GLOBAL GOVERNANCE OF PLASTICS AND ASSOCIATED CHEMICALS

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Microplastics and nanoplastics function as vectors for chemical contaminants, and potentially as a chemical threat to human health and the environment.
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Acronyms and Abbreviations

BRS	Basel, Rotterdam, Stockholm
BAT	Best available techniques
BEP	Best environmental practice
BPA	Bisphenol A
BPS	Bisphenol S
CAS	Chemicals Abstract Service
CBD	Convention on Biological Diversity
CBO	Community based organisation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CiP	Chemicals in Products
CO2	Carbon dioxide
COP	Conference of the Parties
CLP	Classification, labelling and packaging of substances and mixtures
CMR	Carcinogenic, mutagenic and reprotoxic
CRC	Chemical Review Committee
CTCN	Climate Technology Centre and Network
DecaBDE	Decabromodiphenyl ether
ECHA	European Chemicals Agency
EDC	Endocrine-disrupting chemicals
EPR	Extended producer responsibility
EPS	Expanded polystyrene
ESG	Environmental, Social, Governance
ESM	Environmentally sound management
ESPR	Ecodesign for Sustainable Products Regulation
EU	European Union
EUTR	European Union Timber Regulation
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GBF	Global Biodiversity Framework
GEF	Global Environment Facility
GHG	Greenhouse gas
GHS	Global Harmonized System of Classification and Labelling of Chemicals
HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HFC	Hydrofluorocarbon
HS	Harmonized System
HSLEEP	Hazardous substances within the life cycle of electrical and electronic products
IAS	Intentionally added substance
ILO	International Labour Organization
INC	Intergovernmental Negotiating Committee
LRTP	Long-range environmental transport potential
MARPOL	International Convention for the Prevention of Pollution from Ships
MCCPs	Medium-chain chlorinated paraffins
MAD	Mutual Acceptance of Data in the Assessment of Chemicals
MEA	Multilateral environmental agreement
MERCOSUR	Mercado Común del Sur (Common Market of the South)
MLF	Multilateral fund
NAP	National action plan
NDC	National determined contribution
NIAS	Non-intentionally added substances
NIPs	National implementation plans
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
ODS	Ozone depleting substance
OHCHR	Office of the UN High Commissioner on Human Rights
PAHs	Polycyclic aromatic hydrocarbons
PBT	Persistent, bioaccumulative and toxic
PCBs	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzofurans
PCNs	Polychlorinated naphthalenes
PCP	Pentachlorophenol
PeCB	Pentachlorobenzene
PFASs	Per- and polyfluoroalkyl substances
PFHxS	Perfluorohexane sulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PIC	Prior informed consent
PLC	Polymer of low concern
PMT	Persistent, mobile and toxic
POPRC	Persistent Organic Pollutants Review Committee
POPs	Persistent organic pollutants
PRTR	Pollutant Release and Transfer Register
PS	Polystyrene
PVC	Polyvinyl chloride
PVDC	Polyvinylidene dichloride
PUR	Polyurethane
PWC	Plastic Waste Partnership
RDF	Refuse derived fuel
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SAICM	Strategic Approach to International Chemicals Management
SCCPs	Short-chain chlorinated paraffins
SDGs	Sustainable Development Goals
SEEA	System of Environmental Economic Accounting
SSbD	Safe and Sustainable by Design
TESS	Forum on Trade, Environment and the SDGs
UNCLOS	United Nations Convention on the Law of the Sea
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNCLOS	Law of the Sea Convention
UNFCCC	United Nations Framework Convention on Climate Change
UPOPs	Unintentional Persistent Organic Pollutants
VCM	Vinyl chloride monomer
vPvB	very Persistent and very Bio-accumulative
WTO	World Trade Organization
XPS	Extruded polystyrene

EXECUTIVE SUMMARY

Chemical hazard pictograms. Toxic focus with multiple coloured test tubes. Photo © Antoine2k. Dreamstime.com

Executive Summary

I. Objective

The main objective of the study is to map the global governance of plastics and associated chemicals, identify governance gaps, and identify complementarities with existing multilateral instruments in particular the Basel, Rotterdam and Stockholm (BRS) conventions, in the context of ongoing intergovernmental efforts to end plastic pollution. In addition, the study discusses the role of international sustainability criteria for plastics and associated chemicals.

II. Background

Recognising the fragmented and inadequate global governance landscape to address plastic pollution, 175 Member States adopted Resolution 5/14 at the United Nations Environment Assembly (UNEA) session in March 2022. The decision to commence negotiations leading to a global, legally binding instrument to end plastic pollution (hereafter: plastics instrument), is a recognition of the need to address governance gaps across the full life cycle of plastics and associated chemicals to prevent impacts on human health, human well-being and the environment.

This study builds on UNEA Resolution 5/14 that reaffirmed "the importance of cooperation, coordination and complementarity among relevant regional and international conventions and instruments, with due respect for their respective mandates to prevent plastic pollution and its related risks to human health and adverse effects on human well-being and the environment."[1] To this end, this study focuses on mapping the global governance landscape of plastics and their associated chemicals to understand the governance gaps and possible mechanisms to 1) address the full life cycle of plastics, 2) prevent adverse effects on human health and the environment, and 3) "promote sustainable production and consumption of plastics, including, among others, product design, and environmentally sound waste management, including through resource efficiency and circular economy approaches."[2]

To successfully deliver on this mandate, there is a need to rethink how the new plastics instrument can address plastics starting from a molecular level, then as a material and a product, and finally as waste to help minimise the environmental and human health burden. This study aims to deepen our understanding of the possible mechanisms for existing global instruments, in particular the BRS conventions, and the plastics instrument to achieve this.

Several aspects of plastic pollution have been addressed by different multilateral environmental agreements (MEAs). However, these largely focus on plastics as waste, with limited measures to address upstream activities, including production and use of chemical constituents of plastics – such as additives and processing aids – many of which have been proven to be harmful to human health, human well-being, and the environment. Additionally, little attention has been paid to reduce the overall use of plastics, in particular problematic and unnecessary plastics, as well as microplastics and nanoplastics.

To be effective and impactful, it is necessary to consider closing the governance gaps across the full life cycle of plastics and associated chemicals, while complementing and preventing overlaps with the measures that exist or can be strengthened in the current suite of relevant MEAs. This requires clarity on obligations included in existing MEAs that may address some components of the life cycle of plastics, including associated chemicals. This study aims to improve such understanding across four primary life

1 UNEP/EA.5/Res.14, preamble.

2 UNEP/EA.5/Res.14, para 3b.

cycle phases, thereby identifying opportunities for existing instruments and the plastics instrument to move the world closer to safe and non-toxic circularity for plastics, including global elimination of leakage/discharge of plastics, thus preventing harmful plastic pollution and its contribution to the triple planetary crisis.

