Hazardous Substances Strategic Holistic Action Plan (HAZ-SHAP) – improving management to reduce risk and impact

Baltic Marine Environment Protection Commission

Hazardous substances

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This document represents an overview of the work carried out in the project. The report also outlines the key developments with regard to the systematic holistic framework developed towards a regional approach to address hazardous substances. The overarching aim of this development work is to provide a system that supports the management of hazardous substances and thereby prevents or minimises their impact on the Baltic Sea marine environment.

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Layout: Laura Ramos Tirado

General background

The lack of a harmonised and strategic approach for hazardous substances in the Baltic Sea (HELCOM) region was identified as a significant gap during the 2021 update of the Baltic Sea Action Plan (BSAP). (e.g., HELCOM work on hazardous substances in the Baltic Sea, BSEP 182). For example, a major driver of HELCOM priority substance monitoring and evaluation was Recommendation 31E/1 that addressed a very limited number of priority substances, especially when considering the increasing weight of evidence on new and emerging substances or the cumulative effects of hazardous substances in the marine environment. As a consequence of this, a number of broad actions on hazardous substances were included among the 199 actions in the updated BSAP, each having its own description of achievement and a deadline for completion provided. These actions included action HL1 stating "Develop a regional strategic approach and, on the basis of that approach, an action plan for HELCOM work on hazardous substances by 2024" and action HL10 stating "Establish a mechanism for managing the HELCOM list of priority substances starting from 2025 and respond to screening and assessment results pointing out regional challenges for the Baltic Sea environment and contaminants of emerging concern", among others. These actions and the conceptual management framework utilised in HELCOM, DAPSIM (Drivers-Activities-Pressures-State-Impact-Measures), represent the core starting point for the work. The work of the project therefore focussed on the development of a strategic approach (a framework) that could build a systematic way to address these issues and gaps in the region.

At the outset, a thorough review of the policy landscape was carried out to ensure that the strategic framework under development would align with existing systems and would not have a detrimental impact on those structures or waste resources and effort by duplicating already existing actions. The same process facilitated utilisation of the best elements and know-how from existing systems and allowed development to explore the most suitable for application in the marine environment. Similarly, this review process enabled fulfilling another important requirement for the new framework: promote the utilisation of data generated by other policies – and vice versa promote the support and/or influencing of those other policies (e.g. EU MSFD Directive, WFD Directive).

Procedure by which the development was carried out (HELCOM regional)

A key consideration when developing the project was to ensure acceptability of the work and a thus the likelihood of its utilisation regionally. This is the case for international work in particular, where common vision and agreement across the region benefits effective uptake of the work and implementation of either the findings or the methodologies (strategic approach) developed. To take this aspect into consideration, the work carried out in the project was regularly presented to core regional groups in HELCOM, the Expert Group on Hazardous substances (EG Haz) and the Working Group on Source to Sea Management of Nutrients and Hazardous Substances and Sustainable Agricultural Practices (WG Source to Sea). In addition, to also allow more focussed discussion on key elements of the project development, the work was regularly presented to the principal sub-teams active withing the EG Haz – the sub-team on the strategic-holistic approach and the sub-team on priority substances, substances of emerging concern and screening.

This process allowed for regular exchange on the development work carried out and explanation of any uncertainties within the work as well as guidance on appropriate use of data or suggestions for improvements. Overall, the progress of the project was presented on three occasions to each of those regional groups throughout the process.

General structure and framework of the strategic approach

The conceptual management framework applied by HELCOM – DAPSIM (Figure 1) – addresses a number of major components where relevant information can be derived when developing a strategic holistic framework for the management of hazardous substances. While Drivers (D) may not be simple to quantify or easy to set measures for, and the setting of Measures (M) itself was outside of the scope of this project (this requires a process through HELCOM and approval at the most senior levels), all other elements of the conceptual management framework offer highly relevant information. For example, there is an extensive array of Activities (A) generating hazardous substances or catalysing their direct or indirect release into the Baltic Sea that creates Pressures (P), which in turn influence the State (S) and have Impacts (I) on the ecosystem and society. Ultimately, there is a need to mediate those through Measures (M).

