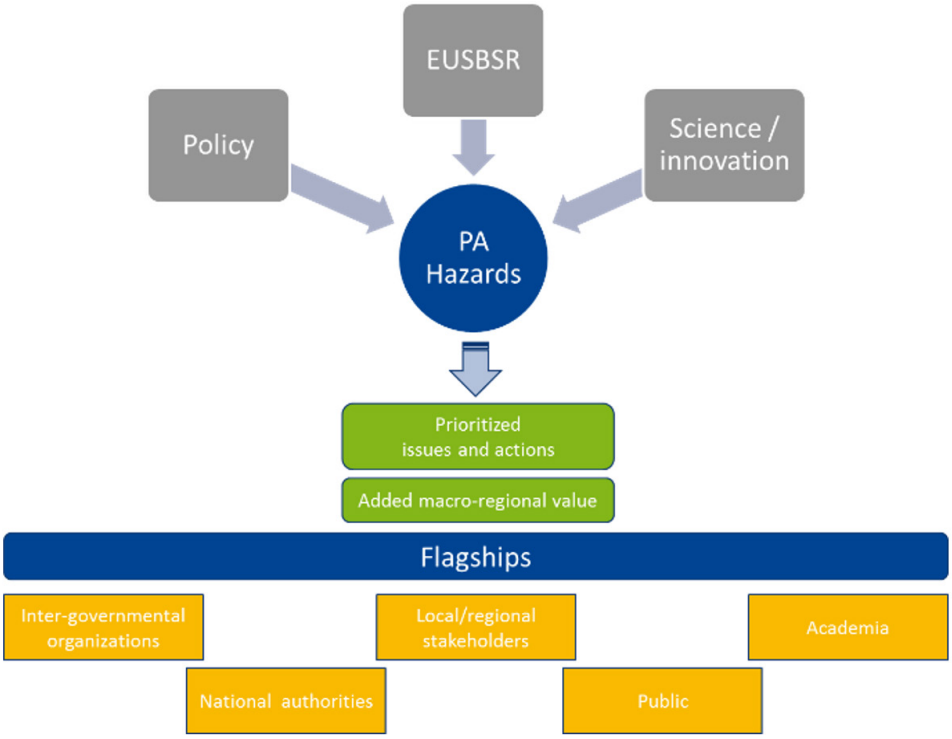

Figure 9. Overview of PA Hazards organization, from webpage[9].

7.4. MSFD implementation coordination

In relation to the EU, HELCOM's role as coordinating platform for MSFD is a key function. The Ministerial Declaration from Moscow 2010 states that a core set of indicators with quantitative targets shall be developed for hazardous substances and the other segments of the BSAP, and at the same time ensure that these indicators can be used for other international monitoring and reporting requirements (EU MSFD). The Copenhagen MD 2013 further specifies that "regional knowledge and specificities" of the Baltic Sea should be promoted at the European and in international fora, and that limited resources should be used efficiently by drawing on synergies between HELCOM and other organizations, mentioning Regional Sea Conventions/Organizations and the MSFD CIS. Joint documentation to support coordination and coherence should be produced, i.e. Baltic Sea Roof Reports.

It is the WG GEAR that is responsible for the implementation of the BSAP and follow-up decisions in MDs, and coordination of implementation of MSFD including coordination of activities under the Maritime Doctrine of Russia[10]. Coherence should be ensured between assessments of GES, establishment of environmental targets, monitoring programs and Programs of Measures (PoMs). Work on MSFD regional coordination by those Contracting Parties who are also EU Member States will support the overall effort in HELCOM to streamline and link up work so that it can serve various objectives, including the next BSAP and other policy requirements. Synergies with other processes and organisations should also be ensured (e.g. other regional seas conventions such as OSPAR and other EU Directives such as Habitats-, Birds- and Water Framework Directives, and UN SDGs). GEAR is responsible for identifying collaboration needs/opportunities with OSPAR and Black Sea Commission. GEAR is also tasked to analyze relationships between activities of HELCOM and EU Strategy for the Baltic Sea Region (EUSBSR) and propose ways on how to get better synergies in the implementation and improve coordination between HELCOM and EUSBSR.

7.5. EUSBSR – PA Hazards

The EU Strategy for the Baltic Sea Region (EUSBSR) was adopted by the EC in 2009[11]. EUSBSR is a platform for cooperation and coordination of activities in the region. One objective is to "save the sea" and to do this, "hazards" are mentioned as a policy area (PA),

9 Baltic Sea countries, area Hazards, Steering group organization and documentation – Swedish Environmental Protection Agency (swedishepa.se)
10 https://helcom.fi/media/documents/GEAR-Terms-of-Reference-1.pdf
11 https://portal.helcom.fi/meetings/PRESSURE%201-2014-184/Documents/Presentation%2010_PA%20Hazards%20and%20projects.pdf

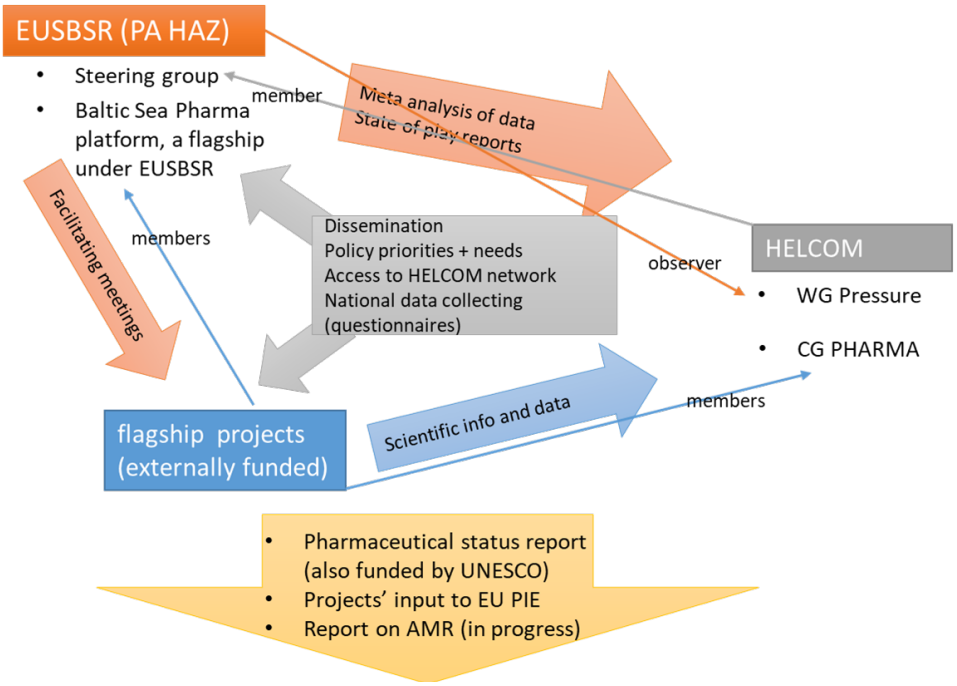

Figure 10. Interactions and information flows between PA Hazards and HELCOM.

in this case meaning use and impact of hazardous substances in the region. PA Hazards is coordinated by Swedish EPA. The steering group is composed of national representatives from all Baltic Sea EU countries, the European Commission and HELCOM. The steering group is chaired by the Policy Area Coordinator (PAC). PA Hazards works by linking policy and science/innovation. This is done by arranging meetings (platforms for stakeholders) aiming to connect stakeholders (including researchers) and provide opportunities to disseminate project results. PA Hazards works though "flagships" which can be projects, sets of activities or processes. PA Hazards work to facilitate funding of transnational projects fitting the PA Hazards priorities. Such externally funded projects can be nominated flagship projects by the steering group. PA Hazards also sometimes funds smaller commissioned projects (e.g. literature reviews) on subjects related to the priority policy areas with funding from EU INTERREG Baltic Sea Programme (priority 4.2 support EUSBSR coordination).

