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Ad hoc open-ended expert group on marine litter and microplastics
Fourth meeting
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Item 4 (d) of the draft provisional agenda*
Analysis of effectiveness (subparagraph 7d)

Summary of the analysis of the effectiveness of existing and potential response options and activities on marine litter and microplastics at all levels to determine the contribution in solving the global problem**

Note by the Secretariat

1. The ad hoc open-ended expert group (AHEG) was established through United Nations Environment Assembly (UNEA) resolution 3/7 paragraph 10. Its mandate was extended through resolution 4/6 paragraph 7, which also requested the group to, among other things, through subparagraph 7(d):

> *"Analyse the effectiveness of existing and potential response options and activities on marine litter and microplastics at all levels to determine the contribution in solving the global problem."*

2. As requested by the expert group of the Secretariat during the third ad hoc open-ended meeting on marine litter and microplastics,[1] the analysis builds on the stock-taking exercise mandated under resolution 4/6 subparagraph 7(a) and described in UNEP/AHEG/4/2. Additionally, comments provided during the third meeting of the expert group and intersessionally by Member States, the Scientific Advisory Committee, and major groups and stakeholders have informed the revised methodology; the existing body of work on effectiveness analysis methodologies has been considered; and three pilot studies that apply the updated methodology have been taken into consideration.

3. This report has been revised based on feedback received from consultations prior to AHEG-4 to ensure that it adequately responds to the request set out in subparagraph 7(d).

I. Introduction

4. This document responds to United Nations Environment Assembly (UNEA) resolutions 3/7 and 4/6 and the outcome document of AHEG-3, in which the importance of achieving the global goal of long-term elimination of discharge of litter and microplastics to the oceans was agreed. Analysis is

* UNEP/AHEG/4/1.

** The present document is being issued without formal editing.

[1] Outcome document from the third ad hoc open-ended expert group on marine litter and microplastics. Final version, 22 November 2019, Bangkok, Thailand. https://papersmart.unon.org/resolution/uploads/aheg_3_outcome_document_0.pdf.

provided on the effectiveness of response options to determine their contribution in solving the global problem. Due to the complexity of this and the large number of variables, further attention can be given to options for strengthening implementation of these response options.

5. The discharge of plastic waste into the environment presents a risk to the oceans in the form of marine plastic litter and microplastics. Preventive and mitigative actions have been put in place at the international, regional, national and subnational levels to prevent such discharge into the environment and to mitigate the impacts thereof once discharged. An analysis of the effectiveness of existing and potential response options must identify and consider the barriers which undermine the goal of long-term elimination of discharge into the ocean, whereas discussion of the enabling conditions can assist in enhancing the effectiveness of response options.

II. Submissions on methodological approaches

6. In accordance with the guidance to the Secretariat on preparations for the fourth meeting of the open-ended expert group (AHEG-4), the Scientific Advisory Committee convened by the Executive Director of UNEP to guide and provide input to the preparation of an assessment on sources, pathways and hazards of litter including plastic litter and microplastics pollution was invited to provide advice on methodological approaches to analyse the effectiveness of existing and potential response options. Member States and major groups and stakeholders were subsequently invited to submit further suggestions for improving the methodology. Submissions were uploaded to the UNEP papersmart portal or emailed directly to the Secretariat.

7. The proposed revised methodology was presented to Member States and major groups and stakeholders during an online webinar on 17 February 2020. Comments were noted during the webinar and the methodology was revised. A second webinar was held in May 2020, with presentations on the revised methodology and response option archetypes to be included in the study along with an introduction to the three pilot studies. The pilot studies were subsequently presented to Member States and major groups and stakeholders during an interactive technical briefing on 12 August 2020. All comments received throughout the intersessional period have been taken into account, which has further refined the methodology as well as the structure of this study.

III. Method

8. The revised methodology builds on submissions from Member States, the Scientific Advisory Committee, and major groups and stakeholders with regard to the methodology and the pilot studies. Previous work conducted under UNEA and the AHEG meetings have served as additional references, including the discussion papers on barriers (UNEP/AHEG/2018/1/2), national, regional and international response options (UNEP/AHEG/2018/1/3), environmental, social and economic costs and benefits (UNEP/AHEG/2018/1/4), and the feasibility and effectiveness of different response options (UNEP/AHEG/2018/1/5), as well as the report submitted in delivery of UNEA resolution 2/11, Combating marine plastic litter and microplastics: an assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches (UNEP/AHEG/2018/1/INF/3).

9. Activities relevant to the different response options submitted to the stock-taking survey, undertaken in delivery of UNEA Res. 4/6 para. 7(a), have been included as supporting examples. Submissions in response to UNEA resolution 3/7 paragraph 10(d) have informed the selection of response options.

10. Ten response option archetypes emerged from this work:

(a) Existing response options

(i) Regional marine litter action plans (UNEA Res. 2/11, UNEA Res. 3/7, UNEA Res. 4/6, UNEA Res. 4/9);

(ii) National marine litter action plans (UNEA Res. 2/11, UNEA Res. 3/7);

(iii) National solid waste management strategies (UNEA Res. 1/6, UNEA Res. 3/7, UNEA Res. 4/6, UNEA Res. 4/9; UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(iv) National regulatory measures (UNEA Res. 2/11, UNEA Res. 4/9, UNEP/AHEG/2018/1/2; UNEP/AHEG/2018/2/2 Consolidated Background Paper

of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(v) Market-based instruments (UNEA Res. 2/11, UNEA Res. 3/7, UNEA Res. 4/9, UNEP/AHEG/2018/1/2, UNEP/AHEG/2018/1/3; UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1).

(b) Potential response options

(i) Strengthening the international framework (UNEP/AHEG/2018/1/2, UNEP/AHEG/2018/1/3; UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(ii) Strengthening regional frameworks (UNEA Res. 4/6, UNEP/AHEG/2018/1/2, UNEP/AHEG/2018/1/3; UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(iii) Global design standards (UNEA Res. 2/11, UNEA Res. 4/9, UNEP/AHEG/2018/1/2, UNEP/AHEG/2018/1/3; UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(iv) A new international framework (UNEP/AHEG/2018/1/2, UNEP/AHEG/2018/1/3, UNEP/AHEG/2018/2/2 Consolidated Background Paper of the Discussion Papers presented at the Ad hoc open-ended expert group on marine litter and microplastics First meeting, Nairobi, 29–31 May 2018, Annex 1);

(v) National microplastics strategies (UNEA Res. 1/6, UNEA Res. 2/11, UNEA Res. 3/7, UNEA Res 4/6)

11. Lack of funds has repeatedly been identified as a barrier to effective implementation of national waste management strategies, demonstrating the need to strengthen funding globally. Response options for regulatory measures and market-based instruments have been combined with solid waste management to provide an integrated and holistic approach to waste management supported by sustainable domestic sources of finance.

IV. Findings

A. Strengthening the existing international framework

12. Strengthening the existing international framework is a potential response option that aims to close gaps in addressing the life cycle of marine litter and microplastics and to harmonize national action in this regard. All life cycle phases will benefit from strengthened measures, and all environmental zones will be better protected by these measures. The scale rating for this potential response option is high because it is adopted at the international level, although its success will be determined by how effectively such measures are adopted in relevant instruments.