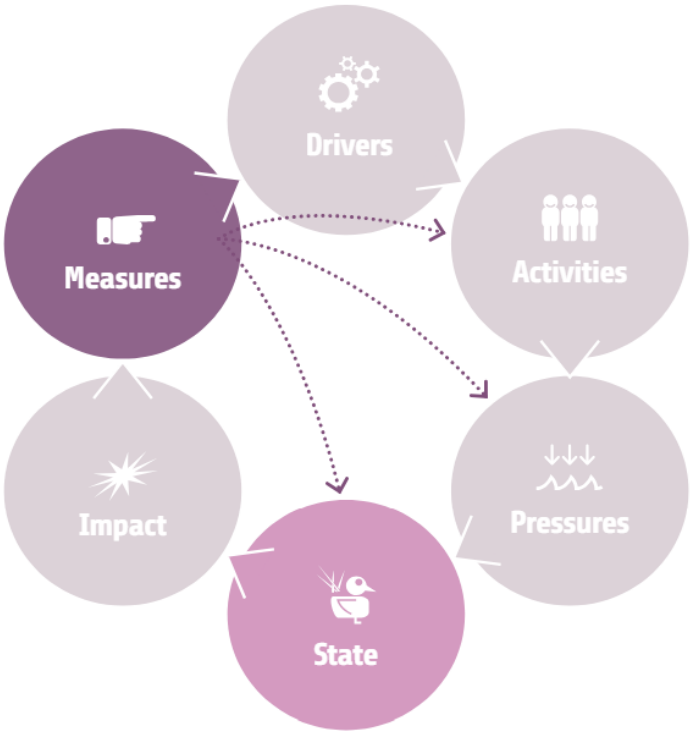

Figure 1. DAPSIM – Drivers-Activities-Pressures-State-Impact-Measures. The conceptual management framework applied in HELCOM and utilised as a base for construction of the strategic framework for hazardous substances.

It is also important to note that once hazardous substances enter the marine environment (or other environments for that matter), they commonly become widely dispersed and often become diluted to concentrations significantly lower than their original sources. However, their toxicity or risk to cause harm doesn't necessarily decrease proportionally. Some substances remain highly toxic even at low concentrations. More importantly, many substances have the potential to bioconcentrate and bioaccumulate through the trophic chain, and therefore their levels in marine organisms or marine sediment reach very high levels. Additionally, substances rarely occur alone but in complex mixtures leading to mixture effects under various environmental conditions. This is increasingly recognised as a major concern due to the growing number of substances in the environment. In this work it was thus considered that as much information as possible should be compiled from all relevant components as it was apparent that action (i.e., Measures) implemented early in the process (i.e., targeted at Activities or Pressures – for example production, sources, uses, inputs) offers a more effective, more

achievable, and more cost-effective way to address hazardous substances. On this basis, the initial proposal for the framework presented for consideration is shown in the Figure 2.

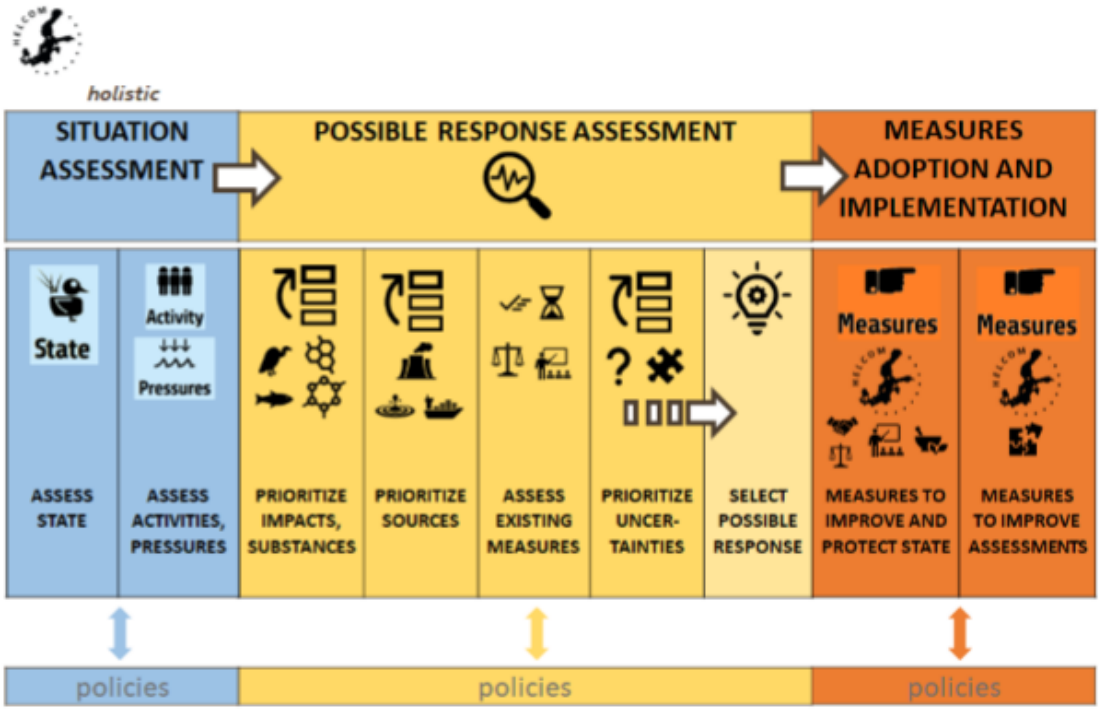

Figure 2. Initial framework proposal for the holistic strategic management of hazardous substances.

The 'situation assessment' represents the collection of data to form a baseline of knowledge on aspects related to State (S), Activities (A) and Pressures (P). From this information the 'possible response assessment' would be applied, generating priority substances and sources as well as priority uncertainties (knowledge gaps) that could be compared to existing measures. This information in turn could lead to proposals on measures ('measures adoption and implementation').