PA Hazards works on focus topics[12]. The years 2020 to 2025, the policy area is prioritizing:

— Pharmaceuticals in the Baltic Sea environment (PIE)
— Highly fluorinated substances (PFAS/ PFOS)

HELCOM and PA Hazards work jointly to address pharmaceuticals in the Baltic Sea. This work has so far resulted in the regional status report on pharmaceuticals (also funded by UNESCO) and the HELCOM Correspondence Group on Pharmaceuticals (CG PHARMA), which also deals with follow-up activities from the status report[13].

The link between PA Hazards and HELCOM is strong as the HELCOM secretariat is represented in the steering group and PA Hazard PAC regularly attends HELCOM Pressure group meetings as an observer. The CG Pharma platform helps keeping momentum to the HELCOM work on pharmaceuticals. Cooperation has involved data collection (HELCOM) and data processing (PA Hazards producing Status report). A recent example of the cooperation is regarding development of an indicator for antibiotic resistance, where HELCOM collects data from CPs, PA Hazards organizes and funds the data analysis (publication of data in report). Figure 10 shows suggested information flows by PA Hazards and currently existing links[14].

7.6. ECHA

The European Chemicals Agency implements EU's chemicals legislation, i.e. regulates chemicals and biocides on the EU market. In this work ECHA examines and helps companies to comply with REACH, CLP (Classification, Labelling and Packaging), BPR (Biocidal Products Regulation) and PIC (Prior Informed Con-

12 http://www.swedishepa.se/Environmental-objectives-and-cooperation/Cooperation-internationally-and-in-the-EU/International-cooperation/Multilateral-cooperation/Baltic-Sea-Region-EUSBSR/Policy-Area-Hazards/

13 https://portal.helcom.fi/meetings/PRESSURE%207-2017-462/MeetingDocuments/7-4%20Cooperation%20between%20HELCOM%20and%20PA%20Hazards%20of%20EU%20SBSR.pdf

14 https://portal.helcom.fi/meetings/PRESSURE%207-2017-462/MeetingDocuments/7-4%20Cooperation%20between%20HELCOM%20and%20PA%20Hazards%20of%20EU%20SBSR.pdf

sent Regulation, regarding obligations on companies exporting hazardous substances to non-EU countries, implementing the Rotterdam Convention). ECHA works with the European Commission, EU governments and national authorities to identify substances of concern and develop EU-level risk management.

ECHA collects and provides different types of (non-confidential) information on chemicals, e.g. information from REACH registration dossiers. ECHA also cooperates with industry and has recently collected data on plastic additives in the plastic additives initiative. SCIP is a new ECHA database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (WFD). Companies supplying articles containing substances of very high concern (SVHCs) on the Candidate List (currently listing 211 SVHCs) in a concentration above 0.1% weight by weight (w/w) on the EU market have to submit information on these articles to ECHA, as from 5 January 2021, including the name, concentration range and location of the SVHC in the article. The information will be available via the database to waste operators and consumers.

There are a number of expert groups coordinated and hosted by ECHA that provide informal, non-binding scientific advice to ECHA and EU member competent authorities, e.g. the PBT Expert Group, Endocrine Disruptor Expert Group an REACH Exposure Expert group.

There is currently no clear link between HELCOM and ECHA. ECHA could potentially be a source of information regarding use and emissions of hazardous substances for use in HELCOM work regarding inputs of chemicals (pressure) in the Baltic Sea region, and identification of hazardous substances to prioritize (in the Baltic Sea).

7.7. EFSA

The European Food Safety Authority is a European agency funded by the European Union that operates independently of the European legislative and executive institutions (Commission, Council, Parliament) and EU Member States. EFSA gives scientific advice upon request from the EC, European Parliament and EU Member States. EFSA activities include data collection and monitoring and other technical assistance on chemicals in food and feed. EFSA carries out risk assessments on a wide range of chemicals that can be present in food and feed due to food production, distribution, packaging or consumption, as well as those that might be present in the environment naturally or as a result of man-made activity. This work is carried out by EFSA's Panel on Contaminants in the Food Chain (CONTAM), which provides scientific advice on contaminants in the food chain and undesirable substances including residues of unauthorized substances. There are also a number of chemical contaminants working groups, e.g. PFAS in food, BFRs in food, nickel in food, Non-allowed pharmacologically active substances in food and feed and their reference points for action (2015-2018).

The link to HELCOM is via the MSFD Descriptor 9: Contaminants in seafood are below safe levels. Safe levels are defined for contaminants listed in Regulation (EC) No 1881/2006, but additional contaminants can be included by Member States; this must be done in regional cooperation. EFSA is, together with the Food and Agriculture Organization of the United Nations (FAO), listed as partner in the MSFD Expert Network on Contaminants related to Descriptor 9 specifically. This group is part of the MSFD Competence Centre hosted by JRC. The MSFD Expert Network on Contaminants also covers Descriptor 8: Concentrations of contaminants are at levels not giving rise to pollution effects, for which several groups in HELCOM, OSPAR and ICES are listed as collaboration partners.

7.8. UNEP

The United Nations Environment Programme (UNEP) work includes assessing global, regional and national environmental conditions and trends; developing international and national environmental instruments; and strengthening institutions for the wise management of the environment[15]. The UNEP Regional Seas Programme was launched in 1974, and there are currently 18 Regional Sea Programmes, of which seven are administered by UN Environment. HELCOM is in this context an independent regional seas program, i.e. not established under the auspices of UNEP. Independent RSPs can participate in global meetings to share experiences and exchange policy advice and support to the developing RSPs, however this is not a re-occurring activity of HELCOM oral consultation with the Secretariat. UNEP is mentioned as a partner organization at the HELCOM website. UNEP usually does not participate in HELCOM meetings, however a representative participated in the 58th HOD meeting in June 2020 as observer.

The link to HELCOM is instead mainly via the UN Sustainable Development Goals. The 2030 Agenda for Sustainable Development was adopted by the UN General Assembly in September 2015. It contains 17 Sustainable Development Goals and 169 targets, many of which are highly relevant to the work of the Regional Seas Conventions and Action Plans[16]. HELCOM is a platform for coordination of regional implementation, whereas the responsibility to implementing commitments to achieve the SDGs lies with the governments. SDG targets and HELCOM targets are in many cases aligned.

The SDGs are generally formulated, and coincide with goals of EU directives and BSAP.

HELCOM has mapped how HELCOM commitments and goals match the targets of UN Sustainable Development Goals[17]. The main HELCOM contribution is to:

— SDG 14.1. By 2025, prevent and significantly reduce **marine pollution of all kinds**, in particular from land-based activities, including marine debris and nutrient pollution.