Box A: Global Governance of Plastics and Associated Chemicals report overview

SECTION 1 **Introduction**	• Linking chemicals and plastics • Linking plastics and human rights • The need to define plastic pollution • Overview of challenges across the life cycle of plastics
SECTION 2 **Complementarities and gaps within global binding multilateral instruments** (where relevant to plastics and associated chemicals)	• Multilateral instruments addressing chemicals • Multilateral instruments governing wastes • Framework agreements of relevance • Full mappings provided in Appendix 2 and 3 • Opportunities to address the plastics life cycle
SECTION 3 **Opportunities to strengthen governance of plastics based on globally agreed principles and approaches**	• Objectives and scope of the plastics instrument • Obligations, measures and voluntary approaches across the full life cycle • Assessment • Cooperation and coordination • Financing and capacity building • Supporting measures
SECTION 4 **Potential mechanisms for closing the governance gaps across the full life cycle of plastics and associated chemicals**	• Developing international sustainability criteria for plastics and associated chemicals • Identifying and addressing chemicals and polymers of concern • Other possible mechanisms for closing the governance gaps
APPENDIX 1	Compilation of summary tables of governance elements included in the multilateral instruments reviewed
APPENDIX 2	Mapping of legally binding multilateral instruments that could address plastics and associated chemicals
APPENDIX 3	Summarised mapping of non-binding measures for plastics and associated chemicals
APPENDIX 4	Chemicals of relevance for plastics listed by the Stockholm Convention, Minamata Convention and Montreal Protocol
APPENDIX 5	Compilation of existing selection criteria
APPENDIX 6	OECD Chemicals Perspective for Sustainable Plastics Design
APPENDIX 7	Examples of key terms

Key content of the full report, available at the BRS conventions website http://www.basel.int/tabid/8335

III. The life cycle phases of plastics and associated chemicals

The intention of this study is to clarify the policy options currently available that meet general circularity approaches. The full life cycle of plastics and associated chemicals is yet to be defined, as are the approaches that may be considered as promoting circularity thereof. Without pre-empting a definition of the full life cycle of plastics, this study is based on seven life cycle phases for plastics and associated chemicals, namely extraction, production, manufacture, consumption, sorting/collection (waste management), recovery/final disposal (waste management), and remediation. These have been further grouped into four primary phases that may assist in delineating opportunities for the new plastics instrument and identify complementarities with relevant MEAs. Figure A illustrates the groupings within the four primary life cycle phases.

The four primary life cycle phases of plastics applied in this study are:

1. The **sourcing/extraction phase** – extraction of raw materials, both organic (hydrocarbons, including from bio-based sources) and inorganic, to produce plastics and associated chemicals.
2. The **chemical phase** – production of building blocks and chemical processing to produce polymers and commodity/speciality chemicals.
3. The **material phase** – the manufacture of materials, the manufacture of intermediate and final products, and consumption.
4. The **dematerialisation phase** – waste management, including collection/sorting and recovery/final disposal operations,[3] and remediation.

International trade manifests within each life cycle phase, and between each phase identified above, and therefore, needs to be considered when developing measures to strengthen the global governance of plastics and associated chemicals. Distribution/transportation are also activities that are embedded in each of the phases, contributing to harmful environmental outcomes that must be reduced at the global level.

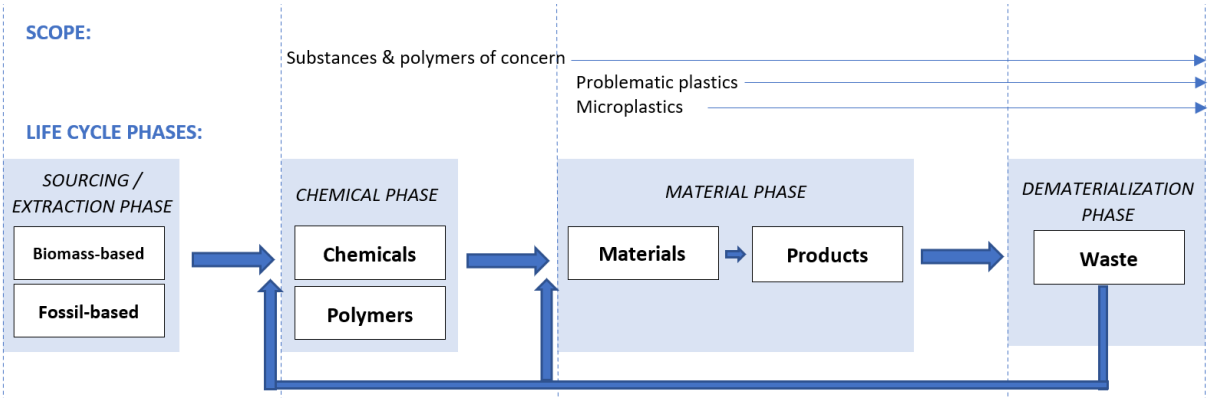

Figure A: Possible scope of plastic pollution

3 Waste management presented in this study includes activities considered within the scope of the Basel Convention's definition of waste management and disposal operations. The Basel Convention defines waste as "substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law." The management of such wastes includes "the collection, transport and disposal of hazardous wastes or other wastes, including after-care of disposal sites" (Art. 2 para 1,2). Annex IV to the Convention further differentiates disposal operations into those that do, or do not, "lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses." Disposal operations that do not lead to these activities are referred to as "final disposal operations" and include landfilling and incineration (on land or at sea), whereas disposal operations that do lead to such activities, sometimes referred to as "recovery operations" include waste-to-energy, recycling and reclamation, amongst others.

IV. Key messages

The key messages are organised into three groupings: 1) by the life cycle phase analysed, 2) by the governance elements analysed, and 3) by those that could benefit from further research.

Key messages of the mapping that emerge from analysis of the life cycle phases are as follows:

1. The **sourcing/extraction phase** is addressed by the Minamata Convention that identifies the full life cycle starting from the resource extraction phase, but is only relevant for specific uses in plastics, namely for vinyl chloride monomer production and for the production of polyurethane using mercury containing catalysts. The UN Framework Convention on Climate Change (UNFCCC) aims to mitigate greenhouse gas (GHG) emissions, and while it does not directly address plastics, it is highly relevant for global plastics governance since petrochemical feedstocks used to produce plastics account roughly for 10.5% of global oil demand (IEA, 2022) and plastics play a role in measures to prevent and reduce GHG emissions.

2. Only a fraction of chemicals associated with the plastics life cycle are regulated by existing MEAs: the **chemical phase** regulates around 4% (128) of 3,200 chemicals of potential concern in plastics, including additives, processing aids and monomers and non-intentionally-added substances (NIAS), with the Stockholm Convention, Minamata Convention and Montreal Protocol being of greatest relevance in this regard (UNEP, 2022). Additionally, around 6,000 chemicals used in plastics lack hazard data (many of which may also be potentially hazardous) (UNEP, 2022). Hazard and risk assessment of chemicals is articulated as a voluntary measure under the Strategic Approach to International Chemicals Management (SAICM) that has encouraged many countries to develop a regulatory framework for chemical safety assessment. However, the large number of chemicals that lack hazard data implies the existence of weak regulatory capacity and enforcement in many countries. Moreover, a challenge is that most countries have regulatory gaps that do not require hazard and risk profiles for polymers, or testing does not reflect latest scientific findings. Chemical simplification that encourages the use of a smaller number of chemicals and facilitates a move from a chemicals-specific approach to addressing groups of chemicals of concern, where appropriate, could prove more effective in light of the large number of chemicals and help ensure that restriction does not lead to regrettable substitution. For several groups of chemicals, the scientific consensus that human health harm is caused by plastic-related exposure is either high (bisphenols, flame retardants and phthalates) or medium (per-and polyfluoroalkyl substances, PFAS) (Merkl and Charles, 2022). At the same time, the principles of prevention and precaution suggest that exploring safer and more sustainable chemicals through methods such as substitution, engineering, and the use of non-chemical alternatives should be taken into account.