Some key aspects in this vision / initial proposal were that: i) measures/actions are linked with the assessment of the situation instead of being adopted on an ad hoc basis; ii) the assessment is holistic in all respects (and thus prioritisation is a necessary middle step); iii) there is interaction with existing policies in all steps of the framework.

Stepwise application of the framework

To apply the proposed framework, a stepwise structure was developed, following four key steps (Figure 3). The first step represents populating a Master Table with relevant substances of concern according to the data available, the second step consists in gathering as much information as possible on those substances, the third step involves the conversion of the information in the Master Table into three priority lists (priority substances, priority inputs, and priority uncertainties), and the fourth and final step establishes the setting of measures. The steps are set out in greater detail below.

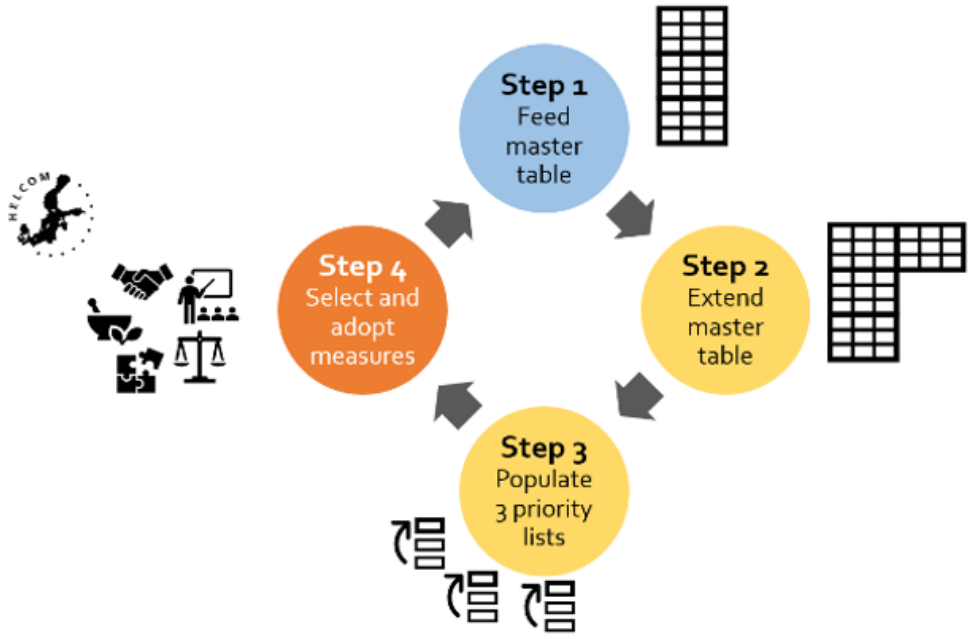

Figure 3. Key steps in the framework, further detail on each step provided below.

Operation of the step-wise components within the framework

This section describes the application of each step in greater detail. The specific details of how the steps are applied will in practice depend on the locality where the process is applied (e.g., Baltic Sea or other environment/situation) and the scale at which it is applied, as the latter can also determine the level of available data to address each component. The level of ambition on what data sources you try to feed the approach with and the depth at which you go to will also likely determine the complexity or added value of the resulting outputs. This document aims to set out the general principles of the framework, as developed within the project, though future publications will also document the details applied e.g. in interacting with other policies and existing HELCOM processes, in decision making steps (e.g., the specifics of what data sources to use, or how to score or rank each component) and the outcomes of the official application of the developed framework. There is flexibility in the framework to allow its adaptability to available resources, data quality and, where necessary, allowing expert opinion to be applied. There are also multiple options for how the specific details within the framework can be applied, for example scoring of components. These options are not covered here but in the future the details applied in the HELCOM primary run (e.g., the options selected for practical use) of the process will also be published. It is however an essential feature of the framework that it provides a structure, in which each type of data has a concrete place and role (e.g. concentrations in the marine environment or rivers, market information, persistence and bioaccumulativity properties, hazardous mode of action etc.). Therefore it enables a systematic assessment of an overall complex issue. It is easy to absorb scientific developments and data becoming newly available to the framework. It also makes it easy to identify key gaps in data or methodologies, which would be priority for resolving towards the consequent run of the framework cycle (priority uncertainties).

Step 1. Generate the Master Table

The aim of this step is to populate the Master Table with substances or groups of substances that are considered as of concern, based on a defined selection of triggers (Figure 4). Step one is ideally a heavily data driven process, though where information or knowledge is lacking many aspects can also be contributed to or replaced with expert-based options.