Also relevant to HELCOM work are:

— SDG 14.2. By 2020, sustainably **manage and protect marine and coastal ecosystems** to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
— SDG 6.3. By 2030, improve water quality by reducing pollu-

15 https://www.unenvironment.org/about-un-environment/what-we-do
16 https://helcom.fi/wp-content/uploads/2019/08/Outcome.pdf
17 https://portal.helcom.fi/meetings/HELCOM%2038-2017-401/MeetingDocuments/2-2%20Measuring%20progress%20for%20the%20same%20targets%20%E2%80%93%20HELCOM%20and%20UN%20Sustainable%20Development%20Goals.pdf

tion, eliminating dumping and minimizing release of **hazardous chemicals** and materials, halving the proportion of **untreated wastewater** and substantially increasing **recycling** and safe **reuse** globally.

- SDG 6.5. By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
- SDG 8.4. Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead.
- SDG 12.4. By 2020, achieve the environmentally sound **management of chemicals** and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly **reduce their release** to air, water and soil in order to minimize their adverse impacts on human health and the environment.

SDG 14 is fully dedicated to the conservation and sustainable use of the oceans and seas and is co-led globally by Sweden together with Fiji. The United Nations Conference "Our oceans, our future: partnering for the implementation of Sustainable Development Goal 14", 5-9 June 2017, New York, was an opportunity for CPs to make a contribution and consider a joint follow-up. HELCOM Heads of Delegation agreed on the importance of showcasing at the SDG 14 Conference the added value of regional cooperation in Regional Sea Conventions, including the Baltic Sea being an exemplary region for policy making based on best available science, for stakeholder involvement, and for establishing partnerships for integrated management of human activities[18]. HELCOM CPs met in a high-level session on 28 February 2017 to prepare for the SDG 14 Conference and pointed out issues to implement SDGs in the Baltic Sea region. This meeting did however not point out hazardous substances as a key issue in the future HELCOM agenda.

7.9. EEA

The European Environment Agency (EEA) is an agency of the European Union. EEA supports sustainable development by helping to achieve significant and measurable improvement in Europe's environment, through the provision of information on the environment to policymaking agents and the public. The European environment information and observation network (Eionet) is a partnership network of the EEA and its member and cooperating countries. Through Eionet, the EEA brings together environmental information from individual countries and forms the basis of thematic and integrated environmental assessments.

EEA also uses information and data provided by HELCOM and other RSCs for its reports, e.g. Contaminants in Europe's seas (2019), where the classification and mapping of 'nonproblem areas' and 'problem areas' (the terminology originating from the OSPAR Common procedure) with respect to contaminants was carried out using the indicator-based assessment tool CHASE+, based on earlier versions of the 'Chemical Status Assessment Tool' (CHASE) developed for HELCOM holistic assessments. MSFD article 20 in fact includes a provision for the European Commission to review the status of the marine environment in coordination with the European Environment Agency and the relevant regional marine and fisheries organisations and conventions, the first assessment due in 2019, up-dates required every 6 years. Before carrying out the assessment, EEA therefore hosted a workshop with participation of the EC, HELCOM, OSPAR and ICES with the aim to establish a collaboration with RSCs and make use of the regional and national status reports[19]. The purpose was to initiate a discussion on how these assessments can best be designed to support one another and also how to secure the necessary information flows from the regional to the European level, both technically regarding practical coordination and in the long term how to establish a formal framework for continued collaboration. Key conclusions were that EEA assessments should rely on data products and not re-process raw data delivered by the RSCs, focus on indicators and topics that provide added-value and avoid repetition of RSCs work.

7.10. EMSA

The European Maritime Safety Agency (EMSA) serves primarily EU Member States and the EC, with the purpose to ensure maritime safety and maritime security, prevention of and response to pollution (oil and chemical spills) caused by ships, response to marine pollution caused by oil and gas installations and contribute to the overall efficiency of maritime traffic and maritime transport. EMSA cooperates with stakeholders active in the field of marine pollution preparedness and response[20]. EMSA participates as part in the EU delegation in work under several Regional Agreements, e.g. agreements signed by countries around a particular sea area to plan for pollution preparedness and coordinate responses in case of a large-scale marine pollution incident, including HELCOM. EMSA also participates in the work of the International Maritime Organisation (IMO) as part of the European Commission delegation.

EMSA mainly interacts with the HELCOM Maritime Working Group (WG MARITIME), which works to prevent any pollution from ships – including deliberate operational discharges as well as accidental pollution. WG MARITIME collects and compiles information on shipping accidents in the Baltic Sea in liaison with EMSA for the annual HELCOM report on shipping accidents. HELCOM uses data from EMSA for the monitoring of oil spills [28], e.g. satellite observations of the CleanSeaNet (CSN) satellite surveillance service. HELCOM and EMSA have also cooperated in projects, e.g. on monitoring enforcement of regulations on oil transport in the Baltic Sea[21] and have had joint meetings to discuss the update of the BSAP[22].

18 https://helcom.fi/helcom-at-work/events/sdg-14-ocean-conference/

19 https://portal.helcom.fi/meetings/GEAR%2012-2015-274/MeetingDocuments/5-1%20RSC-EEA%20meeting%20report.pdf

20 www.emsa.europa.eu/opr-documents/faq-pollution/301-cooperation-information/2168-who-does-emsa-cooperate-with-in-the-field-of-pollution-response.html

21 http://www.emsa.europa.eu/single-hull-tankers.html

22 https://portal.helcom.fi/meetings/MARITIME%2019-2019-582/MeetingDocuments/Outcome%20of%20MARITIME%2019-2019.pdf

8. Overview of HELCOM data compilation and analysis

8.1. Data on activities potentially emitting hazardous substances in the Baltic Sea catchment

Many human activities that can be linked to emissions of hazardous substances, and information regarding location and intensity of various activities can be mapped and used as proxy for emissions, e.g. population, industry, agriculture, urban wastewater treatment facilities, waste handling facilities, land-based and maritime traffic, dredging etc. A challenge is to derive chemical emission factors for such activities. The HOLAS II project calculated a Baltic Sea Pressure Index [29], where pressures where in some cases estimated from spatial distribution and intensity of activities, such as physical disturbance by construction work at sea and shorelines, extraction of sand and gravel, dredging, and heat input calculated based on location of fossil fuel energy production facilities. For hazardous substances, however, the pressure intensity was assumed to be proportional to measured concentrations at monitoring stations, hence without a link to the activities causing the emissions.

In the Sufficiency of Measures (SOM) analysis[1] performed in support of the BSAP update process, activity-pressure links were investigated via an expert survey asking for percent contribution of each activity (see the list in the Table 3) to the total input of four indicator substances (Hg, TBT, PFOS and diclofenac) to the Baltic Sea. The uncertainty in these estimations can be considered high.

8.2. Data on inputs of hazardous substances

8.2.1 Pollution Load Compilation (PLC)

Inputs of hazardous substances is the responsibility of the Pressure working group. A continuous activity of Pressure WG is to "**Guide Pollution Load Compilations (PLCs) and prepare related reports meeting policy needs, including core indicators**". The 2013 Monitoring and Assessment Strategy and HELCOM Ministerial Declarations 2013 and 2018 demands a number of PLC products, mainly related to nutrient inputs, but also "assessment of input of selected hazardous substances". The assessments supports follow up of [30]:

- HELCOM BSAP and other HELCOM commitments
- EU member CPs' River Basin Management Plans under WFD and
- Programs of Measures (PoMs) under MSFD.