3. The **material phase** presents the greatest global governance gap with limited means to address problematic and avoidable plastics, and microplastics and nanoplastics. Restricting and reducing the overall production and use of plastics, in particular problematic plastics, will help reduce resource use, chemicals use, and plastic waste generation. This will, ultimately, help mitigate GHG emissions, transition towards a chemically safe circular economy and bring other benefits, including for individuals, groups and peoples disproportionately impacted by chemicals in plastic and plastic waste. Therefore, this phase holds the highest potential to address the global governance gaps for plastics through a focus on product and material controls and restrictions, as well as design.[4] Currently, sustainable design is not addressed in the binding global governance framework for plastics, except indirectly within the Basel Convention's work on waste minimisation and prevention. UNEA resolutions provide aspirational language on design, including highlighting "the importance

4 Although design is primarily a function of the material phase, the application of sustainable design principles should consider all life cycle phases to ensure positive net outcomes for each phase.

of minimising and preventing, when feasible, the use of hazardous substances in material cycles and managing chemicals in products throughout their life cycle, from design to waste" (UNEA Res. 4/8, para 3). Moreover, SAICM outlines voluntary activities related to sustainable design that relates to plastics, such as e-products. Moving forward, sustainable design should integrate the chemical component in product and material design to facilitate safe and non-toxic circularity of plastics and associated chemicals. This could be realised through the development of international sustainability criteria that simultaneously address chemicals and polymers of concern and facilitate the design for product safety, longevity, reuse, repair, remanufacture and recycling, building on ISO[5] and OECD[6] initiatives currently underway. Additional research is necessary to define sustainable material and product design that improves end-of-life processes, including reuse, remanufacture and recycling. This may include aspects like multi-layer structures, colours, disassembly, and others, as well as increasing transparency.

4. The **dematerialisation phase** is most comprehensively addressed, namely by the Basel Convention and its recent plastic waste amendments which entered into force in 2021, as well as the e-waste amendments entering into force in 2025. However, no provision is made within the text of the Basel Convention for a financial mechanism to assist with implementation.[7] Additionally, MARPOL Annex V and the London Convention and its Protocol address the discharge and dumping of plastic waste directly into the oceans. Remediation is included in the Convention on Biological Diversity (CBD) with an obligation to rehabilitate and restore degraded ecosystems, and promote the recovery of threatened species, while provisions relevant for plastic waste are articulated only in "soft law." Measures for remediation of sites contaminated with chemicals – some of which are used in the production of plastics – are included in the Minamata and Stockholm Conventions with obligations to endeavour to develop appropriate strategies for identifying sites contaminated by chemicals listed by the conventions. The conventions highlight that if remediation of those sites is undertaken (Stockholm Convention) or if any actions to reduce the risks posed by such sites is undertaken (Minamata Convention), it has to be performed in an environmentally sound manner. The waste hierarchy suggests that in the dematerialisation phase the emphasis should be on recovery (rather than final disposal) in order to achieve circularity, meaning to promote operations which will obtain some useful benefit from the waste, primarily by bringing materials back into productive use and secondary by recovering energy from waste[8]. The different options for recovery will need to be assessed to understand not only their environmental and human health benefits and challenges, but also the optimal life cycle outcomes possible through design of materials and products.[9]

Other key messages of the mapping, as derived from analysis of the governance elements are as follows:

5. **Targets** and **indicators**, which could assist in tracking progress towards reduced environmental impact and safer circularity of plastics and associated chemicals, are predominantly lacking at the global level. The development of measurable, time-bound and achievable targets along the life cycle of plastics, accompanied by national action plans that include national targets is recommended for mobilising action and tracking progress. The Montreal Protocol and the Minamata Convention have adopted mitigation targets with time schedules that are relevant for some chemicals of concern used in plastics.[10]

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5 See for example https://www.iso.org/committee/49256/x/catalogue/

6 See for example https://www.oecd.org/env/waste/global-forum-on-environment-plastics-in-a-circular-economy.htm

7 Funding is available through the Basel Convention Regional Centres, technology assistance, an implementation fund and the UNEP Special Programme for institutional strengthening.

8 See the Basel Convention glossary of terms: www.basel.int/Implementation/LegalMatters/LegalClarity/Glossaryofterms/SmallIntersessionalWorkingGroup/tabid/3622/Default.aspx

9 Refer to footnote #3 for disposal operations as defined under the Basel Convention.

10 Similarly, the Stockholm Convention has adopted time-bound targets, but they are not relevant for uses in plastics e.g. elimination of PCBs in equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) by 2025.

6. **Control measures** that aim to phase out or regulate chemicals/materials/products or minimise releases/emissions related to plastics are deployed by MEAs, yet significant governance gaps remain. In addition to limited coverage of *chemicals of concern* (as noted above), a notable gap is that *polymers of concern* are unaddressed, which is partly explained by a lack of hazard data and/or data on polymer identities. Moreover, *microplastics and nanoplastics* also remain unaddressed, despite functioning as vectors for chemical contaminants, and potentially as a chemical threat to human health and the environment. Lastly, *problematic and avoidable* plastics are unaddressed at the global level, although UNEA Res. 4/9 highlights the need to address single-use plastic products pollution. To protect human health and the environment, it is therefore key to address, as appropriate, chemicals and polymers of concern used in the production, manufacture, consumption and end-of-life processes of the plastics life cycle, as well as problematic plastics and microplastics. Such an approach will support a foundational shift towards safe and non-toxic circularity of plastics, thereby enhancing resource efficiency and reducing environmental pressures, including climate change and biodiversity loss. The principles of prevention, precaution and polluter-pays need to be given consideration in the development of control measures.

7. The **trade of plastic products** and their constituent materials are not regulated at the global level, weakening the control of products placed on the markets of all countries, including through international online sales. Tracking of trade should encompass information on the imports and exports of plastics, including volumes and qualities of plastic products and materials traded. Trade restrictions apply to plastic wastes (including e-waste) and some chemicals associated with plastics. Licensing systems used by the Montreal Protocol have proven useful for tracking trade of ozone depleting substances (ODS), which could be modelled for use in collection of trade-related information. Trade controls of plastics and related materials can build on trade measures used for e-waste and the work of the World Trade Organization (WTO) Informal Dialogue on Plastic Pollution[11] and the Forum on Trade, Environment and the SDGs (TESS).[12]

8. **Monitoring** and **reporting** are fragmented at the global, regional and national levels, and are inadequate to track progress towards global goals and targets, requiring the development of globally agreed definitions to assist in harmonising these processes. The Protocol on Pollutant Release and Transfer Registers (PRTRs) provides an important model as it requires reporting on pollutant releases and transfers by operators and owners on the production facilities of plastics and some associated chemicals, as well as reporting on recovery and final disposal operations.