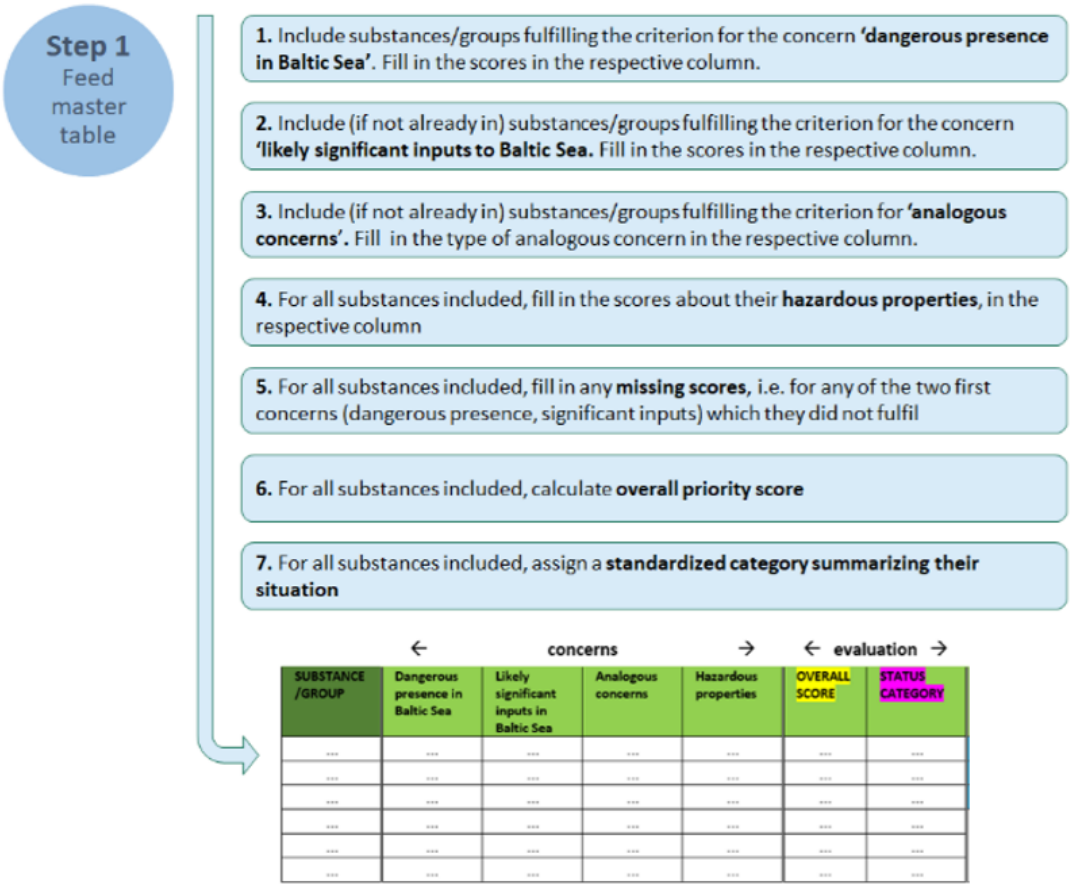

Figure 4. Flow diagram highlighting the key stages required to fulfil Step 1, populate the Master Table. The numbered components in the figure represent stages within the overall Step (stage 1.1-1.7).

The primary part of this step is to generate the list of substances within the Master Table, via the following questions.

- ✓ Firstly, is there recorded significant presence in the Baltic Sea or other environment/situation (i.e., have concentrations been detected above target levels of threshold values indicative of good status – stage 1.1)?
- ✓ Secondly, is there evidence to suggest significant likely inputs to the Baltic Sea (e.g., releases from off-shore activities, concentrations in rivers or waste-water treatment discharges, information on market volumes and use patterns – stage 1.2)?
- ✓ Thirdly, are there analogous concerns related to other substances or clusters of substances with similar properties (e.g., biological effects that can be reliably linked to a substance or group of substances, or likely significant inputs in the near future, or high concentrations detected in a neighbouring sea region and no definitive analysis to suggest it may not also be an issue for the Baltic Sea – stage 1.3).

- ✓ All substances to which any of the answers is 'yes' are listed in the Master table overview. The inclusion in the table itself can also be extended to a scaled scoring system, where the higher / more frequent the exceedance the larger the score applied. This is typically necessary to allow ranking of hundreds or thousands of substances, which contribute to overall impacts or threats.

Essential here is the fact that the possible concern is being assessed based on three independent, but complementary perspectives. None of them alone would be good enough for identifying the substances likely inducing the highest impact or posing the highest threat for the environmental body assessed. E.g. focusing on the marine concentrations may miss substances for which there is no sufficient monitoring, not covered by screening techniques, or which are not easy to analyse – or it may miss mixture effects. However, in combination they comprise a powerful tool for a holistic identification of concerns, which may be expressed as the evidence suggests: as individual substances, groups, or even clusters based on observed biological effects. Biological effects or bioaccumulation studies may also identify additional issues for flagging. In certain cases, the chemical behaviours and modes of action identified from such studies can further strengthen the justification for including a category or substances in these lists.