1 https://helcom.fi/baltic-sea-action-plan/som/

Table 3. Activities used to assess activity–pressure relationships in the SOM (Sufficiency of Measures) analysis

Aquaculture – land
Agriculture
Forestry
Non-renewable energy generation (fossil fuel and nuclear powerplants)
Land claim
Canalisation and other watercourse modifications (dams, culverting, trenching, weirs, large-scale water deviation)
Coastal defence and flood protection (seawalls, flood protection)
Transport – air, including infrastructure
Transport – land (cars and trucks, trains), including infrastructure
Urban uses (land use), including storm water runoff
Industrial uses (oil, gas, industrial plants)
Waste waters (urban, industrial, and industrial animal farms; includes all waste streams entering waste water systems e.g. microplastics, pharmaceuticals, etc.)
Solid waste (e.g. land-based disposal of dredged material, land-fill, solid waste streams)
Aquaculture – marine, including infrastructure
Renewable energy generation (wind, wave and tidal power), including infrastructure
Transmission of electricity and communications (cables)
Fish and shellfish harvesting (all gears; professional, recreational)
Fish and shellfish processing
Marine plant harvesting
Hunting and population control
Extraction of minerals (rock, metal ores, gravel, sand, shell)
Extraction of oil and gas, including infrastructure (e.g. pipelines)
Offshore structures (other than for oil/gas/renewables)
Restructuring of seabed morphology (dredging, beach replenishment, sea-based deposit of dredged material)
Tourism and leisure activities (boating, beach use, water sports, etc.)
Tourism and leisure infrastructure (piers, marinas)
Transport – shipping (incl. anchoring, mooring)
Transport – shipping infrastructure (harbours, ports, ship-building)
Military operations (infrastructure, munitions disposal)
Research, survey and educational activities (seismic surveys, fish surveys)
Activities and sources outside the Baltic Sea Region
Marine and coastal construction

The data on input of hazardous substances are used to update Baltic Sea Fact Sheets. PLC collects and analyses monitoring data reported by CPs annually and/or periodically (usually every 6 years). Reporting is either mandatory or voluntary depending on parameter. The CPs ability to report is variable.

PLC waterborne inputs

The PLC projects cover data on "selected hazardous substances". Waterborne inputs are estimated only for metals. The reporting by CPs is mandatory for some parameters and voluntary for others.

Mandatory reporting: Annual reporting on Hg, Cd, Zn, Cu, Pb, Ni, Cr from

- Point sources discharging directly into the Baltic Sea. Preferably reported individually for each point source but can be reported as sum per BS sub-basin for municipal and industrial effluents.
- These metals in municipal effluents discharged directly to the BS should be reported for MWWTPs with PE > 20 000.
- Metals in industrial effluents emitted directly to the BS should be reported if monitoring of the parameter is required in the permit conditions for the industrial plant.
- Metals in monitored rivers is mandatory to report for Hg, Cd and Pb, unless the concentrations are below the limit of quantification (LOQ), in which case the value is reported as 0 and number of samples > LOQ should be reported.
- Metals might be measured as dissolved concentrations in accordance with WFD (for metals on the WFD Priority List this is mandatory). Dissolved concentrations are concentrations measured in filtered samples (0.45 µm pore size). Estimations of concentrations recorded as <LOQ or <LOD are done according to the EU IED guidance document on monitoring (Estimate = ((100%-A) x LOQ or LOD)/100 where A= percentage of samples below LOQ or LOD).

Voluntary reporting: For Hg, Cd and Pb, voluntary reporting every 6th year for MWWTPs and industries in both monitored and unmonitored areas are requested, again dissolved concentrations can be reported.

The total waterborne input is the sum of total riverine inputs from monitored and unmonitored areas plus the input from point sources discharging directly to the Baltic Sea (also called direct discharges) and is quantified per Contracting Party and per Baltic Sea sub-basin.

To summarize, waterborne inputs are only estimated for a few metals and is mandatory only for Hg, Cd, Pb, which are also selected as HELCOM Core Indicators. The BSEP 162 [31] summarizes data on inputs of hazardous substances, and describes a number of weaknesses in the dataset. It is noted that limitations in national monitoring programs and/or lack of proper laboratory resources have in some cases prevented reporting of heavy metal input data, and results of PLC-6 reporting are therefore only indicative. It is also noted that upstream countries' metal inputs via rivers is included in the total estimated riverine inputs (i.e. contributions from non-HELCOM countries).

The report shows that the spatial coverage is poor, in some countries and for come metals data is available from only a few % of the catchment area. The data for point sources is not fully covered, as there are only requirements for large MWWTPs, and metal reporting obligations may not be included in the permits. It is also not possible to separate inland point sources and diffuse sources (collected in rivers), as metal emissions from MWWTPs or industries are only quantified separately when located at the coast and discharging into the Baltic Sea directly. The analysis on data handling and quality control shows that there is a mismatch between PLC guidelines (report total loads, including particulate fraction) and EU WFD (measure dissolved metal concentrations, e.g. filtered samples, to provide data on biologically available metals). Countries report differently, and for Lithuania it is not clear what is measured (total or dissolved fraction). This makes estimations of total loads uncertain (underestimation in most cases) and not comparable between countries. The use of different analytical methods and levels of quantification introduces problems since LOQ is used in the estimations of concentrations (e.g. LOQ/2) and this results in differences between nations, and overestimations of loads in particular for Russia, making the information less useful. There is also different spatial coverage between countries, which hinders comparisons. The LOQs reported are in many cases considerably higher than recommended in the guidelines, in particular by Latvia, Poland and Russia. It is only Sweden and Finland that use analytical methods that give an LOQ at or below guideline values for all three metals Cd, Hg and Pb. Most countries have not been able to report annually, leaving gaps in the time series. Analytical methods and/or LOQ may have changed over time, making the time trends unreliable.

Legal drivers for measurements in wastewater at EU level

National requirements on monitoring of wastewater differs in the CPs, and are sometimes stricter than EU directives that set the minimum requirements for all CPs but Russia. The Urban Wastewater Directive does not require measurement of metals or other micropollutants in wastewater. The Industrial Emission Directive requires reporting of emissions of certain hazardous substances from a broad range of industrial activities and waste treatment facilities operating in accordance with permits given by the member states, with conditions in the permits defined by Best Available Technology (BAT) conclusions. The EU wide minimum requirements for emission limits and rules for monitoring are based on the BAT conclusions for different activities[2]. Reporting (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn and a range of organic pollutants) to E-PRTR is mandatory for specified industrial sectors and UWWTDs with >100 000 PE, in both cases if emissions exceed emission threshold values[3]. The Environmental Impact Assessment directive requires an assessment for wastewater treatment plants >150 000 PE, which may include demands on reporting in the permit[4].

PLC airborne inputs

The airborne inputs of hazardous substances are estimated in cooperation with European Monitoring and Evaluation Programme (EMEP). EMEP and HELCOM have a long-term contract in accordance with the Memorandum of Understanding HELCOM and the United Nations Economic Commission for Europe (UN ECE).