9. The development of **inventories** of emissions and releases for relevant sources of mercury under the Minamata Convention is mandatory. While not mandatory, inventories of persistent organic pollutants (POPs) present in plastics under the Stockholm Convention have been considered helpful in tracking progress and assessing financial needs. Under the Basel Convention, Parties can report annually on their generation of plastic wastes and they must report annually on all imports and exports of plastic wastes. The development of inventories for plastics could focus on material flows of plastic products and associated chemicals (extraction, production, consumption, recovery and final disposal, and trade that manifests in all phases), as well as emissions, leakage and contamination, and thus could help to provide needed quantitative data for tracking progress towards agreed goals. They could also be helpful in identifying required policies and actions to be reflected in the national action plans. Moreover, data on pollutant releases across the life cycle of plastics could be disaggregated from other multilateral instruments, including mandatory inventories for greenhouse gas emissions and removals under the UNFCCC and Paris Agreement, and voluntary PRTR systems promoted by SAICM (and included as mandatory requirement for Parties to the UNECE Kyiv Protocol on PRTRs).

11 See https://www.wto.org/english/tratop_e/ppesp_e/ppesp_e.htm

12 See https://tessforum.org/news/themes/plastic-pollution

10. The requirement to develop and implement **national action plans** (NAPs) under current MEAs is limited, although specific components are addressed, including implementation plans for persistent organic pollutants (POPs) under the Stockholm Convention. The Paris Agreement provides a useful model for advancing global governance of plastics, requiring targets and measures agreed at the global level to be included in NAPs and strengthened in successive plans as per agreed timelines. Moreover, NAPs have the potential to facilitate effective links to other MEAs, as well as involve all relevant sectors and influence national planning processes, as articulated for NAPs developed under the CBD. However, it should be acknowledged that a NAP mechanism to address plastics pollution is not in itself a key building block of cohesive global action towards closing the governance gaps identified. Action plans could serve as a means of coordinating national action to implement binding commitments and deliver international sustainability criteria that address the governance gaps, such as the lack of adequate access to data related to plastic pollution as a steppingstone for further action by different stakeholders and across sectors.

11. **Transparency and information sharing** of plastic products and associated chemicals is limited across the full life cycle. The Stockholm Convention includes mandatory labelling requirements for some POPs with specific exemptions for uses in plastics. Also, the Rotterdam Convention is relevant as it provides information on the trade of particular chemicals, some that have uses in plastics. In addition, under the Basel Convention, any transboundary movement of plastic wastes must be accompanied by a movement document specifying the hazardous characteristic of the waste or that its management requires special consideration. However, the general requirement to provide information on chemicals throughout their life cycle, including chemicals in products, is articulated only as a voluntary measure under SAICM. Consequently, adequate information about potential exposure to chemicals of concern is not accessible to many of those affected by them, including consumers and workers, in particular those in vulnerable situations. This means that consumers and retailers cannot take informed decisions as they are not aware of the environmental and societal impacts of different types of plastics and associated chemicals. Moreover, inadequate information on chemical content of plastic products hinders effective control by customs authorities, and risks contaminating recycling streams. Increased transparency and sharing of information regarding chemicals used in plastics, such as the identities, occurrence and hazard traits of chemicals and polymers of concern, is necessary. Moreover, labelling may warrant further examination, including possibilities for taking use of modern technologies, such as digital product passports that can contain information, among others, on the chemical content of products. This should be coupled with efforts to raise awareness of society about plastic pollution.

Lastly, additional key messages stemming from the analysis of aspects that could benefit from further research are as follows:

12. There is no financial mechanism dedicated to the implementation of a globally coordinated set of measures to prevent plastic pollution. Given the extensive nature of plastics and associated chemicals, and the challenges in establishing and implementing systems for transparency, monitoring, tracking, enforcement, accountability and public participation (amongst others), a **financial mechanism** may be necessary that extends beyond a multilateral fund. This could include the Global Environment Facility (GEF) and private sector arrangements. Relevant funding needs may include institutional strengthening (i.e. multi-sectoral coordination bodies), enabling activities (i.e. national action plans, international sustainability criteria, and reporting), and compliance with control measures (i.e. mitigation targets), facilitating transfer of technologies and capacity building (i.e. sharing of experiences).

13. Global **institutional arrangements** are inadequate and may benefit from a strengthened science-policy interface focused on the full life cycle of plastics. This interface could aid in identification of alternatives to plastics, promoting sustainable design of plastic products, and identifying chemicals

and polymers of global concern. In this context, and taking into account existing subsidiary bodies under MEAs, the possible role of a scientific subsidiary body and the science-policy panel to contribute further to the sound management of chemicals and waste and to prevent pollution may warrant further examination. Moreover, identifying ways for inclusive, effective, and transparent public participation in decision-making, as envisioned in the Aarhus Convention and the Almaty Guidelines on Promoting the Application of the Principles of the Aarhus Convention in International Forums, is recommended.

V. Potential mechanisms for closing the governance gaps across the full life cycle of plastics and associated chemicals

The study outlines two mechanisms that could be considered in strengthening the governance of plastics and associated chemicals across the full life cycle of plastics, in particular to fill in the governance void in the chemical and material phases. It is in these phases that the level of hazard within plastic products is determined, and such focus can benefit the entire global value chain, including end of life management of plastics, as well as people's health and wellbeing, particularly of those groups most impacted by plastic pollution. The proposed mechanisms aim to help transition to a non-toxic value chain that facilitates safe circularity of plastics, which is a prerequisite for ensuring effective, sustainable and safe plastic waste management services, and, ultimately, to ensure that leakage of plastic pollution comes to an end.

Firstly, the development of **international sustainability criteria for plastics and associated chemicals** could be considered in order to increase:

1. Transparency and traceability across the value-chain of plastic products, including plastic trade flows, supply chains and trade policies,
2. Environmental and safety performance through product/material redesign, and
3. Societal benefits and enhance human and environmental health.

The sustainability criteria are intended to provide governments and industry a level playing field. This is required to transform the global plastics value chain to effectively address safety and sustainability considerations across the life cycle of plastics, to generate system-thinking, and to empower Parties to catalyse a transformative shift across the value chain of plastics by helping to address design in its broadest sense. This is intended to complement and significantly strengthen the development of national action plans that is envisaged as a key obligation in the plastics instrument as per UNEA Resolution 5/14.

None of the existing multilateral instruments have the needed scope to accommodate the sustainability criteria. The breadth of the envisaged criteria suggests including them in the plastics instrument possibly as an annex, which could function as a living document to be updated on a regular basis. It is recommended to start the development of the initial sustainability criteria by the INC to avoid delays in their operationalisation.

Secondly, the development of a global approach for **identifying, addressing and providing transparency for chemicals of concern in plastics** could be taken into account, which may:

1. Include a grouping-of-chemicals approach to avoid regrettable substitution,
2. Combine hazard and exposure data to assess risk, and
3. Require full transparency and access to information of chemical inputs to all plastic products.