13. The pressure influencing the first driver of the source materials phase of the life cycle (see paragraph 13 above) is unsustainable development. It can be addressed by integrating the Sustainable Development Goals (SDGs) to guide the development of measures to combat marine litter and microplastics. The SDG approach may be limited by lack of understanding of the links between such measures and opportunities to achieve other SDGs in addition to SDG 14 (Life Below Water). This barrier can be overcome by expanding the mandate of an existing international body to build linkages across existing instruments and coordinate activities across the life cycle to drive action

towards relevant SDGs, thereby harmonizing national and regional action towards sustainable materials management (SMM).[2]

14. The pressure influencing the second driver of the product manufacture phase of the life cycle is lack of global regulatory measures and guidance on production methods. To address this barrier, global design standards can be developed to reduce marine pollution from land-based sources, giving effect to Article 207(4) of the UN Law of the Sea Convention (UNCLOS) that requests states to endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control pollution of the marine environment from land-based sources. Global product standards can incorporate and expand on restrictions on the use of persistent organic pollutants (POPs) under the Stockholm Convention to better manage all plastics additives (e.g. through the Strategic Approach to International Chemicals Management (SAICM)), as well as support the development of upstream measures to minimize the generation of hazardous wastes and other wastes at source as per Article 4.2(a) of the Basel Convention. The effectiveness of preventive control may be limited by slow adoption of these standards in national policies, laws and regulations to stimulate eco-design by industries operating within Member State jurisdictions. Capacity-building can assist with the development of national legal and policy frameworks in this regard, including through developing a standardized set of definitions. Technical workshops can strengthen the science-policy interface. Pilot projects can promote context-appropriate transfer of technology. Research on design options to prevent abandoned, lost and otherwise discarded fishing gear (ALDFG) and microplastics in the fishing and aquaculture industries can also be prioritized. Adoption of the voluntary IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code)[3] can be promoted to prevent cargo loss during shipping.

15. The pressure influencing the third driver, the use phase of the life cycle, is lack of global measures with regard to sustainable consumption patterns that specifically target reductions of marine litter and microplastic. This can be addressed through the adoption of binding and/or voluntary measures that target sustainable consumption within high-impact industries such as tourism, shipping, agriculture and fisheries. The effect of preventive control can be reduced by lack of participation. That barrier can be overcome through developing sectoral guidelines to promote reuse, repair, and a reduction in the generation of wastes; adoption of guidelines developed by the Food and Agriculture Organization of the UN (FAO) , such as those for marking of fishing gear, within fishing licensing schemes; and increasing the number of regional fisheries bodies that include binding measures to prevent ALDFG and ghost fishing.

16. The pressure influencing the fourth driver, the end-of-life phase of the life cycle, is unsustainable waste management. This can be addressed by strengthening compliance with the Basel Convention in line with its definition of environmentally sustainable waste management in Article 2(8)[4] and of the principle of proximity in Article 4.2(b), and in compliance with the Stockholm Convention to ensure products containing substances regulated by the Convention are “not permitted to be subjected to disposal operations that may lead to recovery, recycling, reclamation, direct reuse or alternative uses of persistent organic pollutants” (Article 6.1.d(iii)). Lack of infrastructure, which contributes to international trade in waste, undermines the ability to achieve these goals. This barrier can be overcome by providing capacity-building and sharing best practices to create a policy environment that incentivizes private investment. That includes developing market-based instruments to incentivize return schemes (including for fishing gear) and enacting laws that consider illegal traffic in hazardous wastes or other wastes to be criminal activities (Basel Convention, Article 4.3) and that ensure transparency of trade in plastic waste, as set out in the 2019 amendments to the Basel Convention.

[2] The Organisation for Economic Co-operation and Development (OECD) defines SMM as “a policy approach that aims to address the social, environmental and economic considerations throughout the life-cycle of a product or material, thereby improving resource security and competitiveness through better resource productivity.” For OECD work in this field, go to https://www.oecd.org/env/waste/smm.htm.

[3] International Maritime Organization (IMO)/International Labour Organization (ILO)/United Nations Economic Commission for Europe (UN ECE) (2014). *IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code). 2014 Edition.* https://www.unece.org/trans/wp24/guidelinespackingctus/intro.html.

[4] Basel Convention, Article 2(8): “‘Environmentally sound management of hazardous wastes or other wastes’ means taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.” *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.* https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf.

17. Post-discharge mitigative activities can include providing capacity-building and assistance to identify hotspots, particularly where sensitive ecosystems are impacted, and sustainable removal of marine litter from these areas. Technology transfer for capture devices, including for wastewater treatment, can be achieved through pilot projects and assistance to existing facilities with upgrades.

18. Monitoring and evaluation of the global status of marine litter and progress in reducing its discharge into the ocean is not currently an objective of any international instrument. The Honolulu Strategy, a global framework for prevention and management of marine debris, suggests approaches, but no measurable targets or timelines are provided. This strategy could be revised to include agreed indicators of success and to identify institutions that are appropriate to conduct monitoring. For example, impacts on biodiversity could be monitored under the Convention on Biological Diversity (CBD). Monitoring of cargo losses from shipping could be strengthened to complement the International Maritime Organization (IMO) Action Plan to address marine plastic litter from ships. The number of regional fisheries bodies that have adopted binding measures for the reporting and monitoring of losses or sightings of ALDFG could be expanded. Reporting of losses and sightings could also be included in national fishing licensing schemes. Global standards for national monitoring and reporting on production, consumption, use, final treatment and trade of products could be developed to allow aggregation at the international level to measure progress on targets using indicators to be agreed.

19. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of strengthening the existing international framework to contribute to the global goal of eliminating the discharge of marine litter and microplastics to the ocean, as per UNEA 3 resolution 3/7 paragraph 1:

(a) Maturity

(i) High. This response option emerged following the UN Conference on the Human Environment in 1972. Subsequent adoptions and revisions of international conventions regulate a variety of relevant topics, including transboundary movements of hazardous wastes, POPs, and dumping at sea. According to UNEP/AHEG/2018/1/INF/3, there are eight relevant legally binding international instruments. In addition, voluntary instruments have been adopted in sectors including fisheries.

(b) Feasibility

(i) Medium. Feasibility can be demonstrated through eight international conventions and a number of voluntary instruments that are widely recognized by Member States. The United Nations Convention on the Law of the Sea (UNCLOS) sets out general obligations with regard to protection and preservation of the marine environment. Pollution from sea-based sources is addressed in the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V; the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and its Protocol (the London Convention and the London Protocol); the UN Fish Stock Agreement; and the FAO Code of Conduct for Responsible Fisheries.

(ii) Strengthening mostly applies to land-based sources of marine litter and microplastics. At a minimum, the Stockholm Convention and the Basel Convention will require strengthening through measures specific to marine litter and microplastics. Negotiations may take a number of years. Addressing the full life cycle, including additives, across all phases may be challenging.

(iii) Monitoring and reporting progress that is specific to marine litter and microplastics may be challenging to coordinate and to aggregate across multiple instruments.

(c) Time frame

(i) Long. International instruments that tackle marine pollution, directly or indirectly, have been adopted for long-term enforcement (five or more years). Amendments, implementing agreements and reviews are adopted or conducted to take into account new developments and mandates.

(d) Impact

(i) High. Strengthening existing international frameworks is an effective response option to prevent and reduce marine litter at the international level. It has a global impact, in that it overcomes a number of pressures and barriers.

(ii) These international instruments have not specifically or adequately included microplastic pollution in their mandates, nor have they employed a full life cycle perspective for marine pollution. They could be supplemented with relevant reviews, amendments, implementing agreements or voluntary instruments.

B. Developing global design standards

20. The development of global design standards to improve products' environmental performance is another potential response option intended to harmonize national action to drive global markets. These standards would be designed to take effect at the international level, providing a scale rating of high, but their effectiveness would be determined by the ways in which they were adopted at the national level.