Atmospheric deposition in the Baltic Sea region is calculated using EMEP/MSC-E Eulerian Heavy Metal transport model MSCE-HM and MSC-E Eulerian Persistent Organic Pollutant transport model MSCE-POP in Moscow. For HELCOM, EMEP provides annual assessments of atmospheric input to the Baltic Sea drainage area of Cd,

2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075

3 Guidance Document for the implementation of the European PRTR Annex II https://ec.europa.eu/environment/industry/stationary/e-prtr/pdf/en_prtr.pdf

4 EIA directive https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX-:32011L0092&from=EN

Pb, Hg, and PCDD/Fs. EMEP has also published model assessments of emissions to the atmosphere and atmospheric deposition in the Baltic Sea drainage area for PCB-153[5] and BDE99 (main constituent of pentaBDE)[6]. Data on PFOS has been considered too scarce to perform model assessments[7].

Legal drivers for air emission data and estimates at EU level

EMEP is a programme under the Convention on Long-range Transboundary Air Pollution (CLRTAP) for international co-operation to solve transboundary air pollution problems. EMEP considers: Pb, Cd, Hg (first priority metals), and second priority As, Ni, Cr, Zn, Cu, Se. POPs: PCDD/Fs, Hexachlorobenzene (HCB), selected PAHs, and PCBs. New POPs included in the Protocol on POPs are PentaBDE, PFOS, Polychlorinated Naphthalenes (PCN); Pentachlorobenzene (PeCBz); Hexachlorobutadien (HCBD); Octabromodiphenyl ether (OctaBDE); Short Chain Chlorinated Paraffins (SCCP), and POP-like substances under consideration are: Pentachlorophenol (PCP); Endosulphan; Dicifol; Hexabromocyclododecane (HBCD), Trifluralin[8].

EMEP uses emission data reported annually by CLRTAP-contracting parties as input to modelling of trends in deposition and concentrations, and source apportionments. The emission data is reported by nations to fulfil reporting obligations under various protocols under the CLRTAP, specifically: the 1998 Aarhus Protocol on heavy metals and its 2012 amended version; the 1998 Aarhus Protocol on persistent organic pollutants and its 2009 amended version. The Parties are obliged to annually report emission inventories for Cd, Pb, Hg, PAHs, PCDD/Fs, PCBs and HCB (Guideline for reporting LRTAP). Emissions are estimated from measurements and estimations based on activity data and emission factors. Emissions are reported for sectors including energy, industrial processes and product use, agriculture, waste and "other". Emissions from large point sources are reported if the emissions exceed certain thresholds set for European Union's pollutant release and transfer register (E-PRTR) reporting (Guideline for reporting LRTAP). The reporting to CLRTAP follows the methodology described in the EMEP/EAA air pollutant emission inventory guidebook. This guidance is also used for reporting to the E-PRTR. E-PRTR covers more than 91 substances, released to air and water from industrial installations in 65 different sectors of activity and includes transfers of waste and wastewater from industrial facilities to other locations as well as data on emissions caused by accidents on-site.

Note that EEA has found that comparison of national inventories on releases of hazardous substances to water based on data in E-PRTR is hampered by differences in definitions (sources, pathways), methods, reporting timeframes, formats and thresholds, resulting in national reports which are incomplete, inconsistent and incomparable on an EU scale[9]. For a set of 8 most commonly-reported pollutants investigated by EEA, releases derived from E-PRTR represented a limited part of the total releases to water. The incompleteness of E-PRTR as a source of emissions is also discussed in BSEP 171 regarding dioxins and PCBs [32].

8.2.2 Data on inputs and concentrations from HELCOM Actions and temporary projects

In addition to the regular reporting of inputs of hazardous substances, HELCOM WGs can decide on Actions related to this issue, e.g. launch a data call, cooperate with research projects or finance a commissioned project (CP contributions, or in cooperation with other organization e.g. PA Hazard).

Core Indicator reports

Core Indicators with quantitative thresholds are used to assess the status of the Baltic Sea and the progress towards the goal of achieving good environmental status (GES)[10]. The Core Indicator reports contain information regarding monitoring data (levels, temporal trends) and thresholds that are used, however usually only sparsely with information regarding inputs of hazardous substances, qualitative rather than quantitative.

Concentrations presented in the Core Indicator reports are reported by CPs according to the Monitoring and assessment strategy [33]. The Dataflow project starting in July 2020 will look into providing a gap analysis of data reporting in existing data flows and suggest improvements[11]. Currently, concentration data has been reported according to Table 4.

UNESCO/HELCOM Pharma status report

The Status report on pharmaceuticals from 2017 contains qualitative and quantitative data on a wide range of pharmaceuticals in the Baltic Sea environment for the period 2003 – 2014 [34]. The data covers several stages of the pharmaceutical life cycle: sales, consumption, household pharmaceutical waste handling, concentrations in MWWTP influents, effluents and sludge, concentrations in freshwater, concentrations in marine water, sediment and biota.

HELCOM Action on micropollutants (data call)

The HELCOM Action on micropollutants (outcome of HOD 49-2015[12]) has included identification of target substances via a questionnaire identifying "substances of high concern for the Baltic Sea region" and data availability (national monitoring data), resulting in the selection of nonyl-octylphenols, PFAS, heavy metals, and pharmaceuticals as focus for a Pressure WG data-call in 2017[13]. The BSR Water project platform provided additional resources for data aggregation and analysis for nonyl-octylphenols, PFAS and heavy metals[14]. The INTERREG Project CWPharma provided an analysis of the data on pharmaceuticals[15]. The dataset includes measured concentrations in influents, effluents, sludge and surface water, with variable coverage depending on substance, matrix and nation.

5 https://emep.int/publ/helcom/2018/index.html
6 https://emep.int/publ/helcom/2016/index.html
7 https://portal.helcom.fi/meetings/PRESSURE%207-2017-462/MeetingDocuments/7-6%20Airborne%20input%20of%20PFOS%20into%20the%20Baltic%20Sea.pdf
8 http://en.msceast.org/index.php/pollution-assessment/pollutants-menu
9 https://www.eionet.europa.eu/etcs/etc-icm/products/etc-icm-reports/emissions-of-pollutants-to-europes-waters-sources-pathways-and-trends
10 https://portal.helcom.fi/meetings/STATE%20-%20CONSERVATION%2012-2020-740/MeetingDocuments/4J-5%20Draft%20HELCOM%20Indicator%20Manual%20Version%201.0.pdf
11 https://portal.helcom.fi/meetings/STATE%20-%20CONSERVATION%2012-2020-740/MeetingDocuments/3MA-14%20Status%20of%20HELCOM%20Data%20flows.pdf
12 https://portal.helcom.fi/meetings/HOD%2049-2015-247/MeetingDocuments/Outcome%20of%20HOD%2049-2015.pdf
13 https://portal.helcom.fi/meetings/PRESSURE%2011-2019-628/MeetingDocuments/6-5%20Micropollutants%20in%20WWTP.pdf
14 https://portal.helcom.fi/meetings/PRESSURE%2011-2019-628/MeetingDocuments/6-5-Att.1%20Micropollutants%20in%20WWTP_nonyl%20and%20octylphenols,%20PFAS%20and%20heavy%20metals.pdf
15 https://portal.helcom.fi/meetings/PRESSURE%2011-2019-628/MeetingDocuments/6-5-Att.2%20Micropollutants%20in%20WWTP_pharmaceuticals.pdf

Table 4. Concentration data from individual Contracting Parties for Core Indicator reports.