VI. Opportunities for the new global instrument to complement existing MEAs

The **Basel Convention** explicitly addresses significant aspects of the plastics life cycle, while the **Rotterdam and Stockholm Conventions** are relevant to some aspects of the plastics life cycle and the global governance of plastics. The plastics instrument has the greatest potential to complement activities under the BRS conventions in the chemicals, material and dematerialisation phases, while building on these Conventions to address the full life cycle of plastics and associated chemicals. Measures to reduce extraction, production and consumption of plastics and associated chemicals have the greatest potential to reduce the impact of plastics on the triple planetary crises, when coupled with a concerted effort to facilitate safe and non-toxic circularity of plastics and associated chemicals. The opportunities are discussed separately for three MEA clusters analysed.

1. Binding multilateral instruments directly addressing chemicals in plastics

The **Stockholm Convention** provides a valuable opportunity to continue listing POPs used in plastics among other uses. Since its adoption,[13] the Convention has begun to address groups of chemicals. Given the large number of chemicals of concern that may be used in plastics, a groups-of-chemicals approach is suggested at the global, where appropriate, for addressing related chemicals in plastics that do not fall within the scope of existing multilateral instruments.

The **Montreal Protocol** provides an exemption for use of ODSs as feedstocks and process agents, including for manufacturing of fluoropolymers. Possible emissions from the use of feedstock consist of residual levels in the ultimate products, and fugitive leaks in the production, storage and/or transport processes. Scholars suggest that Parties to the Montreal Protocol consider narrowing these exemptions, and possibly start to control vinyl chloride along with its principal feedstock, ethylene dichloride as "associated feedstocks" to help curb production of polyvinyl chloride (PVC).

The **ILO Chemicals Convention (C170)** has been ratified by 23 countries, providing a geographically narrow reach, and is not expected to have a significant role in supporting the plastics instrument from an occupational safety aspect. The improvement of worker safety issues in the life cycle of plastics, such as transparency of hazard information through labelling and other means is recommended in context of ongoing intergovernmental efforts to end plastic pollution. This could possibly be achieved through international sustainability criteria for plastics and associated chemicals.

The Rotterdam Convention aims to provide information on the trade of particular chemicals, some of which are used in plastics. The prior informed consent (PIC) procedure is intended to ensure that importing countries are informed about the hazards associated with chemicals listed in Annex III to enable to make informed decisions about their import. When a chemical is not listed in Annex III but is banned or severely restricted by an exporting Party, that Party must regularly notify any importing Parties. However, the convention was not designed to regulate chemicals and does not directly govern or regulate plastics or associated chemicals. Moreover, the convention only applies to chemicals and not to chemicals in articles (materials).

13 This includes group of PCBs.

2. Binding multilateral instruments directly addressing aspects of the plastics life cycle

Progress is being made by Parties to the **Basel Convention** on the development of national waste inventories for the purposes of national reporting, supported by guidance documents. This includes inventories of plastic wastes. Because these inventories are still in the developmental phase, this information is yet to be generated by Parties to the Basel Convention. The related guidance document developed under the Basel Convention is geared towards obtaining information on the amount of plastic waste generated at a country level, as well as its disposal and its imports/exports.[14] The provision of information on imports and exports of plastic wastes is mandatory under the Basel Convention, while the provision of information on the generation of plastic wastes is voluntary. The guidance could provide a foundation for strengthening the voluntary transmission of inventories of the generation and disposal of plastic wastes under the Basel Convention, or of the transmission of such information on a mandatory basis under the new plastics instrument. The development of global monitoring programmes, national inventories and national action plans could include pollution by plastics and associated chemicals across the full life cycle of plastics.

Plastics can occur or be found in other waste streams, such as refuse derived fuel (RDF), e-waste, paper waste containing plastic and textiles waste, noting that controls in place under the Basel Convention may apply to waste streams mixed with plastic waste when subject to transboundary movement. There is a need to build on the broad range of waste streams covered by the Basel Convention by tracking the full life cycle of plastics, including extraction of raw materials from the environment, material flows within the plastics value chain (including circularity), and emissions of plastics and associated pollution during and following recovery and final disposal.

Efforts to reduce the generation of hazardous wastes and other wastes to a minimum must focus on the waste management phase, as promoted in the Basel Convention guidance documents.[15] This obligation could be strengthened, addressing the generation of wastes from plastics and associated chemicals across the full life cycle (e.g. single-use plastic and less hazardous additive requirements).

The principles of the **London Protocol** to promote the prevention of microplastic contamination of waste materials could be further emphasised in context of intergovernmental efforts to end plastic pollution. This could include evaluating and phasing out unnecessary and avoidable sources. This would reduce contamination of agricultural land by the unintentional application of microplastics in sewage sludge used as a soil improver. “Essential uses” could be identified and exempted but promoted for innovative alternative materials and practices to reduce waste generation and releases.

3. Binding framework agreements of relevance

Transitioning towards safe and non-toxic circularity of plastics could significantly benefit the climate and biodiversity agendas, making it highly relevant for the **Convention on Biological Diversity (CBD), as well as the UNFCCC and Paris Agreement**.

99% of chemical additives and polymers derive from fossil fuels (Ögmundarson et al., 2020), thus reducing the use of fossil fuel resources in the production of plastics and associated chemicals is key. It may be practical to consider that emissions generated by the energy and fossil feedstock consumption to generate plastics are addressed and tracked under the **UNFCCC and Paris Agreement**, where applicable to plastics and associated chemicals while also acknowledging the need to track GHG emissions directly related to plastics as materials, products and waste.

14 See the Practical guidance on the development of inventories of plastic waste (UNEP/CHW.15/INF/19/Rev.1).

15 See Guidance to assist Parties in developing efficient strategies for achieving the prevention and minimization of the generation of hazardous and other wastes and their disposal (UNEP/CHW.13/INF/11/Rev.1).

The **CBD** provides an avenue for remediation of plastic litter through its obligation to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species (Art. 8, para f). To this end, the CBD is particularly relevant for removing plastic litter that directly affects many marine and terrestrial species via ingestion or entanglement. However, the removal of legacy plastics from existing landfills and diversion from future landfilling is closely linked to achieving climate goals under the UNFCCC and Paris Agreement, given it helps to mitigate landfill fires and methane leaks. Moving forward, remediation can benefit from the use of market-based instruments, such as extended producer responsibility (EPR) schemes, complemented by measures that control toxic additives. For instance, the EU Single Use Plastics Directive applies EPR schemes to tobacco filters and fishing gear to cover the cost of cleaning up litter.

Other relevant instruments

SAICM is a voluntary instrument that is relevant for plastics and associated chemicals through some emerging policy issues and other issues of concern, such as the chemicals in products (CIP) and endocrine disrupting chemicals (EDCs).[16] SAICM also encourages the establishment of PRTRs that are a publicly accessible inventory of chemicals and pollutants released to air, water and soil.

The establishment of PRTRs is mandatory under the **Kyiv Protocol on PRTRs** that covers releases from production of plastic and several associated chemicals, and recovery or final disposal operations. One approach to promoting greater monitoring, reporting, and accessibility of data on plastic releases could be to explore the development of "plastic pollution release and transfer registers" that present data in a more detailed and easily accessible manner, building on existing structures (UNECE, 2022).

In line with **the 2030 Agenda for Sustainable Development**, there is a need to ensure that no one is left behind in global efforts to end plastic pollution, giving particular attention to vulnerable groups, such as waste pickers and informal recyclers. The move towards a rights-based approach for the global governance of plastics and associated chemicals can be fulfilled by promoting Principle 10[17] of the Rio Declaration and upholding the human right to a clean, healthy and sustainable environment as per UNGA Resolution 76/300.