21. The pressure influencing the first driver, the source materials phase of the life cycle, is unsustainable development. Strengthened corporate environmental responsibility can reduce the impact of material extraction and the production of feedstocks (e.g. pellets). Plastic is not the primary product of the oil and natural gas extractive industries, which can affect motivation to make significant changes to processes. Environmental performance rating schemes can drive changes in processes that reduce the impacts of material extraction, including contributions to climate change, inefficient use of resources, and generation of hazardous wastes and other hazardous by-products. Schemes that provide a rating system for processes' environmental performance are in place. One example, Operation Clean Sweep (OCS), is an international programme designed to minimize the discharge of plastic pellets, flakes and powders from both production and transport processes.

22. The pressure influencing the second driver, the product manufacture phase of the life cycle, is lack of due diligence by manufacturers. A product rating and labelling system that evaluates the inclusion of design criteria can promote innovation in design for the environment. Such a rating system could include criteria such as use of non-hazardous recycled content, limited production of hazardous and other wastes, reduced amounts of packaging, design for remanufacture and use of remanufacturing systems (combining reused, repaired and new components). The effectiveness of a rating system as a preventive control can be reduced by lack of standards to guide design; uncertainty about environmental benefits versus possible loss of functionality; poor market demand for products that meet particular standards; limited availability of high-quality secondary materials; slow uptake by industry; and lack of national product standards that integrate global design standards (environmental and other) into legislation. In addition, eco-design indicators are poorly represented in government research and development programmes. These barriers can be overcome by establishing a technical advisory body to develop definitions and appropriate design standards, as well as to estimate the environmental, economic and social benefits of different design options. Market demand can be increased by mandating the inclusion of non-hazardous recycled and recyclable content, supported by awareness-raising campaigns to create a competitive advantage for manufacturers that meet standards. Promoting measurable and time-bound commitments by industry can improve the uptake of design standards for safe remanufacturing. Fiscal and economic incentives can encourage design for remanufacturing and the adoption of remanufacturing processes. International capacity-building can assist Member States to develop such domestic regulatory and market-based instruments. It can also support the inclusion of eco-design indicators in research and development (R&D) programmes.

23. The pressure influencing the third driver, the use phase of the life cycle, is the high rate of product disposal and microplastic releases. A product rating and labelling system that evaluates the inclusion of design for material durability, reuse, repair, reduced product redundancy (longevity) and avoidance of microplastic emissions can stimulate the design of products with a longer disposal time frame. The effectiveness of such preventive control can be reduced by lack of standards to guide design, poor understanding of systems (e.g. regulatory and policy frameworks, infrastructure) to support reuse and repair schemes, slow uptake by manufacturers and retailers, low consumer participation in repair or return for reuse schemes, and conflict between product functionality and the environmental outcomes of design for reduced abrasion. These barriers can be overcome by establishing a technical advisory body to develop appropriate definitions and design standards and to estimate the environmental benefits of various design options. Technology transfer, capacity-building and exchange platforms with experts can provide knowledge on provision of supporting infrastructure and on policy environments that stimulate industry uptake of reuse and return schemes, coupled with

awareness-raising to encourage consumer participation. Industry uptake of design standards for durability, reuse, repair, reduced redundancy, and avoidance of emissions of microplastics can be improved by encouraging measurable and time-bound commitments. A technical advisory body can assist with design options to reduce abrasion of materials. Rate-of-abrasion labelling can improve use of materials to minimize microplastic emissions.

24. The pressure influencing the fourth driver, the end-of-life phase of the life cycle, is the abundance of products that are difficult to recycle. A product rating and labelling system that evaluates the inclusion of design for recyclability criteria can increase the share of products on the market that are easy and economically feasible to recycle. The effectiveness of such preventive control can be reduced by lack of standards to guide design, lack of suitable end-of-life infrastructure, limited end markets for secondary materials, lack of national product standards to integrate global design standards (environmental or other) into legislation, and poor representation of eco-design indicators in government research and development programmes. Regulators may also lack expertise in addressing eco-design and be inflexible or slow to change. These barriers can be overcome by establishing a technical advisory body to research and develop appropriate design standards for recyclability and to estimate the environmental, economic and social benefits of various design options. Market demand for secondary materials can be increased by mandating the inclusion of non-hazardous recycled and recyclable content. Promoting measurable and time-bound commitments by industry can improve the uptake of design standards. Technology transfer, capacity-building, and exchange platforms with experts can provide knowledge on the provision of supporting infrastructure and policy environments that stimulate industry innovation in materials and investment in infrastructure.

25. Post-discharge mitigative activities can focus on design options to reduce the environmental and social impacts of marine litter and microplastics. For example, a scoping study by the OSPAR Commission,5 one of the Regional Seas, examines the feasibility of design options for fishing gear to improve recyclability and management at end of life and reduce the environmental impact of abandoned, lost or otherwise discarded gear.

26. Monitoring and evaluation activities lack information about, and methods of tracing, the uptake and impact of design changes. No global targets in this regard have been set using indicators to report against. Developing definitions of terms such as “recyclable” can assist in refining indicators and targets. Mechanisms are needed to track industry commitment and transition to the manufacture of products that meet environmental standards. These could, where relevant, build on efforts currently underway in other areas, such as the Greenhouse Gas Protocol, the UN Alliance for Sustainable Fashion and the Ellen MacArthur Foundation’s New Textiles Economy.

27. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of global design standards in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) Low. This response option is not well established.

(b) Feasibility

(i) Medium. Feasibility has not been demonstrated. Global design standards have good potential. Some level of confidence is provided by building on existing efforts to develop standards, including in fora addressing other environmental issues.

(c) Time frame

(i) Medium to long. Global design standards based on high-level performance criteria could be developed in the medium term of two to five years. More detailed or challenging design standards may need a longer time frame of five or more years.

(d) Impact

(i) High. Well-constructed global design standards could address most of the pressures and barriers identified across all phases of the life cycle and operate at global scale.

[5] OSPAR Commission (2020). *OSPAR Scoping Study on Best Practices for the Design and Recycling of Fishing Gear as a Means to Reduce Quantities of Fishing Gear Found as Marine Litter in the North-East Atlantic*. https://www.ospar.org/documents?v=42718.

C. New international framework

28. A new international framework is a potential response option that aims to harmonize action to prevent the generation of litter and microplastics at the global level across all life cycle phases and targeting all environmental zones for protection. Wide participation by Member States can be assumed, providing a scale rating of high.

29. The pressure influencing the first driver, the source materials phase of the life cycle, is unsustainable development practices. The development and implementation of National Marin Litter Action Plans (NAP-MaLis) provides the opportunity to address these practices in the context of marine litter and microplastics, including by targeting resource efficiency. Barriers to successful implementation of NAP-MaLi s include lack of capacity and funding in some Member States, a weak science-policy interface, and lack of global information and targets for source materials. Capacity-building can be achieved by developing guidelines to assist Member States in the design and implementation of NAP-MaLis. It can be supported through workshops hosted by regional coordinating units and regional activity centres. Concerning existing Multilateral Environmental Agreements (MEAs), international funding can assist with the process of developing NAP-MaLis. Science-based approaches can be enhanced by establishing an intergovernmental science-policy platform, which could strengthen confidence in the outcomes of policy interventions, including environmental and social outcomes. Improved baseline information is required, particularly within some regions, to better understand global trends and the development of global indicators for source materials.

30. The pressure influencing the second driver, the product manufacture phase of the life cycle, is poor due diligence by industry. Adoption of the principle of design for sustainability can reduce the amount of waste generated during the use of products and at the end-of-life phase, as well as minimizing harm from additives of concern. Barriers to achieving sustainable design of products are lack of capacity for the development of standards, legislation and regulations to implement upstream interventions; a weak science-policy interface with regard to alternate materials and design standards; and lack of information and global targets for product manufacture. These barriers can be addressed by enhancing capacity and sharing best practices. The science-policy interface could be strengthened through a scientific advisory body to, for example, prioritize the type of research required and define product performance features to guide the development of product standards, as well research and innovation by the private sector. Such scientific advisory body could also develop standard definitions, targets and indicators for reporting, together with methods for improving the traceability of materials and additives used and traded. Global targets could be adopted voluntarily by industry or made mandatory, where appropriate.