	DE	DK	EE	FI	LT	LV	PL	RU	SE	Starting year
Water (partly coordinated, data adequate for determination of state, not temporal changes)										2005 - 2011
PCB	x				x	x				
PAH			x		x					
Metals	x			x	x	x			x	
PBDE	x									
Radionuclides										
Sediment (partly coordinated, data adequate for determination of state, not temporal changes)										1999 - 2008
PCB	x	x			x		x		x	
PAH	x	x		x	x	x			x	
TBT	x	x		x	x	x			x	
Metals	x	x			x	x			x	
Furans		x								
Biota (fully coordinated, data adequate)										1979 - 2014
PCB, PCDD/F	x	x	x	x			x		x	
PAH	x	x		x			x		x	
TBT	x	x					x		x	
Metals	x	x	x	x	x		x		x	
PBDE & BDE	x	x		x			x		x	
PFOA, PFOS, PFOSA	x	x		x			x		x	
HBCDD	x	x		x			x		x	
Imposex in snails (data not adequate)										1998 and 2008
		x							x	
Seafood (currently no coordinated monitoring programme)										

CWPharma data on pharmaceuticals

The Interreg BSR CW Pharma project (2017 – 2020) compiled information on pharmaceutical environmental levels, consumption, waste management and the use of pharmaceuticals in veterinary medicine. A number of reports are published on the project website[16]. Part of the project (regarding pharmaceutical waste handling and the use of pharmaceuticals in veterinary) was conducted as a joint activity of CWPharma and HELCOM in the frame of cooperation between HELCOM and PA Hazards[17]. Two questionnaires were sent out via the secretariat to the CPs regarding pharmaceutical waste handling and the use of pharmaceuticals in veterinary, respectively. Denmark, Germany, Poland, Latvia, Lithuania, Estonia, and Finland responded to both questionnaires. No information was received from Sweden and Russia.

NonHazCity

The Interreg BSR project NonHazCity[18] conducted a "snapshot" survey, sampling water of different types in industrial, residential, service sector, stormwater and WWTP environments. The aim was to show detection frequency (rather than representative concentrations) for Metals (Cadmium, Chromium, Copper, Lead, Nickel, Zinc), Organics (Alkylphenols, Bipshenol-A (BPA), Pharmaceuticals, Phthalates) and Perfluorinated Substances

The SOM analysis in support of the BSAP update

The SOM project has collected information on effectiveness of measures and the linkage between pressures (inputs) and state (concentrations) in the Baltic Sea for Hg, TBT, PFOS and diclofenac (to be published autumn 2020). As a complement, background reports were produced reviewing scientific and national (CPs) information regarding sources, transport pathways and temporal trends in the Baltic Sea environment for diclofenac, dioxins &

16 https://www.cwpharma.fi/en-US/Publications

17 https://portal.helcom.fi/meetings/PRESSURE%2011-2019-628/MeetingDocuments/6-3%20Overview%20of%20the%20data%20on%20pharmaceutical%20waste%20handling%20and%20use%20of%20pharmaceuticals%20in%20veterinary.pdf

18 https://projects.interreg-baltic.eu/projects/nonhazcity-7.html

PCBs, PBDEs and PFOS/PFAS. These were published as BSEPs[19]. In addition, similar background reports were prepared for organotins [20] and mercury[21].

The HAZBREF project

The Interreg BSR project HAZBREF[22] cooperates with HELCOM. One aim of the project was to identify hazardous substances relevant to different industrial sectors under the Industrial Emission Directive. HAZBREF used information from the public ECHA database on chemicals (use categories and technical functions of substances) and based on that information tried to link substances to different IED industrial sectors. However, the data in ECHA database is not directly usable for reliable grouping of substances to each sector (see HAZBREF webpage for more information) and therefore the results should be used with caution[23]. The project also performed an evaluation of fate of some the identified chemicals in WWTPs applying the SimpleTreat-model. The assessment presents conclusions regarding legal status of 23 substances (including volatile organic chemicals, phthalates, alkylphenols and ethoxylates, siloxanes, metal salts, plastic additives, biocides, dyes, solvents, foaming agents) and fraction estimated to be eliminated during wastewater treatment. However, information on absolute quantities used and emitted is not available. Besides these activities the project presented recommendations for better chemical management in the industry.[24]

19 https://helcom.fi/wp-content/uploads/2020/06/Helcom_170_Diclofenac.pdf

https://helcom.fi/wp-content/uploads/2020/06/Helcom_171_Dioxins_PCBs.pdf

https://helcom.fi/wp-content/uploads/2020/06/Helcom_172_PBDE.pdf

https://helcom.fi/wp-content/uploads/2020/06/Helcom_173_PFOS_PFAS.pdf

20 https://portal.helcom.fi/meetings/HELCOM%20SOM-HZ%20WS%201-2019-666/MeetingDocuments/1-5%20Draft%20background%20document%20on%20Organotins.docx

21 https://portal.helcom.fi/meetings/HELCOM%20SOM-HZ%20WS%201-2019-666/MeetingDocuments/1-6%20Draft%20background%20doucment%20on%20Mercury.docx

22 https://www.syke.fi/en-US/Research__Development/Research_and_development_projects/Projects/Hazardous_industrial_chemicals_in_the_IED_BREFs_HAZBREF

23 https://www.syke.fi/en-US/Research__Development/Research_and_development_projects/Projects/Hazardous_industrial_chemicals_in_the_IED_BREFs_HAZBREF/Work_packages/Target_chemicals_WP2 Results available from February 2021.

24 https://www.syke.fi/en-US/Research__Development/Research_and_development_projects/Projects/Hazardous_industrial_chemicals_in_the_IED_BREFs_HAZBREF/Publications

9. History of effect-based monitoring work in HELCOM

9.1. The BONUS BEAST Project (2009 – 2012) and collaboration with HELCOM CORESET (2010 – 2013)

The BEAST project[1] (Biological Effects of Anthropogenic Chemical Stress, 2009-2012), a BONUS funded project preceded by the BEEP project (2001-2004)[2], developed a number of suitable biological effect Core Indicator proposals to support the goals of BSAP and MSFD D8. The target of BEAST was to generate quality assured data and information to facilitate the implementation of biological effects methods (to complement the existing chemical parameters) into the Baltic Sea monitoring programme.

During the BEAST project, field campaigns were launched collecting twenty-five species of algae, zooplankton, crustaceans, bivalves, gastropods, chironomids and fish, and then analyzed for different biological effects. The biotests included both established and R&D methods, ranging from molecular responses to stress-related impact on health status. Amphipod bioassays and sediment chemical analysis was used to characterize and compare the contamination status of different areas in the sea. Experiments were also conducted to study combined effects of contaminants, hypoxia, salinity stress, pH and eutrophication. Based on these studies, "Core" and "Candidate" indicators were developed by BEAST and provided as recommendations to the HELCOM CORESET project (2010 – 2013)[3]. The suggested indicators reflect changes in a) the general health status, stress and reproductive success impairments caused by a range of contaminants, b) effects caused by genotoxic, neurotoxic, carcinogenic and endocrinologically active contaminants, and c) specific effects caused by TBT and PAHs. BEAST also produced coherent and Baltic Sea adapted guidelines for the biological effect techniques identified as most useful. BEAST also organized training and intercalibration activities to inform end users in the Baltic Sea region. In addition, the database BonusHAZ was developed containing parameters and measures of effects of contaminants on a range of key species: 60 different parameters for approximately 600 single specimens of different fish species (e.g., eelpout, flounder, and herring), bivalves (Macoma balthica) or crustaceans (amphipods) (details can be found in BEAST Deliverable 3.1).
BEAST recommended six biological effect indicators[4], which were also approved for inclusion in the HELCOM overall list of indicators for hazardous substances by the Joint Advisory Board of the HELCOM CORESET and TARGREV projects[5]. Subsequently, The CORESET project (2010-2013) continued to develop indicators, with 20 core indicators for biodiversity and 13 for hazardous substances and their biological effects. The CORESET project report suggested, in addition to the concentration indicators, the same 6 biological effect core indicators as BEAST, with only slight modifications.