The second part involves assigning each substance brought into the Master Table with a score related to their hazardous properties (stage 1.4). The scoring system is flexible and can consider various well-documented factors such as the mode of action of acute/chronic aquatic impacts, or of human toxicity (paying attention not to take twice into account a factor considered in the other assessments, e.g. toxicity thresholds or PB properties, if these were taken into account to evaluate the significance of concentrations in the marine environment or in rivers etc.). Each factor contributes weight to the final score assigned to each substance in the Master Table. In addition, once a substance is included through stages 1.1-1.3, it is critical to complete the information for the missing columns per substance, providing a score for each aspect (stage 1.5).

The third part is where each substance is given an overall priority score (stage 1.6), based on the input values for the prior columns. This provides a scaling of the sum of the key information elements gathered per substance in the previous columns, those elements being selected based on systematic structured ways to reflect important considerations related to the behaviour, presence or impact of a substance. The overall score is aimed to, and in implementation of the approach should be designed to, be a rough evaluation of the likely magnitude of impact or threat of a substance for the environmental body on focus. The approach also facilitates later stages of the framework (see Step 2). The final stage (1.7) categorises the listed substances in a broad manner and represents a simple way in which the listed substances can be handled later in the framework, for example a type of ranking or selection that may take the top 50 substances for further consideration, a selection that may target a specific sector, or supporting the linking of similar issues in later steps of the process.

Step 2. Extend the Master Table

Step two focuses on gathering more detailed information about the listed substances. The process developed by HELCOM aims for a holistic overview, searching across as many information sources as possible to identify which substances warrant action. While other considerations should also be applied at this stage (e.g., targeting a single sector or activity), this HELCOM process focuses on comprehending, to the extent possible, the array of substances in or potentially impacting the Baltic Sea, and prioritising those of highest concern (i.e., those the framework identified as needing the most urgent action). Thus, a ranking of substances added

to the Master Table in Step 1 is needed, followed by gathering further detailed information on the selected substances to guide the next steps of the process (Figure 5).

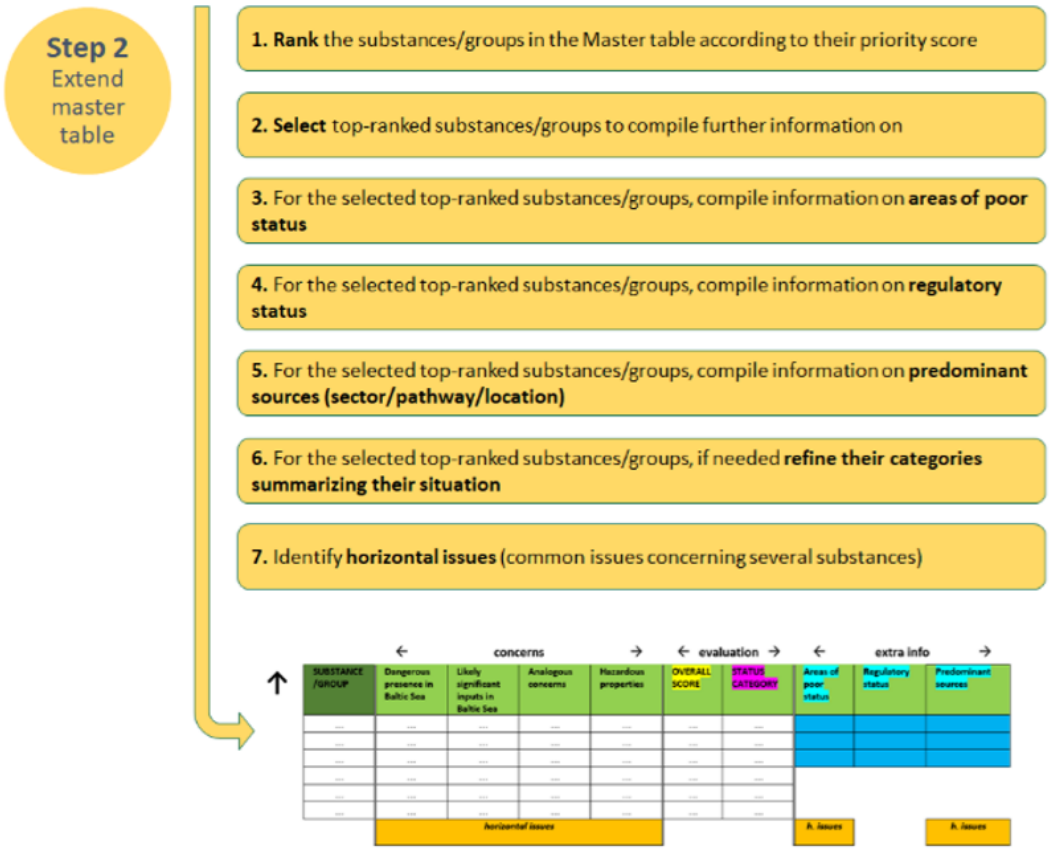

Figure 5. Flow diagram highlighting the key stages required to fulfil step 2, extend the Master Table. The numbered components in the figure represent stages within the overall Step (stage 2.1-2.7).