31. The pressure influencing the third driver, the use phase of the life cycle, is slow market reform. The types of products placed on the market and consumer decisions can be influenced by labelling and certification schemes reflecting the content of products and their human health and environmental risks, among others. Barriers to successful implementation include lack of resources for the development and administration of certification schemes, lack of information on consumption patterns, and lack of global targets against which to track progress. An advisory body made up of industry actors and stakeholders across the life cycle could define performance criteria and standards to meet certification requirements, building on existing efforts and standards in place.

32. The pressure influencing the fourth driver, the end-of-life phase of the life cycle, is poor governance of waste. Environmentally sound management of waste requires the development of integrated and holistic waste management practices that complement approaches promoted under the Basel Convention. A lack of knowledge on policy interventions that incentivize private sector investment in sound waste management (thereby supporting domestic financing of these services) can be addressed by engaging actors across the value chain, enhancing understanding of socio-economic context, in particular the informal sector, and facilitating technology transfer. A scientific advisory body could also develop methods to close information gaps at the global level, as well as develop global targets and indicators for tracking progress towards environmentally sound waste management.

33. Once plastic litter and microplastics have discharged into the environment, a new international framework can assist in harmonizing monitoring and evaluation activities and methods to facilitate the aggregation of national results at regional and national levels. Guidelines for the Monitoring and Assessment of Plastic Litter in the Ocean were published in 2019 by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Pollution (GESAMP).6 These guidelines could be

[6] http://www.gesamp.org/publications/guidelines-for-the-monitoring-and-assessment-of-plastic-litter-in-the-ocean.

expanded to include all environmental compartments (e.g. air, land, soils, freshwater systems). Workshops, such as the GPML "training of trainers," can be expanded to further improve capacity and adherence to such guidelines. Standards for reporting at the national, regional and international level can facilitate the assessment of trends and progress towards global targets, informing regular reviews of the effectiveness of implementation measures.

34. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of a new international framework in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) Low. This response option is not well established.

(b) Feasibility

(i) Medium. Feasibility has not been demonstrated. The international framework has potential, and some level of confidence is provided by building on existing efforts under various fora, measures and activities adopted under various MEAs, and activities in a small number of Member States that have already adopted NAP-MaLis for marine litter and microplastics. Feasibility also depends on the voluntary or binding nature of the framework. A binding framework is likely to be more complex, particularly where industry measures are mandatory. While a global management target has been set in UNEA resolution 3/7, operational targets across the life cycle will be more challenging and require information that may take years to collect.

(c) Time frame

(i) Medium to long. A voluntary framework could be developed in the medium term (two to five years). A binding framework might require a longer time frame (five years or more).

(d) Impact

(i) High. A well-designed international framework can address most pressures and barriers identified across all phases of the life cycle and operate at the global scale.

D. Strengthening the existing regional framework

35. Strengthening the existing regional framework is a potential response option that aims to close the geographic gaps as well the life cycle gaps in regional legally binding instruments to manage pollution of the marine environment. In particular, upstream measures are needed that address the full life cycle and target protection of all environmental zones. Once all regions have adopted strengthened and harmonized protocols to control land-based sources of pollution, together with regional protocols to prohibit dumping, the scale rating could be assessed as high.

36. The pressure influencing the source materials phase of the life cycle is limited use of sustainable materials management (SMM) within the existing regional framework. This can be addressed by implementing best environmental practices (BEPs), as promoted by many instruments. However, poor application of the most appropriate combinations of environmental measures and strategies can limit the effectiveness of such an approach. This barrier can be overcome by providing technical guidance on specific aspects of BEPs, such as use of clean technologies, saving resources, and social and economic implications.

37. The pressure influencing the product manufacture phase of the life cycle is lack of regulatory measures and guidance on production methods, including product design, additives of concern and discharge of pellets. This can be addressed by developing regional codes of good environmental practice that cover all aspects of a product's life cycle, supported by certification schemes. The effectiveness of product standards and pellet emission best practices can be restrained by limited capacities in Member States. This barrier can be overcome through regional cooperation on innovation and development, including regional pilot programmes and demonstration sites, demonstration projects, platforms for the exchange of technology and best practices, and the development of regional model policy.

38. The pressure influencing the use phase of the life cycle is lack of measures to encourage behavioural change by industry and consumers. To address this, the existing regional framework could target sectors relevant to the region (e.g. tourism, agriculture, fisheries) as well as consumers.

For example, to reduce abandoned, lost and otherwise discarded fishing gear (ALDFG), regional fisheries bodies with the mandate to establish binding measures can strengthen management measures for prevention and remediation. The effectiveness of stakeholder participation in preventive activities may be limited by poor awareness of the issues as well as lack of availability of alternative systems, products or materials. These barriers can be overcome by the promotion of reuse and repair systems involving manufacturers and retailers, exchanges of best practices on the use of market-based instruments to drive behavioural change, the development of regional eco-labelling schemes to guide purchasing behaviour, and the development of regionally sensitive awareness-raising campaigns, guidelines and model policy to facilitate national activities.

39. The pressure influencing the end-of-life phase of the life cycle is lack of measures targeting sustainable waste management. To address this, the existing regional framework can be strengthened to promote increased collection and recycling rates, as well as best practices for final treatment including compliance with the Stockholm Convention with regard to recycling and reuse of POPs. Measures to strengthen compliance with the London Protocol and MARPOL Annex V, as well as the Basel Convention, can also be promoted. The effectiveness of such strengthened measures may be reduced by lack of capacity, funding, infrastructure and technology, together with lack of supporting legislation, in Member States. These barriers could be overcome by strengthening implementation of the duty currently established to consider best available techniques and best environmental practice; developing guidelines for waste minimization in target sectors; providing guidelines and technical workshops to improve government and industry knowledge on Design for Recycling (DfE); assessing the feasibility of regional waste processing hubs; enhancing ongoing efforts to develop regional strategies for port reception facilities; increasing the adoption of regional dumping protocols; developing pilot projects to identify and demonstrate context-appropriate technology; and developing model legislation, including with regard to market-based instruments to assist with domestic financing of solid waste management and the return of fishing gear.

40. Post-discharge mitigative activities are poorly reflected in regional frameworks outside marine litter action plans. Regional instruments could strengthen the obligation to restore the marine environment, including through coastal zone clean-ups and removal of litter from the marine environment. Existing regional frameworks have a facilitative role. They promote technical assistance and use of best available techniques and best environmental practices. These frameworks could therefore promote responses including the use of capture technologies such as those for wastewater treatment plants, rivers and stormwater outlets. Further responses for regional marine litter action plans, which can be a delivery mechanism for technical assistance, are outlined in section E.

41. Monitoring and evaluation activities are mandated by articles in regional legally binding instruments, including an obligation to report and review the effectiveness of action plans, programmes and measures implemented to prevent pollution of the marine environment from land-based sources. Few timelines are provided. Thus, there is a mandate to develop regional monitoring programmes, which some regions have already initiated under regional marine litter action plans. They could be strengthened by developing quantitative and operational reduction targets at the regional level to facilitate adoption of targets at the national level. There are examples of indicators for marine litter and biota. These indicators could be expanded to allow progress across all phases of the life cycle to be measured. In particular, ALDFG monitoring needs to be strengthened within the protocols of regional fisheries bodies in order to allow targets to be set in the future.

42. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of regional marine litter action plans in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) High. This response option was initiated in the 1970s with the first regional convention on marine environmental protection, the Barcelona Convention on the Protection of the Mediterranean against Pollution. It was adopted in 1976 and entered into force in 1978. The subsequent adoption of conventions and protocols, as well as reviews and revisions, has taken place in several regions. Out of 18 Regional Seas Programmes, currently 14 regional conventions are in place for the protection of the marine environment (UNEP/AHEG/2018/1/INF/3), of which 13 are in force, and nine protocols for land-based sources of marine pollution, of which five are in force. Twelve regional marine litter action plans have been adopted, six are under development or review and one is binding (see Section E, below).

(b) Feasibility

(i) High. Feasibility has been strongly demonstrated, as there are 14 regional conventions for the protection of the marine environment. Member States who are Parties to these conventions have adopted specific protocols on topical issues including dumping and pollution from land-based sources.

(ii) In regional agreements adopted under the Regional Seas, there are articles concerning pollution from dumping, ships and land-based sources, and scientific and technological cooperation between Contracting Parties. Regional Activity Centres (RACs) and Regional Activity Networks (RANs) have been established under regional conventions for better implementation of agreements and protocols and coordination among Member States. Five regional nodes of the Global Partnership on Marine Litter (GPML) have also been established to assist with, for example, implementation of regional marine litter action plans.

(iii) Some regions have established supplementary trusts for the protection of the marine environment in order to secure funding. Other sustainable funding and self-sufficient financial sources are also being explored.

(c) Time frame

(i) Long. Regional legally binding instruments whose purpose is to protect the marine environment have been adopted for long-term enforcement, i.e. over five or more years. Amending and reviewing these legally binding instruments takes several years. Other regional instruments, including RAP-MaLis (see section E below), provide specific timelines for different activities and projects.

(d) Impact

(i) High. Strengthening existing regional frameworks is an effective response option for regulating and guiding action at the regional level. Overarching agreements and protocols with specific targets can make it obligatory to address pressures and barriers identified in some life cycles. Most regional frameworks have not adopted a full life cycle perspective. To have a greater impact, this approach could be supplemented by strengthened regional marine litter action plans.

E. Regional marine litter action plans

43. Regional marine litter action plans are an existing response option that aims to facilitate action at the national level to prevent (or reduce to the minimum) pollution by marine litter. They target coastal and marine environments. Impacts on habitats, species and ecosystem services, as well as on human health and safety, are also targeted for reduction to a minimum. The scale rating for adoptions is high. Nearly all the 18 Regional Seas Programmes have adopted regional marine litter action plans (RAP-MaLis) or are in the process of developing such action plans. Several additional marine litter action plans have also been adopted under other intergovernmental economic fora.

44. The pressure influencing the source materials phase of the life cycle is poor resource efficiency. Regional action plans target that problem by promoting the 3R hierarchy of reduce, reuse, recycle. Adoption of measures to achieve these goals may be delayed or weakened due to uncertainty about the effectiveness of interventions, as well as industry lobbying. Effective implementation can require coordination across multiple government agencies. Regional action plans have addressed these barriers by developing guidelines and platforms (e.g. regional working groups) to share best practices. Some have developed model legislation.

45. The pressure influencing the product manufacture phase of the life cycle is poor industry practices. Promotion of the extended producer responsibility (EPR) principle is common across regional action plans, including for design of fishing gear. EPR and other economic instruments can drive design for reuse, repair and recyclability; stimulate end markets for recycled materials; and minimize pollution from industrial processes. Regional action plans have identified research topics relevant to this area, conducted some scoping studies and published background documents. However, outputs that address this life cycle phase are generally low apart from efforts to strengthen policies to prevent pellet loss.

46. The pressure influencing the use phase of the life cycle consists of poor practices by both industry and consumers. To address this, regional action plans promote design of products that will enable reuse and repair and promote awareness-raising to encourage consumers to reduce their consumption of avoidable products. The effectiveness of these approaches may be undermined by low

industry engagement, with few examples of systems for reuse and repair; lack of consumer awareness; and lack of alternative products that are less harmful. Eco-labelling and voluntary agreements with retailers for reusable container systems are being promoted, along with fiscal and economic instruments in some countries to reduce consumption of plastic bags, microbeads and other single-use plastics. Some scoping studies have been conducted to understand consumer behaviour contributions to waste generation and provide guidance for policymakers, but outputs to address this life cycle phase are generally low.

47. The pressure influencing the end-of-life phase of the life cycle is weak governance by authorities, limiting confidence in investments in collection and sorting infrastructure and other waste management processes. Regional action plans promote environmentally sound waste management, including addressing illegal dumping and illegal disposal in coastal zones and rivers. Consumer practices can undermine efforts towards environmentally sound waste management, such as sorting and participation in drop-off/return programmes. To facilitate national action in this regard. examples of best practices for the return of fishing gear and prevention of marine litter have been published and research to obtain better understanding of upstream waste flows has been proposed. Sectoral guidelines have been developed on marine litter management, including for commercial shipping and passenger ships.

48. Post-discharge mitigative activities are dominated by research to address knowledge gaps on the sources and pathways of marine litter and microplastics, particularly through sewage and wastewater treatment plants. Restorative activities focus on removal of litter and are promoted through, for example, Adopt-a-Beach and Fishing-for-Litter programmes, as well as participation in activities such as Ocean Conservancy's International Coastal Cleanup Campaign. Sharing of best practices for monitoring and removal is strong.

49. Monitoring and evaluation activities are a dominant feature of regional action plans. Harmonizing monitoring methods across regions and mapping hotspots (e.g. snagging sites for fishing gear) are common across most RAP-MaLis. Workshops and train the trainer sessions are widely used to build capacity across regions and at the national level.

50. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of regional marine litter action plans in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) High. This response option was initiated in 2007/2008, with subsequent reviews and revisions undertaken.

(b) Feasibility

(i) High. Feasibility has been strongly demonstrated. Training and technical assistance are provided to government officials at national and municipal levels, port authorities and the shipping industry, as well as consumers and employees in related industries such as tourism. Ongoing funding tends to be secured. RAP-MaLis therefore have a funding structure in place; however, it is expected that more sustainable funding and self-sufficient financial sources will be identified. In view of existing and possible future technological, financial and stakeholder participation aspects, the feasibility of RAP-MaLis is high.

(ii) Additional upstream preventive measures could be promoted based on best environmental practices and most appropriate technologies and techniques. In that case access by Member States to scientific knowledge, research capacity and technology transfer should be taken into consideration. Examples of relevant technologies include "waste to energy", modification of fishing nets to reduce loss, use of drones for sensing and monitoring, and use of biodegradable materials.7

(c) Time frame

(i) Long. Many regional marine litter action plans have adopted a limited time frame, with specific timelines for different activities and projects. Other action plans have no specified end date.

[7] See UNEP (2016). *Marine Plastic Debris and Microplastics: Global Lessons and Research to Inspire Action and Guide Policy*. http://doi.org/10.13140/RG.2.2.30493.51687.

(d) Impact

(i) High. Regional marine litter action plans are an effective response option to facilitate national action. With some additional and shared outputs they can encourage actions that address most of the pressures and barriers identified across all phases of the life cycle. While these action plans operate at the regional scale, coverage will be nearly global once all regions have adopted them.

F. National marine litter action plans

51. A national marine litter action plan is an existing response option that aims to prevent and reduce to the minimum pollution of the marine environment by litter and microplastics from activities operating under national jurisdiction. The primary life cycle focus is the end-of-life phase, with some attention given to upstream measures, particularly through acknowledgement of the need to transition to a circular economy. National action plans mostly target freshwater and marine environmental zones for protection. The scale rating is small due to limited adoption at the national level, but these plans can be operationalized more broadly as more Member States adopt them.