Lastly, opportunities for building on existing models on transparency and information sharing could be taken into account, in particular those enshrined in the **Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters** (Aarhus Convention) and the **Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean** (Escazu Agreement).[18]

16 SAICM is effectively under renegotiation and will be replaced by the Beyond-2020 Framework for sound management of chemicals and waste to be adopted in 2023.

17 Principle 10 states "Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided".

18 Both treaties are open for accession by any UN Member State. The Aarhus Convention includes three main components: the right to know, the right to participate in decision-making and the right to redress or review. They cover access to environmental information, early, inclusive and effective involvement of the public in decision-making, broad scope of participation, transparent and user-friendly processes, an obligation on authorities to take account of public input, a supportive framework and an effective means of enforcement/appeal.

VII. Summary of the global governance of plastics and associated chemicals

The four primary life cycle phases of 1) sourcing/extraction, 2) chemical, 3) material, and 4) dematerialisation have been applied to the mapping of the global governance landscape.

A summary is provided below, supported by a broader discussion in Section 2 of the study, with detailed mapping (including MEA legal text) in Appendices 2 and 3 of the study.

1. Sourcing/Extraction Phase

MEAs with control measures on feedstocks used in plastics

- The **Minamata Convention** requires Parties to take steps that shall include promoting measures to reduce reliance on mercury from primary mining in vinyl chloride monomer (VCM) production, as well as in the production of polyurethane using catalysts that contain mercury.

2. Chemical Phase

MEAs with control measures on chemicals used in plastics

- The **Stockholm Convention** requires Parties to prohibit and/or take the legal and administrative measures necessary to eliminate production and use of chemicals listed in Annex A, subject to the provisions of that Annex. Parties shall also restrict production and use of chemicals listed in Annex B in accordance with provisions of that Annex. Annexes D and E provide the criteria a chemical must meet to be listed in Annexes A, B and/or C. An evaluation could be undertaken to provide information related to socio-economic considerations associated with control measures (see indicative list of items in Annex F).
- The **Minamata Convention** requires Parties to reduce the use of mercury-containing catalysts in the production of polyurethane (PUR), ideally within 10 years of the Convention's entry into force and reduce the use of mercury in VCM production by 50% by 2020, using 2010 as a base line.
- The **Montreal Protocol** provides measures and targets for the phasing out of production and consumption of ozone depleting substances listed in Annexes A, B, C, and E, as well as for the phasing-down of production and consumption of hydrofluorocarbons (HFCs) listed in Annex F.
- For the protection of workers, the **ILO Chemicals Convention** (C170) prescribes the classification of chemicals by hazards.

MEAs with measures on trade in chemicals

- The **Stockholm Convention** requires Parties to prohibit and/or take the legal and administrative measures necessary to eliminate import and export of chemicals listed in Annex A. Measures shall be taken to ensure that chemicals listed in Annex A or B are imported only for purposes permitted for that Party under Annexes A or B. Export is allowed to a Party that is permitted to use that chemical under Annex A or B or under specific conditions should the importing State not be Party to the Convention.
- Parties to the **Montreal Protocol** shall ban the import of the controlled substances in Annex A from any State not party to the Protocol.
- For informational purposes, the **Rotterdam Convention** requires exports of chemicals listed in Annex III to be subject to PIC procedure. If a chemical is not listed in Annex III but is prohibited or severely restricted by an exporting Party, it shall notify the importing Party before the first shipment occurs, and annually thereafter.

- As per the **Minamata Convention**, Parties shall not allow the export of mercury except to a Party that provides written consent to the exporting Party and only for the purpose of an allowed use or for environmentally sound interim storage. Export to non-Parties is also allowed under the same conditions. In addition, a non-Party must demonstrate that it has measures in place to ensure the protection of human health and the environment and to ensure its compliance with the provisions of the treaty related to interim storage and mercury wastes.
- As per the **ILO Chemicals Convention** (C170), exporting member States shall communicate to any importing country whether uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it.

MEAs with measures on transparency and information exchange

- The **Stockholm Convention** requires Parties to facilitate or undertake the exchange of information relevant to the reduction/elimination of the production, use and release of POPs, as well as alternatives to POPs, including information relating to their risks, and economic and social costs.
- Facilitation is required under the **Minamata Convention** for the exchange of information on the reduction/elimination of production, use, trade, and emissions/releases of mercury, and on alternative manufacturing processes. Parties must also include information in their national reports showing that the trade requirements of the treaty have been met.
- The **Rotterdam Convention** requires facilitation of the exchange of scientific, technical, economic and legal information concerning chemicals within the scope of the Convention, and facilitation of the provision of publicly available information on domestic regulatory actions relevant to the objectives of the Convention, and actions that substantially restrict one or more uses of the chemicals.
- As per the **ILO Chemicals Convention** (C170), suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals. Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets are provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained.
- The **Aarhus Convention** and the **Protocol on PRTRs** require Parties to provide public with access to information on chemicals and their releases.

3. Material Phase

MEAs with control measures on plastics and associated chemicals

- The **Stockholm Convention** requires Parties to prohibit and/or take the legal and administrative measures necessary to eliminate their production and use of chemicals listed in Annex A subject to the provisions of that Annex. Parties shall also restrict their production and use of chemicals listed in Annex B in accordance with the provisions of that Annex. Annexes D and E provide the criteria a chemical must meet to be listed in Annexes A, B and/or C. It also contains provisions (Article 3.3 and 3.4) for both preventing new industrial chemicals and those currently in use to exhibit the characteristics of POPs.
- More broadly, the **Basel Convention** requires Parties to take the appropriate measures to ensure that generation of hazardous wastes and other wastes is reduced to the minimum, taking into account social, technological and economic aspects.

MEAs with measures on trade of plastics and associated chemicals

- The **Stockholm Convention** requires Parties to prohibit and/or take the legal and administrative measures necessary to eliminate import and export of chemicals listed in Annex A. Measures shall be taken to ensure that chemicals listed in Annex A or B are imported only for purposes permitted

for that Party under Annex A or B. Export is allowed to a Party that is permitted to use that chemical under Annex A or B, or under specific conditions should the importing State not be Party to the Convention.

- As per the **ILO Chemicals Convention** (C170), exporting member States shall communicate to any importing country whether uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it.

MEAs with measures on transparency and information exchange

- Parties to the **Stockholm Convention** shall facilitate or undertake the exchange of information relevant to the reduction/elimination of the production, use and release of POPs, alternatives and their risks, develop strategies to identify POPs in products/articles and label certain POPs, e.g., hexabromocyclododecane (HBCD) used in expanded polystyrene (EPS)/ extruded polystyrene (XPS) in buildings.
- As per the **ILO Chemicals Convention** (C170), suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals. Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets are provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained.