It was noted in the CORESET I final report that imposex, malformed embryos and fish disease index can also be used as indicators for biological state of populations as these effects cause lower

1 https://www.bonusportal.org/files/1607/BEAST_Final_Report.pdf
2 http://databases.eucc-d.de/plugins/projectsdb/project.php?show=272
3 The main ideas, criteria and results for the selection of the bioeffect indicators were summarised in BEAST Deliverable 3.3., including Baltic Sea specific Assessment Criteria and Background Documents for the core indicators.

4 Lysosomal membrane stability (LMS) (general stress), Induction of micronuclei (MN) (genotoxic contaminants), Embryo aberrations in fish (eelpout) or amphipods (reproductive success impairments), Fish Disease Index based on externally visible fish diseases, macroscopic liver neoplasms and liver histopathology (general health status), and also two contaminant-specific biological effects indicators: Imposex in marine snails (gastropods) caused by TBT and PAH metabolites in fish.
5 https://portal.helcom.fi/Archive/Shared%20Documents/CORESET-TARGREV%20JAB%203-2011_Minutes%20JAB%203.pdf#search=HELCOM%20CORESET%2FTARGREV%20JAB%203%2F2011%20final%20minutes 5.13, this is four the 4 later meeting JAB6/2012 (table annex 2) mentions that this was contradictory and decisions to be made later, https://portal.helcom.fi/Archive/Shared%20Documents/CORESET-TARGREV%20JAB%206-2012_Minutes%20JAB6%20FINAL%20minutes_Annex1corrected.pdf#search=HELCOM%20CORESET%2FTARGREV%20JAB%206%2F2011%20final%20minutes, MONAS 17-2012 agreed on further development of proposed core indicators for biological effect (i.e. CORESET work), p.33. https://portal.helcom.fi/Archive/Shared%20Documents/HOD%2039-2012_3-6%20Outcome%20of%20MONAS%2017-2012.pdf#search=HELCOM%20monas%2017%2D2012

Table 5. Overview of effect indicators suggested in different projects.

BEAST / CORESET I	CORESET II	HOLAS II
Preliminary/Proposed Core Indicators	**Core Indicators**	**Core Indicators**
PAH and their metabolites	PAH and their metabolites	PAH and their metabolites
TBT and imposex	TBT and imposex	TBT and imposex
Lysosomal membrane stability (LMS) (a)	White-tailed eagle productivity	White-tailed eagle productivity
Malformed eelpout & amphipod embryos (b)	**Pre-Core Indicators**	**Supplementary Indicator**
Fish disease index (c)	Acetylcholinesterase inhibition	Malformed eelpout & amphipod embryos
Micronuclei test (d)	Estrogenic-like chemicals and effects	
Candidate Indicators	Lysosomal membrane stability (LMS) (d)	
Acetylcholinesterase inhibition (e)	Malformed eelpout & amphipod embryos (e)	
EROD activity (f)	**Candidate Indicators**	
Intersex/vitellogenin induction in male fish (g)	EROD activity	
	No progress during CORESET II	
	Fish disease index (f)	
	Micronuclei test (g)	

Lysosomal membrane stability (LMS) (a)	general stress caused by a range of contaminants
Malformed eelpout & amphipod embryos (b)	reproductive success impairments caused by a range of contaminants
Fish disease index (c)	index for the general health status
Micronuclei test (d)	genotoxic contaminants
Acetylcholinesterase inhibition (e)	neurotoxic effects
EROD (ethoxyresorufin-O-deethylase) activity (f)	exposure to organic compounds such as PAHs, planar PCBs and dioxins
Intersex/vitellogenin induction in male fish (g)	exposure to estrogenic substances

population productivity and specific health condition. Additionally, CORESET I noted some candidate indicators[6] for biological effects, which also contained well-established methods but still needed some elaboration since not all the selection criteria listed were fulfilled in the Baltic Sea.

9.2. HELCOM CORESET II (2013 – 2015)

A continuation project, CORESET II (2013-2015) aimed to further operationalize the indicators selected in CORESET I and propose additional indicators where needed. From the previously suggested bio-effect core and candidate indicators (6+3), all except 2 were further developed. Furthermore white-tailed eagle productivity was now included and listed as bio-effect indicator instead of biodiversity indicator.

Former candidate indicators were further developed as pre-core indicators[7], namely Acetylcholinesterase inhibition and vitellogenin induction, which is now included in the pre-core indicator for estrogenic-like chemicals and effects. Overall, 44 indicators were developed towards operationalization in CORESET II.

At the end of the CORESET II project (2015) it was noted that for long-term up-dating purposes of all the hazardous substance and bio-effect indicators it would be beneficial to have an established expert group/network for hazardous substances in the HELCOM community. In 2016, the expert network EN-HZ was established, and in one of the first EN meetings (EN-HZ 2-2016) it was noted that "for bio-effect indicators the aim is to focus efforts on substantiating the indicator reports for *'Lysosomal membrane stability'* and *'Reproductive disorders: malformed eelpout and amphipod embryos'* by 15 August 2016 to ensure that proposals will be made available in time for HOLAS II, while the other pre-core bio-effect indicators will be down-prioritized".

6 From 4J-5 Draft HELCOM Indicator Manual Version 1.0: Candidate indicators are HELCOM indicators where a gap in the assessment of status of the Baltic Sea marine environment has been identified (by Experts or Managers), the concept for an indicator and evaluation has been established, and the relevant HELCOM Working Group has approved the concept for further development (i.e. approved the concept as a candidate indicator).

7 From 4J-5 Draft HELCOM Indicator Manual Version 1.0: A pre-core indicator is an indicator with a defined concept that has been elaborated significantly to provide a full indicator report (within the HELCOM indicator template) and a valid evaluation, yet may be lacking complete data (e.g. full monitoring data) or may not currently have full agreement and consensus on all components (e.g. threshold values).