52. The pressure influencing the source materials phase of the life cycle is the linear economy, with a number of action plans promoting a transition to a circular economy, including the development of strategies to achieve this. The complexity of measures to be undertaken and the number of government authorities that need to be involved may limit the effectiveness of a circular economy approach. These barriers can be addressed by improving the level of knowledge on the social, economic and environmental impacts of marine litter and the benefits of measures to address them. A single national governmental body can be established to oversee management of marine litter prevention and mitigation, including in cases where waste management is decentralized and/or dominated by the informal sector. Including various agencies can attract funding and staff allocation from different government sources for the delivery of NAP-MaLis.

53. The pressure influencing the product manufacture phase of the life cycle is poor application of due diligence, including the polluter pays principle, in various sectors of industry. To improve the use of due diligence, development of national design standards can promote a reduction in the production of unnecessary, disposable and difficult to recycle materials, as well as increasing design for reuse, repair and remanufacture and the use of recycled materials. The effectiveness of national design standards may be limited by a lack of incentive for eco-design that meets national standards. This barrier can be addressed by setting national targets, strengthening end markets to ensure demand (e.g. through establishing sustainable public procurement policies), enhancing industry technical knowledge on the use of recycled content, and developing market-based instruments that encourage or mandate use of design standards where appropriate.

54. The pressure influencing the use phase of the life cycle is poor development of systems for reuse, repair and remanufacture. This can be addressed by developing market-based instruments to encourage development and use of these systems. Their slow uptake presents a barrier to the effectiveness of these instruments. It can be overcome by engaging with manufacturers and retailers to develop appropriate infrastructure and addressing cultural barriers to behavioural change, in particular promoting alternatives to single-use products and participation in reusable systems and eco-labelling schemes and making consumers aware of reuse and repair options. Market-based instruments are further described in Section G.

55. The pressure influencing the end-of-life phase of the life cycle a lack of environmentally sustainable solid waste management. This can be addressed through improved stakeholder engagement across sectors and the life cycle. The effectiveness of stakeholder engagement is reduced waste management strategies are poorly integrated. This barrier can be overcome by integration of the informal sector; integration of innovation in production with end-of-life systems and infrastructure (including waste streams for alternative materials); integration of measures to reduce contamination; and integration of areas poorly covered by waste services. Market-based instruments can play a role in incentivizing private sector investment, as shown in section G.

56. Post-discharge mitigative activities focus on removal activities. Greater attention could be given to capture technology, particularly to capturing microplastics in sewage and wastewater treatment and sludge. The cost of installing and maintaining effective capture technology is a barrier in many countries. Financial assistance for technology transfer could increase the implementation of these technologies. Clean-up and litter capture devices provide an opportunity to gather data, including through citizen science programmes.

57. Monitoring and evaluation of the effectiveness of NAP-MaLis is made less effective by a lack of national targets for the reduction of marine litter against which progress can be reported. Developing national inventories in which to gather data on production, consumption, end-of-life treatment, and trade in materials and waste can assist in understanding baselines and developing targets. This is hampered by lack of data in most Member States. By designing national inventories, Member States can identify gaps in data on material flows and waste generation and identify areas for the development of methods to close such gaps across actors and life cycle phases, including through monitoring programmes.

58. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of national marine litter action plans (NAP-MaLis) in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) Medium. National marine litter action plans have been in place for at least four years, with some subsequent reviews. However, their adoption by Member States is limited.

(b) Feasibility

(i) Medium. Feasibility has been demonstrated to be moderate, with a number of national plans being active. As major participants in international trade and contributors to economic increase, G20 countries have been proactive with regard to adopting marine litter NAP-MaLis. However, the number of these NAP-MaLis is still limited, especially in the case of developing countries not equipped with capacity-building programmes and secured funding.

(ii) Local capacity-building under NAP-MaLis is carried out in various ways including working groups, research institutions and online platforms. These methods require a high level of scientific knowledge and organizing capacities, as well as some degree of regional collaboration. This could be a barrier for countries with limited capacities with regard to research and innovation activities and stakeholder engagement. Diverse funding sources including stakeholder involvement and innovative funding mechanism (e.g. EPR schemes) are therefore critical for industrial innovation and updating technologies. Where large infrastructure investments are required, capacity may be lacking to incentivize private sector investment and manage public-private partnerships

(c) Time frame

(i) Medium. Most NAP-MaLis have adopted a medium time frame (two to years), with specific dates for the achievement of particular activities and projects as well as regular reviews.

(d) Impact

(i) High. Well-designed NAP-MaLis can address most pressures and barriers identified across all actors within the life cycle. NAP-MaLis operate on national and subnational scales. Wider adoption by Member States could greatly increase their impact on a global scale.

G. Strengthening solid waste management using regulatory and market-based instruments

59. A national strategy to strengthen waste management, using regulatory and market-based instruments, is an existing response option that aims to prevent discharge of waste into the environment by improving recycling across all life cycle phases. This strategy predominantly targets land and freshwater zones for protection, with some marine protection measures. The scale rating for adoption remains small, but could be expanded as more Member States develop integrated strategies. Relevant measures may be included within national action plans or be adopted as stand-alone instruments.

60. The pressure influencing the source materials phase of the life cycle is unsustainable materials management (SMM). Strengthening implementation of the 3R waste hierarchy can improve resource efficiency and SMM. Lack of understanding of the effects of particular measures on different sectors, actors and stakeholders across the life cycle may undermine the effectiveness of efforts to manage

waste according to a 3R waste hierarchy. This barrier can be overcome by carrying out comprehensive socio-economic studies and engaging all stakeholders in the design phase.

61. The pressure influencing the product manufacture phase of the life cycle is unsustainable design. Design improvements can be incentivised through well-designed EPR schemes. The effectiveness of design improvements may be reduced by governance and administration challenges, economic challenges, including failure to stimulate adopt Design for Environment (DfE), and start-up issues concerning social impacts, investor uncertainty and free riders8 (including with respect to Internet sales). These barriers can be overcome by clearly defining the roles of government and industry; developing methods to ensure transparency by and comparable data from industry; and providing strong enforcement mechanisms. The design of EPR schemes should take into account: products/range targeted, voluntary or mandatory, individual or collective, organizational/financial responsibility for waste management, responsibility among stakeholders and cost coverage (transparency about cost calculations of end-of-life treatment, full/partial allocation of costs to producers). Investor confidence in the scale of operations can be strengthened by improving certainty about the volume of waste estimated to be collected for recycling, including through identifying and addressing channels of discharge from informal recyclers and legal/illegal trade of waste. At start-up, informal recycling facilities can be transitioned into the formal EPR scheme or alternate employment opportunities can be provided. DfE may be more widely adopted when modulated fees are applied and based on environmental performance criteria of products and processes.

62. The pressure influencing the use phase of the life cycle is the increasingly high rate of consumption of avoidable and necessary products, leading to waste generation. The effect of this pressure can be reduced by reducing or eliminating avoidable or problematic products. However, controls may be hampered by uncertainty about impacts along the value chain and lack of incentives for consumers to alter purchasing choices. These barriers can be overcome through research and stakeholder engagement to determine impacts, as well as through imposing bans and taxes on products to reduce consumption. The effect of rate of consumption pressure can be reduced through reuse, but participation in initiatives aimed at increasing reuse may be limited by design and infrastructure constraints. These barriers can be overcome by promoting design for reuse (see Section B on global design standards) and providing infrastructure, such as return and refill schemes by retailers and manufacturers. Repairing products is another way to reduce high rates of consumption, but it can be hampered by lack of information on how to obtain repairs and access parts. This barrier can be overcome by establishing certified repair partners or making repair instructions and parts readily available. Promoting design for repair, including disassembly, is important in this regard.