4. Dematerialisation Phase

MEAs with control measures on plastics and associated chemicals

- The **Basel Convention** requires Parties to take appropriate measures to ensure that the generation of hazardous and other wastes within it is reduced to a minimum, taking into account social, technological and economic aspects, and ensure the availability of adequate disposal facilities for environmentally sound management (ESM) of wastes within the country of generation, to the extent possible. Parties shall also ensure the transboundary movement of hazardous wastes and other wastes is reduced to the minimum and is conducted in a manner which will protect human health and the environment through the Convention's prior informed consent (PIC) procedure.
- The **Stockholm Convention** requires Parties to manage stockpiles of POPs in a safe, efficient and environmentally sound manner and to dispose of POPs wastes, including products/articles upon becoming waste in such a way that the POP content is destroyed or irreversibly transformed, or otherwise disposed of in an environmentally sound manner, in line with the Basel Convention. Parties are also required to endeavour to develop strategies to identify contaminated sites, and if remediation of those sites is undertaken it has to be performed in an environmentally sound manner. Each Party shall take a minimum set of listed measures to reduce total releases of chemicals listed in Annex C that are unintentionally produced, with the goal of continuing minimisation, and, where feasible, ultimate elimination, e.g. dioxins and furans. The open burning of waste largely fuelled by plastic is the major dioxin/furan source in developing countries, resulting in the contamination of the food chain (Petrlik et al., 2022).
- Parties to the **Minamata Convention** shall manage mercury waste in an environmentally sound manner, and endeavour to develop appropriate strategies to identify and assess sites contaminated by mercury and mercury compounds.
- As per the **Montreal Protocol** Parties shall ensure that HFC-23 emissions generated from the manufacture of certain controlled substances are destroyed to the extent practicable.
- As per the **ILO Chemicals Convention** (C170), employers shall ensure that unneeded hazardous chemicals are disposed of in a manner that eliminates/minimises the risk to safety, health and the environment.

- For sea-based sources of plastic pollution, **MARPOL Annex V** prohibits the discharge of all plastics from ships into the sea, including synthetic fishing gear and incinerator ashes, in all maritime jurisdictions. The instrument provides some exceptions. Parties are also required to provide adequate garbage reception facilities at ports and terminals.
- Parties to the **London Convention** shall prohibit the dumping into the sea of persistent plastics and other persistent synthetic materials. This includes some chemicals used in the plastics life cycle. A permit shall be issued for the dumping of dredged material, which can contain plastics, particularly microplastics.
- By excluding plastics and associated chemicals from the "whitelist" of substances permitted to be assessed for dumping, the **London Protocol** prohibits their dumping into the sea.

MEAs with measures on trade of plastics and associated chemicals

- The **Basel Convention** includes three entries specific to plastic wastes, found in Annexes II, VIII and IX. Plastic wastes that fall within the scope of Annex II (entry Y48) require special consideration, and transboundary movement is subject to the PIC procedure. Plastic wastes that fall within the scope of Annex VIII (entry A3210) are considered hazardous unless otherwise demonstrated and transboundary movement is also subject to the PIC procedure, while those listed in Annex IX (entry B3011) are considered non-hazardous and are not subject to the PIC procedure. Transboundary movements are not permitted to non-Parties unless a valid agreement/arrangement is in place (Article 11) that meets the conditions of the Convention. In addition, transboundary movements of hazardous e-wastes are also currently controlled, while as of 1 January 2025, all e-wastes will fall within the scope of the Convention.
- As per the **Stockholm Convention**, Parties shall take measures to ensure that POPs listed in Annex A or B, including products and articles upon becoming wastes, are imported or exported only for environmentally sound disposal as per Article 6 para 1d, taking into account relevant international rules, standards and guidelines.
- The **Minamata Convention** requires Parties that are also Parties to the Basel Convention to take appropriate measures so that mercury waste is not transported across international boundaries except for the purpose of environmentally sound disposal. In circumstances where the Basel Convention does not apply, a Party must take into account relevant international rules, standards, and guidelines.
- As per the **Montreal Protocol**, if a Party is unable to cease production of a controlled substance for domestic consumption within the applicable phase-out date (other than for essential uses), it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction.
- The export of wastes or other matter for the dumping or incineration at sea shall not be allowed by Parties to the **London Protocol**.

MEAs with measures on transparency and information exchange

- The **Basel Convention** requires Parties to apply the PIC procedure for the transboundary movement of plastic wastes (entry Y48) that are not destined for mechanical recycling operations, or are halogenated, or are not considered unmixed, "clean" or free from contaminants (non-target recyclable plastic). Plastic wastes that fall within the scope of Annex VIII (entry A3210) are considered hazardous unless otherwise demonstrated and transboundary movement is also subject to the PIC procedure. A movement cannot proceed without having preliminarily been consented to by all concerned transit States and the importing State. A movement document is to accompany the shipment showing the waste description, disposal facility and operation, as well as a declaration that the PIC procedure has been followed. Parties must report on any national bans or policies that are stricter than that of the Basel Convention. Parties must report annually on the hazardous wastes and other wastes exported and imported, as well as on any disposal that

did not proceed as intended. Parties may report annually on the amount of hazardous and other wastes generated. Where available, reporting can include the effects on human health and the environment of the generation, transportation and disposal of hazardous wastes or other wastes. Parties should monitor the effects of hazardous waste management on human health and the environment. The Conference of the Partis is to keep under continuous review and evaluation the effective implementation of the Convention.

- Parties to the **Stockholm Convention** are to facilitate or undertake the exchange of information on the release of POPs and develop strategies to identify POPs in stockpiles and waste.
- **MARPOL Annex V** gives the right to port States to inspect and make a copy of ship records regarding each discharge into a reception facility or completed incineration, as well as exempted discharges or accidental losses, when in a port or offshore terminal of another Party.
- Parties to the **London Protocol** shall promote the availability of information to Parties that request it on scientific and technical activities and measures undertaken, and impacts observed from monitoring and assessment.
- The **Aarhus Convention** and the **Protocol on PRTRs** requires Parties to provide public access to information on wastes and their transfers.

National implementation and action plans[19]

- Parties to the **Stockholm Convention** are to develop and endeavour to implement a plan for the implementation of their obligations under the Convention, as well as action plans for the release of unintentional POPs (UPOPs). Parties are to transmit their implementation plan to the Conference of the Parties within two years of the date on which the Convention enters into force for them, and review and update, as appropriate, their implementation plan on a periodic basis and in a manner to be specified by a decision of the Conference of the Parties.
- Parties to the **Minamata Convention** may develop, review and update an implementation plan.

Reporting, monitoring and national inventories[20]

- The **Basel Convention** requires annual reporting, monitoring of the effects of hazardous wastes management on human health and the environment, and review and evaluation of the effective implementation of the Convention. Parties are also to report annually on all imports and exports of wastes and on the development of technologies for reduction and/or elimination of generation of hazardous wastes and other wastes, and they may report on the amount/types of wastes generated.
- Parties to the **Stockholm Convention** are to report statistical data on quantities of production, as well as import and export of POPs listed in Annexes A and B, including, to the extent practicable, the names of the states of import and export. Parties can voluntarily develop POPs inventories, as well as source inventories and release estimates of UPOPs.
- The **Minamata Convention** requires Parties to endeavour to identify individual stocks of mercury/mercury compounds exceeding 50 t, and sources of mercury supply generating stocks exceeding 10 t per year. Parties with relevant sources of mercury emissions and releases shall establish and

19 UNEA Res. 5/14 states that in developing the global plastics instrument, provisions could be included to develop, implement and update national action plans reflecting country-driven approaches to contribute to the objectives of the instrument (para 3d). These provisions should promote action plans that work towards the prevention, reduction and elimination of plastic pollution, and to support regional and international cooperation (para 3e). Such a requirement is not common in binding or voluntary measures across MEAs assessed in this report.