The first part within this step encompasses a ranking of the substances in the Master Table (stage 2.1) and a selection of the top-ranked substances (stage 2.2). The ranking stage uses the overall priority scores from Step 1 while the selection of top ranked substances can be tailored based on the aim of the specific process. For example, it may be appropriate to consider a small number of top ranked substances from a certain activity, or the top 100 substances ranked in the list, or possibly a selection of substances that may all be considered to respond to similar measures (e.g., all have a common source or pathway such as wastewater treatment). Resource availability and information accessibility are also significant factors. Gathering the necessary data for the next stages can be intensive. Moreover, the selection may also be defined based on the aims of the task in hand, for example, it may already be known that setting effective and well-planned actions/measures can only be achieved for a certain number of substances in any given process, thus the number of substances to be selected in 2.2 may reflect that.

The second part of this step involves gathering finer details on the selected substances, including identification of areas where the substance has impacted status/health (stage 2.3), the regulatory status of the substances in question (stage 2.4), and the predominant sources of the substance (stage 2.5). These elements can be adapted based on the area or question addressed. For the Baltic Sea region, HELCOM assessment units[1] are used to assess the spatial impact of

[1] See the HELCOM Indicator Manual, https://helcom.fi/wp-content/uploads/2021/01/BSEP175.pdf

substances (e.g., under stage 2.3). The number of assessment units where there are high concentrations or exceedances of status evaluators can be utilised as a determinant on the scale of the problem. Furthermore, by structuring the information per assessment unit it allows for further considerations and correlations: for instance, linking between observed biological effects, substances that exceeded toxicity thresholds in the same assessment units, and the modes of action of toxicity of these substances. These considerations are important towards identifying likely triggers of the observed effects. Furthermore, by defining the regulatory status of the substance in question as well as the major sources (including sectors, pathways, locations etc. where possible) it is possible to prevent poor focus of effort later in the framework where a substance may for example already be banned, be heavily regulated, or lack information on sources (e.g., on where you may place a measure). As well it can enable identification of sectors or pathways responsible for many substances of concern (see next paragraph).

The third part of this process involves reviewing the categorical information (stage 2.6) that was initially assigned under stage 1.7 so as to reflect the new information gathered under stages 2.3-2.5 for the selected substances. The following step then utilises the categorical component, backed by the detailed information gathered, to determine if there are any obvious horizontal issues at play (stage 2.7). These horizontal issues may be factors such as the identification of a common source for a large number of substances (e.g., could a single targeted measure address many of the substances) or do a number of substances all lack sufficient information on their loads or sources and impacts that may lead to an action requiring more monitoring or research.

Step 3. Populate priority lists

This step utilises the information gathered above in the prior steps to generate three priority lists, each addressing a different angle (Figure 6). The purpose behind these three different lists is to describe the problematic of hazardous pollution from three different perspectives – and thus support the management decisions in Step 4. As shown below in the description of Step 4, each priority list supports the decision about different types of action.

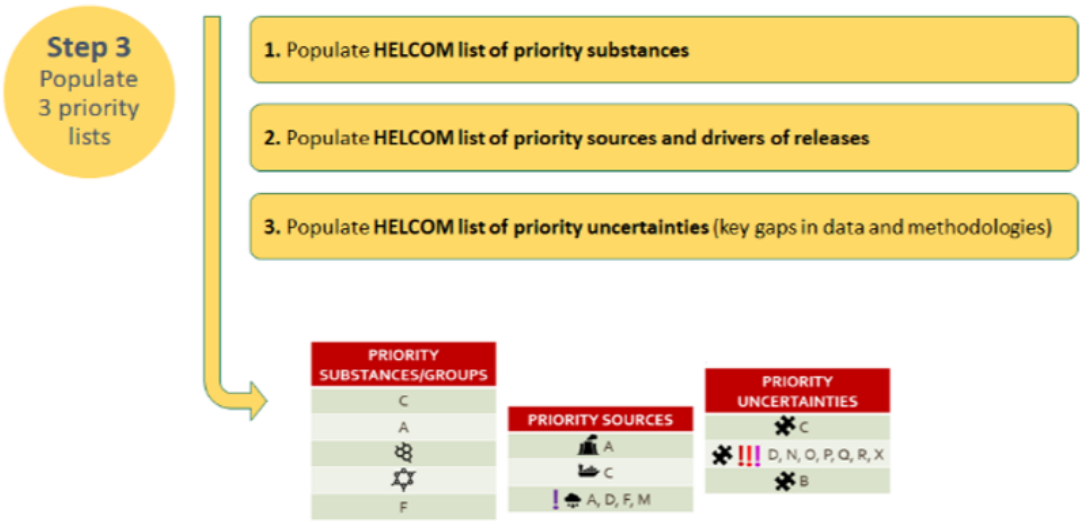

Figure 6. Flow diagram highlighting the key stages required to fulfil step 3, populate priority lists. The numbered components in the figure represent stages within the overall Step (stage 3.1-3.3).