63. The pressure influencing the end-of-life phase of the life cycle is low economic feasibility of environmentally sustainable treatment of waste – limiting private investment in these services, placing financial burdens on local governments, and leading to underdeveloped collection and recycling systems in some Member States. The economic feasibility of collection, sorting and recycling can be enhanced increasing the quantity and quality of recycled material available to recyclers as well as increasing collection and sorting of recyclable materials. The effectiveness of quality improvements is reduced by contamination of recyclables. The effect of this barrier may be reduced by improving sorting, including separation at source of organic, biodegradable and compostable materials. Design for recycling can reduce the use of additives of concern, resins, glues, labels and other material that increase the cost of sorting and disassembly. Container deposit schemes can assist in reducing contamination, as can education of both households and commercial enterprises. The effectiveness of increasing the quantity of recyclable material made available for recycling may be reduced by low recyclable content in products; littering and dumping; and landfilling and incineration of recyclables. These barriers can be overcome by promoting recycled content in products through mandatory and voluntary mechanisms, ensuring littering and dumping fines are high enough to deter such behaviour, and placing a ban on the landfilling and incineration of recyclable materials. Rates of collection are made less effective in the case of many local governments by lack of funds. This barrier can be overcome by establishing a national fund for collection and sorting to support recycling activities. Sources of funds include EPR schemes, advanced recycling fees (ARFs) linked to regulation or licensing schemes, advanced disposal fees (ADFs), pay-as-you-throw (PAYT) schemes, taxes applied to relevant actors across the value chain, environmental levies, fines for littering and dumping, and

[8] Producers which do not contribute financially to any compliance scheme, but still benefit from their existence and action (Bio by Deloitte (2014). *Development of Guidance on Extended Producer Responsibility (EPR).* In collaboration with Arcadis, Ecologic, Institute for European Environmental Policy (IEEP) and Umweltbundesamt (UBA). European Commission – DG Environment. https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/sustainability-services/deloitte_sustainability-les-filieres-a-responsabilite-elargie-du-producteur-en-europe_dec-15.pdf.

landfill disposal fees. Transport can be diversified to cover more geographic areas, including through schemes for deposit return, reverse logistics and backloading.

64. Monitoring and evaluation activities are hampered by lack of comparable information. In the case of EPR schemes, evaluation of economic performance is limited by lack of transparency about fees and costs while evaluation of technical performance is limited by lack of high-quality comparable data on quantities of products placed on the market resulting in waste and final treatment. This hampers development of indicators and targets against which to report, further limiting aggregation of results at the global level.

65. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of solid waste management using regulatory and market-based instruments in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) High. This response option has been adopted across a range of products in many Member States.

(b) Feasibility

(i) Medium. Feasibility has been demonstrated through a high number of national examples with regard to particular products and product ranges. Schemes for producer fees can take a long time to develop and require strong government enforcement. Infrastructure and legislation may need to be adapted in some Member States

(ii) Strong stakeholder engagement is necessary. Consideration of impacts on small and medium-sized enterprises (SMEs) and the informal waste sector could also be needed.

(iii) Collection of data for evaluation may present challenges, particularly in developing countries and where many SMEs exist.

(c) Time frame

(i) Medium to long. Some measures may require less time to implement, such as pay-as-you-throw schemes and partial contributions to the cost of end-of-life treatment. The development of methods to determine full and real-time costs may take longer.

(d) Impact

(i) High. Well-designed regulatory and market-based instruments can be effective in overcoming pressures and barriers by including multiple actors across all life cycle phases, thereby improving waste management services and preventing marine litter. Wider adoption by Member States would greatly increase impact on a global scale.

H. National strategies to prevent pollution by microplastics

66. A national strategy to prevent pollution by all forms of microplastics is a potential response option that aims to prevent and reduce to the minimum pollution by microplastics during all life cycle phases and targeting all environmental zones for protection. The scale rating is small, but could increase to medium or high as more Member States adopt these strategies. Relevant measures may be included within national action plans or be adopted as stand-alone instruments.

67. The pressure influencing the source materials phase of the life cycle is industry losses of microplastics from resin-producing facilities and the transport sector. Best practices, such as those developed under Operation Clean Sweep, can reduce the effects, but may be limited by low industry engagement in recommended best practices. This can be addressed by including losses in environmental quality standards and mandating adherence to recognized industry best practices. Certification and labelling schemes can strengthen industry engagement.

68. The pressures influencing the product manufacture life cycle phase are intentionally added (primary) microplastics, abrasion during use of products resulting in releases of secondary microplastics, and losses due to poor industry practices. Intentionally added microplastics can be targeted for elimination, but industry engagement may be slow. This can be addressed through voluntary phase-out programmes or regulation banning their use. Reducing the effects of abrasion

requires design improvements. Slow industry engagement in sustainable design principles can be addressed through the development of standards and regulations and adoption of certification and labelling schemes. Industry losses are addressed in the same way as in the source materials life cycle phase.

69. The pressure influencing the use phase of the life cycle is poor consumer behaviour. The effect of providing alternatives that are less polluting is reduced in the absence of strong consumer awareness of the issues and of options available to them. This can be strengthened through certification and labelling schemes to drive responsible consumer choices.

70. The pressure influencing the end-of-life phase of the life cycle is lack of options to capture microplastics before they are discharged to the environment. Installation of washing machine filters can improve the rate of capture of microplastics from this source, but requires spending by consumers post-purchase which might reduce uptake of that solution. This can be addressed through legislation that mandates the inclusion of washing machine filters by manufacturers prior to sale.

71. Post-discharge mitigative activities include closing knowledge gaps with regard to the various sources and pathways of microplastic pollution. Improvements to sewage and wastewater treatment plants has been shown to be effective in capturing microplastics. Efforts are under way to prevent use of sewage sludge as fertilizer because of the presence of captured microplastics.

72. Monitoring and evaluation activities are a dominant feature of current efforts, characterized by research to estimate the rate of losses from different sources, including sea-based sources, and the rate of capture by different technologies. This will assist in obtaining baseline data against which progress can be measured. Methods are being developed for the detection and monitoring of microplastics, with some national guidelines provided.

73. The above life cycle analysis, together with the indicator analysis, inform the following assessment of the effectiveness of national microplastics strategy in contributing to the global goal of elimination of discharge of marine litter and microplastics to the ocean:

(a) Maturity

(i) Low. This response option has not been adopted as a holistic strategy, but there are examples of limited adoption or inclusion of individual measures by Member States, including within NAP-MaLis, which are discussed in section F above.

(b) Feasibility

(i) Medium. Feasibility has been demonstrated through a limited number of national practices for particular sources only. To provide a holistic and full life cycle approach addressing all sources, a number of additional measures are required that include developing design standards, labelling and certification schemes and possibly amending environmental quality standards. With limited national strategies in place specific to prevention of microplastic pollution, or clear inclusion in NAP-MaLis, the feasibility of this response option is medium.

(c) Time frame

(i) Medium to long. Some measures may require less time to implement, whereas others such as development of standards and certification schemes will take longer and require ongoing administration.

(d) Impact

(i) **High**. Effective national strategy to prevent pollution by microplastics can address most pressures and barriers identified across all actors within the life cycle. A microplastics strategy would operate at the national and subnational level, but wider adoption by Member States could greatly increase impact on a global scale.

V. Summary of the global contribution of response options

74. Findings are summarized in the matrix below, which provides an overview of the contribution of the response options to solving the global problem. The factors influencing effectiveness are summarized.