CORESET II indicators and conclusions regarding future use[8]

Core indicators

— *White-tailed eagle productivity:* GES established and agreed to publish (note that this indicator was still listed under the ”biodiversity” indicators during the first CORESET project)
— *Polyaromatic hydrocarbons (PAH) and their metabolites:* no agreement on GES and concept needs to be developed further. PAH metabolites is considered a biological effects indicator, however but there is a study reservation on threshold values and application of them (by DK) and currently only PAH concentrations are used as Core Indicators.
— *TBT and imposex:* GES concept and assessment protocol is not adequately described (please note that this has been significantly updated since and was tested in HOLAS II)

Pre-core indicators

— *Acetylcholinesterase inhibition:* Keep as pre-core; proposed as supplementary indicator by some CPs, having the view that bio-effect indicators should be considered as supplementary indicators. The reason for this is that MSFD defines concentrations as primary indicators and effect indicators as secondary. Note that HELCOM CPs have agreed to prioritize primary criteria in development work .
— *Estrogenic-like chemicals and effects:* Keep as pre-core; further development to be agreed on after data compilation for the pharmaceutical assessment is completed
— *Lysosomal membrane stability (LMS):* Keep as pre-core; proposed as supplementary indicator by some CPs.
— *Reproductive disorders:* Malformed eelpout and amphipod embryos: No agreement on GES-threshold, clarification on amphipod boundary derivation was still needed. The final CORESET II meeting had noted to include also other amphipod species then *Monoporeia affinis* for the assessment of indicator malformed amphipods; proposed as supplementary indicator by some CPs (note this has since been used in HOLAS II as a supplementary indicator in Swedish and Finnish waters).

Candidate indicators

— *EROD activity:* kept as candidate; proposed as supplementary indicator by some CP. EROD had been tested with data from Swedish monitoring sites and a GES-boundary for EROD-activity had been tested and proposed based on the link to physiological effects on fish. The indicator and GES values were well developed based on SE data; but at the time only SE and DK were undertaking monitoring (as of CORESET II meeting 2015).

No progress during CORESET II

— *Fish disease index:* was put on hold during CORESET II since there was no task manager lead (Note that the Fish Disease Index approach and methodology has been further developed since CORESET II, in particular in the OSPAR region, Germany is leading this development in OSPAR and promote using this indicator in HELCOM)
— *Micronucleus test:* was put on hold during CORESET II since there was no task manager lead

8 https://portal.helcom.fi/meetings/EN-HZ%208-2018-529/MeetingDocuments/6-1%20ATT.1%20EN-HZ%20extraction%20table_231117.docx

https://portal.helcom.fi/meetings/HOD%2057-2019-620/MeetingDocuments/4-20%20Future%20work%20on%20HELCOM%20Indicators.pdf

https://portal.helcom.fi/meetings/EN-HZ%2011-2019-684/MeetingDocuments/6.1%20Status%20of%20Fish%20Disease%20Index%202019.pdf

9.3. Helcom second holistic assessment HOLAS II (2018)

For the final HOLAS II report, the previously developed core-indicators and one of the pre-core indicators (as supplementary indicator, i.e. applied by more than one, but not all, HELCOM Contracting Parties) were developed enough to be included in the second holistic assessment as Core Indicators: white-tailed sea eagle productivity, PAHs & their metabolites, TBT & imposex, and the supplementary indicator malformed embryos of amphipods. However, PAH metabolites were themselves not included in the PAH indicator due to a study reservation in relation to the threshold values applied.

9.4. Whole effluent assessment and the COHIBA project (2009–2012)

An action of the BSAP from 2007 explicitly mentions the Whole Effluent Assessment method to monitor effects of chemicals mixtures emitted from WWTPs:

"WE AGREE to evaluate as soon as possible, but not later than in the beginning of 2009, the practical introduction of the whole effluent assessment (WEA) approach to monitoring of complex discharges of hazardous substances into the HELCOM framework and to establish a pilot project to test some of the presented methods by making a survey in the HELCOM countries in municipal wastewater treatment plants and some specific industrial sectors. The outcome of this pilot project should be used to evaluate the effluents jointly for the Baltic Sea region and to possibly establish PBT (persistent, bioaccumulating, toxic)-based discharge limit values based on the WEA approach"

The whole effluent assessment (WEA) is a biological method to assess the ecotoxicity of the effluent as a whole, i.e. including combined effects and unknown substances and their effects. In WEA, aquatic test organisms are exposed to waste water samples and the effect on biological parameters such as survival, growth, mobility and/or reproduction of organisms are observed. In monitoring, the idea is to e.g. set whole effluent toxicity limits based on the observed ecotoxicological effects. The Interreg BSR COHIBA project focussed on the 11 substances/groups of substances prioritized in the BSAP and their sources, but aimed also for defining toxicity-based discharge limits, a threshold toxicity, to effluents discharged into receiving waters in the Baltic Sea region. Another aim was to harmonise the chemical and ecotoxicological assessment methods in the Baltic Sea region supporting the fulfilment also of EU WFD and REACH requirements. The results were also to be used as input to the integrated HELCOM assessment of hazardous substances and their sources to the Baltic Sea. At the time of the COHIBA project reporting (2012) such limits were not commonly in use in the Baltic Sea region; Germany employed whole effluent toxicity values for several industrial sectors, but Sweden[9], Denmark and Finland had guidelines and limits only occasionally applied in environmental permits. The method was not used to control municipal wastewater in the Baltic Sea region.

The COHIBA project developed the final recommendations for the use of WEA and toxicity limits and HELCOM HOD 37/2012 welcomed the final report and requested HELCOM LAND and HELCOM MONAS to look into COHIBA's final report and invited CPs to make use of the project deliveries. In 2013 the LAND 18-2013 Meeting considered the Draft HELCOM Recommendation on voluntary introduction of the WEA approach for identification of sources of hazardous substances, and took note of the comments by CPs[10]:

- Germany and Sweden were already implementing WEA in monitoring of effluents;
- Finland and Estonia, in general supporting the use of bio-toxicity in monitoring of municipal and industrial discharges, but not supporting the need for introduction of a general recommendation for this kind of monitoring at this moment;
- Lithuania, referring to on-going national discussions on setting up aquatoxicity-based limit values for wastewater treatment discharges and general supporting of the WEA approach, but being not in a position to support the draft recommendation at this point as the approach may require further testing nationally;
- Russia, supported the application of bio-assays, but not being ready to implement them as broadly as suggested in the proposed draft recommendation

Furthermore, it was pointed out by EUREAU (European Federation of National Associations of Water and Wastewater Services), that there was not enough scientific ground and proof of cost-efficiency for application of the WEA-approach as a tool to monitor hazardous substances in the effluents, and also referred to the EU pointing out that there was still need to improve the understanding of combined effects of chemicals. Based on the discussions and with reference to the commitments on WEA in the HELCOM BSAP, the Meeting suggested to reformulate the respective paragraphs in the Draft Ministerial declaration (for the ministerial meeting in Copenhagen 2013) reflecting the efforts to test and evaluate the applicability of the WEA in the Baltic Sea Area. Further research for assessing possibility to establish PBT (persistent, bio-accumulating, toxic)-based discharge limit values based on bio-testing, including WEA approach, was recognized as needed in general.

The next HOD meeting (HOD 41-2013) took note of general discussion by LAND on progress with testing Whole Effluent Assessment (WEA) approach in the Baltic Sea Area, resulting in a conclusion that at present there is not enough evidence for a separate HELCOM Recommendation on voluntary introduction of the WEA for identification of sources of hazardous substances[11].

The following statement is found in the 2013 Ministerial Declaration from Copenhagen:

"NOTING that the Whole Effluent Assessment approach was tested and evaluated for possible introduction in the Baltic Sea region through a joint region-wide research initiative, WE AGREE that further research is needed before its region-wide application can be recommended as a cost-efficient instrument". After this, the HELCOM work with WEA seems to have been resting.

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