In this step, as with all the steps, substances may be addressed very specifically as individual substances, should that be deemed most relevant. However, where substance naturally fall into common groups (e.g., closely related or similar sources) then they may also be reflected as broader groups. The first list issues in the form of substances or groups and the second in the form of sectors, pathways, or even drivers (each may also be appended with the list of known substances of concern associated to it). The third issues in the form of types of gaps in data or methodologies; again each of them can be appended with an Annex or similar, listing the relevant identified substances with the respective, unless it is about a generic gap – e.g., more information is needed for a specific geographical area.

Step 4. Select and adopt measures

The selection and adoption of measures is a process that, at least in HELCOM work, extends beyond the scope of projects. When setting measures there is a need in regional environmental policy for clear discussion through the Expert and Working Group levels so as to gather national input and experiences as well as a sign off on any adoption of regional measures through relevant processes, culminating in high-level approval (e.g., at Heads of Delegation or HELCOM Commission meetings). This may differ in other processes and organisations but the structure proposed in this step may equally be suitable or adaptable for other applications as it builds directly from the outputs of step three (Figure 7).

A two-tiered approach is needed for this process as not all measure or action settings are equal. This means that all actions to be proposed will not be able to target a specific issue that results in a proposal on an action to reduce inputs or limit impacts. Some may simply require actions that increase the knowledge base to support future management action. Stages 4.1-4.4 can be readily applied to the priority list of substances and the priority list of sources. Working through the stages of selecting an issue or substance from the list (stage 4.1), identifying the existing measures relevant to the topic (stage 4.2), assessing the completeness of the existing measures (stage 4.3), and then developing proposals for new measures for adoption (stage 4.4) allows a systematic way to ensure that new proposals are optimised to the substances/issues and are also harmonised with the existing policy landscape (i.e., do not duplicate or conflict with existing efforts). As part of this process, where jurisdiction allows or where communication channels can be explored, the optimisation of existing measures or replacement (updating/revising) of them may also be a relevant consideration. Where sufficient information is available within the collected material, it should be possible to consider development of actions or measures to address the substances or issues on the priority lists. The measures or actions proposed would be expected to be wide-ranging and varied in their type and specific details as well as adapted to the issue at hand for greatest effectiveness. Simple measures (e.g., all-encompassing bans) may be effective for some issues, but do not necessarily offer good solutions for all cases (e.g., where medical requirements are involved) and all options need to be considered such as more environmentally friendly alternatives, improved waste disposal and recycling, minimising use of key products, better pre-treatment prior to environmental release, adjusted placement of activities, awareness raising, etc.