75. Explanation of the ratings used:

Scale	High = near-global adoption Medium = strong adoption at the national or regional level. Small = limited adoption at the national and subnational level
Maturity	High = well-established over many years in many Member States Medium = well-established for over a few years in only a few Member States Low = not well-established yet in many Member States, recent examples exist.
Feasibility	High = feasibility has been demonstrated Med = feasibility has been demonstrated, but requires additional factors to be in place Low = feasibility has not yet been demonstrated, has potential, but requires additional factors to be in place
Impact	High = addresses most pressures and barriers, can scale well Med = addresses some pressures and barriers, can possibly scale well Low = addresses a small number of pressures and barriers, may be challenging to scale

Response option (existing or potential)	Scope	New, existing, strengthen	Primary life cycle phase	Primary geographic range	Environmental zone	Scale	Maturity	Feasibility	Impact	Factors influencing effectiveness
Strengthen existing global framework (potential)	I	S	All	All	All	High	High	Medium	High	Instruments are strengthened within their mandate. A global body/platform is needed to coordinate activities and reporting across instruments. Barriers of lack of enforcement, limited nationa bodies dedicated to the issue and lack of fundin may not be addressed.
Global design standards (potential)	I	N	All	All	All	Medium - High	Low	Medium	High	Strong technical support and engagement with multiple actors across the life cycle are needed. Strong governmental support is needed to establish an enabling political and economic environment that incentivises industry investment. Slow integration of global design standards in national standards and legislation will limit effectiveness.
New international framework (potential)	I	N	All	All	All	High	Low	Medium	High	Needs a global approach to capacity-building and funding for NAP-MaLi development. Effectiveness is enhanced by developing standards for sustainable design. This requires engagement of multiple actors across the life cycle to develop appropriate and effective global design standards, global targets and indicators. Effectiveness may be limited by lack of information across all actors in the value chain and all life cycle phases.
Strengthen existing regional framework (potential)	R	S	All	All	Fresh-water, marine	High	High	High	High	Fourteen Regional Seas Programmes have adopted binding conventions (13 are in force), nine Regional Seas have adopted protocols to prevent marine pollution from land-based sources (five are in force). Limited adoption of regional dumping protocols. Currently dominant in the post-discharge phase of monitoring, with some providing a mandate to implement upstream preventive measures.

Response option (existing or potential)	Scope	New, existing, strengthen	Primary life cycle phase	Primary geographic range	Environmental zone	Scale	Maturity	Feasibility	Impact	Factors influencing effectiveness
										Strong engagement with industry and capacity-building in this regard is needed.
Regional marine litter action plans (existing)	R	E	End-of-life, monitoring	Entire water catchment, forests or mangroves, freshwater rivers and lakes, urban environment, waste disposal sites coastal zones, maritime areas within national jurisdictions	Fresh-water, marine	High	High	High	High	Regional Action Plans are dominant in the post-discharge areas of monitoring and removal. The life cycle phases of source materials, product manufacture and use can be strengthened, but opportunities to engage with industry in upstream preventive measures may be limited. The effectiveness can be constrained by limited funding at the regional level, as well as lack of capacity, technologies and facilities at the national level. Capacity-building is focused on monitoring and removal activities and can be strengthened for policy and regulatory interventions for upstream prevention.
National marine litter action plans (existing)	N	E	End-of-life	All	Land, fresh-water, marine	Small	Medium	Medium	High	Adoption of national action plans is low. Management and operational targets should cover all life cycle phases. Effectiveness is limited by knowledge gaps, as well as lack of standardized monitoring and reporting to inform design and review processes. Promotion and support of research on policy interventions, including socio-economic studies, can enhance effectiveness.
Strengthen solid waste management using regulatory & market-based instruments (existing)	N	E	Product manufacture, end-of-life	Urban environment, waste disposal sites, coastal zones, maritime areas within national jurisdictions	All	Small	High	Medium	High	There is a need for extensive stakeholder engagement in the design phase and strong government enforcement during implementation. Many mature examples exist in Member States. Careful consideration needs to be given to the impact on small and medium-sized enterprises (SMEs) and the informal sector of formalizing collection and sorting systems.

Response option (existing or potential)	Scope	New, existing, strengthen	Primary life cycle phase	Primary geographic range	Environmental zone	Scale	Maturity	Feasibility	Impact	Factors influencing effectiveness
Microplastics (potential)	N	N	All	All	All	Small	Low	Medium	High	Effectiveness is reduced by lack of knowledge on all sources and pathways. Improvements to product design may be challenging. High-level environmental performance criteria can be developed as a first step. Technology transfer and capacity-building are required to ensure robust monitoring methods.

VI. Annex I: Summary of methodology

76. A three-phased approach has been used for all response option archetypes. A life cycle analysis is conducted, followed by an analysis of indicators. These analyses inform a final discussion, which provides further analysis of response options' objectives and the context of the barriers and enabling conditions that contribute to their effectiveness.

77. The life cycle analysis incorporates the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) 31010 Bowtie analysis methodology used to identify the source of a risk (drivers), pressures, control measures, and any barriers affecting the success of those controls within the response option archetype of a new international framework. Response options are reviewed for actions that target each life cycle phase. The analysis incorporates the drivers, pressures, state, impact and responses (DPSIR) framework, which can help describe cause-effect relationships across different sectors.*** This first phase of the life cycle assessment informs the final discussion and analysis of effectiveness.†††

78. The indicator analysis uses the indicators suggested in submissions by Member States, the Scientific Advisory Group, and major groups and stakeholders. They are grouped into input, process and performance indicators, providing an overview of the management and enabling factors that can improve the overall effectiveness of the response option. Indicators are given a rating of high, medium or low, or a yes/no rating based on their inclusion in the instruments relevant to the response option.

79. The final discussion provides a qualitative analysis of the response options. This includes a discussion of:

(a) Maturity

(i) High = well established over many years in many Member States.

(ii) Medium = well established over a few years in only a few Member States.

(iii) Low = not well established yet in many Member States, but recent examples exist.

(b) Feasibility

(i) High = feasibility has been demonstrated.

(ii) Medium = feasibility has been demonstrated, but requires additional factors to be in place.

(iii) Low = feasibility has not yet been demonstrated. It has potential, but requires additional factors to be in place.

(c) Time frame for planning and implementation

(i) Short = 0-2 years.

(ii) Medium = 2-5 years.

(iii) Long = 5+ years.

(d) Impact

(i) High = addresses most pressures and barriers, can scale well.

(ii) Medium = addresses some pressures and barriers, can possibly scale well.

(iii) Low = a small number of pressures and barriers are addressed, may be challenging to scale.

(e) Overall comments

*** See UNEP (2017). *Strengthening the Science-Policy Interface: A Gap Analysis*. https://wedocs.unep.org/bitstream/handle/20.500.11822/22261/Gap_Analysis_2017.pdf?sequence=1&isAllowed=y.

††† See Astles, K.L. and Cormier, R. (2018). Implementing sustainably managed fisheries using ecological risk assessment and bowtie analysis. *Sustainability* 10(10), 3659. http://doi.org/3390/su10103659; Cormier, R., Elliot, M. and Kannen, A. (2018). *IEC/ISO Bowtie analysis of marine legislation: A case study of the Marine Strategy Framework Directive*. ICES Cooperative Research Report No. 342, 56. https://doi.org/10.17895/ices.pub.4504.

(i) There are conditions that increase or reduce the effectiveness of the response option.

Astles, K.L., Cormier, R., 2018. *Implementing Sustainably Managed Fisheries Using Ecological Risk Assessment and Bowtie Analysis*. 10. 10.3390/su10103659
Cormier, R., Elliot, M., Kannen, A., 2018. *IEC/ISO Bowtie analysis of marine legislation: A case study of the Marine Strategy Framework Directive*. ICES Cooperative Research Report No. 342, 56. https://doi.org/10.17895/ices.pub.4504
UNEP, 2017. Strengthening the Science-face: A gap analysis.