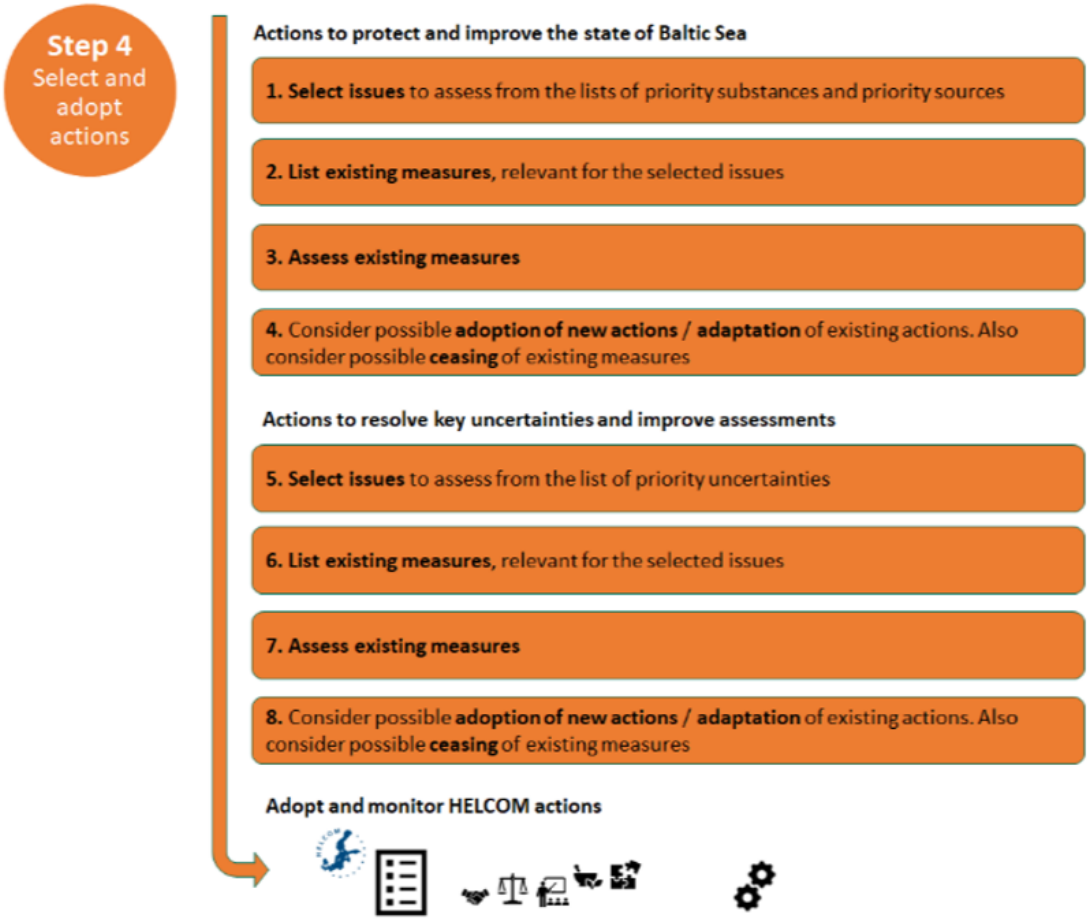

Figure 7. Flow diagram highlighting the key stages required to fulfil step 4, select and adopt measures. The numbered components in the figure represent stages within the overall Step (stage 4.1-4.8).

Stages 4.5 to 4.8 are most suited to the priority list of uncertainties, though issues identified under the other two priority lists may also result in similar outcomes to those under this process. Here the stages are in essence identical to those described above but for this category of priority substances/issues on uncertainties it would be expected that the major action or measure proposed would be focussed on gathering more or sufficient data and knowledge to allow informed decision making in future iterations of the framework.

Important aspects in Step 4 include that the assessment promotes actions of added value and at the same time in synergy with other policies and existing measures, and of course actions which are linked to the assessment of the situation made in the previous steps. Decision-tree-like considerations developed in the project comprise also a first step (principles) towards facilitating the identification of those modes of action which are likely to be more effective and more resource-efficient.

A simple overview of a preliminary run of the framework and what outputs it can generate

A preliminary test run of the framework has been applied utilising data from multiple sources. Those sources, among others, include: national monitoring data, HELCOM indicators from HOLAS 3, peer-reviewed publications, a project examining shipping emissions (EMERGE), the recently completed regional non-target screening of as many as 95,000 substances (PreEMPT project), and data from national reporting under the Marine Strategy Framework Directive (MSFD) and Water Framework Directive (WFD). Biological effects flagging to identify analogous concerns was also developed in association with the HAPhazard project. The preliminary run has also utilised core information from the European Chemicals Agency (ECHA) and REACH (e.g., on volumes of use or production in the region), information reported under the E-PRTR Regulation, and further relevant information. This current run can act as a type of baseline for future iterations.

Overall, the preliminary run identified roughly 1,500 substances with data about presence or inputs, 350 of which were taken onboard in the Master Table. Of these 120 individual substances plus 20 broader cluster entries ended up on the priority substances list, falling into the following major categories: offshore releases, personal care products, pharmaceuticals and hormones, REACH substances and byproducts, biocides, and pesticides. In addition, 11 issues related to priority sources and 18 issues related to priority uncertainties were recorded. This output will provide key input to the regional HELCOM workshop at which initial discussion towards prioritisation and setting of measures will be initiated. The workshop will also consider whether adaptation of the framework is needed.

Conclusions and outlook

The strategic framework developed in this project offers a flexible and adaptable structured approach for managing hazardous substances. The system has been developed with a focus on the health of the Baltic Sea, though the general structure is likely applicable to other marine regions or even non-marine processes. The framework can target specific issues (e.g., a chemical group or an activity/industry) or be applied broadly, incorporating multiple information sources (e.g., peer-reviewed data, national and regional data sets) and expert based evaluation. A holistic or all-encompassing approach, taking onboard as many aspects as possible from multiple data sources, has been the focus of the HELCOM process to date.

The framework developed will be tested in HELCOM work with the ultimate aim of developing an action plan on hazardous substances, derived based on the outputs of the framework. That action plan will go through the official regional review and approval processes in HELCOM. The preliminary pilot run to test the structure of the framework appears to produce promising results, and a large number of substances or issues requiring further evaluation or action have been identified.

The framework is considered a dynamic blueprint guiding a logical and structured approach to proceed from identifying initial triggers (e.g., high concentrations or increases in certain activities) to setting optimal management measures. In this sense, the framework recognises the dynamic nature of the activities, pressures, status, and impact it addresses. New activities occur regularly, resulting in new inputs of hazardous or potentially hazardous substances (pressures) and potential impacts on the ecosystem (or human health). Similarly, new research and monitoring continuously improve our understanding, allowing for more confident evaluations. Regular application of the framework is therefore crucial.

The framework also recognizes the fact that focusing only on individual substances is not sufficient to resolve the challenges of hazardous pollution. Having integrated assessment of manifested biological effects and further horizontal issues to the approach, it allows for identification of what really matters the most – in terms of substances or clusters of substances, in terms of activities, and in terms of gaps. For example, this applies to the actual triggers of these effects or effects (which should be prevented) that can be expected to manifest on the basis of the findings.

By iterating the process, the framework can be updated and self-evaluated with new information but also, more importantly, the framework can improve the quality and effectiveness of existing management measures in place.