20 Paragraphs 3f, 3g and 3h of UNEA Res. 5/14 suggest that the new global plastics instrument could include provisions for national reporting, as appropriate, and to periodically assess the progress of implementation of the instrument, and the effectiveness of the instrument in achieving its objectives. The development of national monitoring programmes and inventories are important in delivering on this.

maintain inventories of emissions and releases. Parties shall endeavour to develop strategies to identify/assess contaminated sites and endeavour to cooperate to develop/improve modelling and monitoring of levels of mercury/mercury compounds in vulnerable populations and in environmental media. They shall report on efforts to develop or identify alternatives for mercury in Vinyl chloride monomer/Polyurethane (VCM/PUR) production and submit information of use of mercury in facilities that produce VCM/PUR.

- Parties to the **Montreal Protocol** shall provide statistical data on annual production of each of the controlled substances, as well as separately for each controlled substance regarding amounts used for feedstocks and import and export thereof, and for amounts destroyed by technologies approved by Parties.
- To protect workers, parties to the **ILO Chemicals Convention** (C170) shall require employers to assess the risks of using chemicals at work, including identifying chemicals that can eliminate/ minimise risk and limit exposure. Employers shall assess the exposure of workers to hazardous chemicals, and ensure they are not exposed to chemicals exceeding limits.
- As per **MARPOL Annex V**, each discharge of wastes to a reception facility, as well as completed incinerations, shall be recorded in a Garbage Record Book for larger ships, and in the ship's official logbook for smaller ships.
- The **London Convention** requires Parties to keep records of all matter permitted to be dumped and cooperate in the development of reporting procedures for illegal dumping.
- Parties to the **London Protocol** shall establish procedures, no more than two years after entry into force of the Protocol, for assessing and promoting compliance with the Protocol and continually evaluate its effectiveness. National action lists shall be developed as a mechanism for screening wastes that may be considered for dumping permits.
- The **Rotterdam Convention** promotes the establishment of national registers and databases, including safety information for chemicals.

1 INTRODUCTION

Landfilling of plastics creates a risk of landfill fires and slow degradation with associated methane emissions, as well as leakage of plastics and associated toxic chemicals into the surrounding environment. Photo © Vchalup. Dreamstime.com

1. Introduction

In March 2022, the UN Environment Assembly (UNEA) adopted a resolution to develop an international legally binding instrument to end plastic pollution (hereafter "plastic pollution instrument"). The resolution requested the Executive Director of the United Nations Environment Programme (UNEP) to convene an intergovernmental negotiating committee (INC), to begin its work during the second half of 2022, with the aim of completing its work by the end of 2024.[21]

To date, the development of global plastics governance has focused predominantly on plastics as waste, while little, if any, attention is given to managing the chemical constituents of plastics, or to identify alternatives to plastic usage. Fortunately, the resolution opens a window of opportunity to address the global plastics pollution crisis in a holistic manner. First, the resolution refers boldly to plastic pollution – instead of marine plastic debris and microplastics – and calls for addressing the full life cycle of plastics. Second, it refers to the need "to prevent plastic pollution and its related risks to human health and adverse effects on human well-being and the environment."[22] Implicit in prevention is the minimisation of use, or production of plastic where safer, more circular alternatives exist. Third, the new instrument is set to include provisions to "promote sustainable production and consumption of plastics, including, among others, product design, and environmentally sound waste management, including through resource efficiency and circular economy approaches."[23]

To successfully deliver on its mandate, there is a need to rethink how to address plastics starting from extraction of raw materials, then at a molecular level, then as materials and products, and finally as waste to help minimise the environmental, and human health and well-being burden. The scale of the challenge can be illustrated with key production figures and trends of the chemical and plastics industry. A key finding of the second edition of the Global Chemicals Outlook was that the value of the chemicals industry is USD 3.5 trillion (excluding pharmaceuticals) and is expected to double by 2030 (UNEP, 2019). The production of plastic resins, fibres and additives constitute around 43% of global chemical production (Levi and Cullen, 2018; Geyer et al., 2017).[24] Trajectories show that global plastics use is projected to triple between 2019 and 2060, from 460 Mt to 1,321 Mt (OECD, 2022a). For single-use plastics, an increase in their use with an annualised growth rate of 2.6.% has been observed between 2019 and 2021, from 133 Mt to 139 Mt (Charles & Kimman, 2023).

The impacts of plastic pollution on the environment, including climate, biodiversity and ecosystem services have been well documented, and include lethal and non-lethal effects ranging from ingestion, entanglement, reduced reproductivity, smothering and exposure to chemicals associated with the plastics life cycle (UNEP, 2021a). We are only beginning to understand the entirety of the global plastic pollution crisis, but new research is helping to expand our knowledge and prompt decision-makers to prioritise action targeting areas of plastic pollution where there is high scientific certainty of large-scale harm to human health, human well-being and the environment, such as chemicals of concern used in plastics (Merki and Charles, 2022). More than 5,000 academic papers have been published describing plastic-related harms to human health – focusing largely on three groups of chemicals of concern (phthalates, flame retardants, and bisphenols)–with an estimated global social cost exceeding USD 100 billion annually (Merki and Charles, 2022). This is attributed to leaching of chemicals of concern used in plastics that enter the environment and humans (Geueke et al., 2022) with large-scale consequences for endocrine diseases and dysfunctions, including infertility, early puberty, developmental issues such

21 UNEP/EA.5/Res.14, para 1.

22 UNEP/EA.5/Res.14, preamble.

23 UNEP/EA.5/Res.14, para 3b.

24 The production of plastic resins and fibres constitute about 40% global chemical production (329 Mt in 2013) (Levi & Cullen, 2018). This does not account for plastic additives estimated by Geyer et al. 2017 to constitute 7% of plastics by mass on average, meaning that plastic production would total up to 43% of global chemical production.

as ADHD and autism, and metabolic disorders such as type II diabetes and obesity (Trasande, 2022). Persons and groups in vulnerable conditions are disproportionately exposed to the impacts of plastic pollution (HRC, 2021a). This "hidden cost" is in addition to the economic impact of plastic pollution for fishing, tourism, and shipping estimated at USD 13 billion annually (UNEP, 2014). Moreover, microplastics have been found in human matrices, including placenta, blood and breast milk, which poses another grave concern – yet with unknown consequences for human health (Leslie et al., 2022; Ragusa et al., 2021, Ragusa et al., 2022).

Against this background, measures to reduce pollution from plastics need to be viewed beyond improving waste management and increasing recycling rates. They should include innovation for improved product design, and the development of alternative practices to plastics use that reduce risk to the environment, human health and human well-being throughout the life cycle of plastics. Global co-operation has been called for in all six resolutions adopted by UNEA regarding marine litter and plastic pollution.[25] Since the inception of UNEA in 2014, the call for action by all countries has progressed, with UNEA Res. 3/7 calling for all countries to develop and implement action plans for:

- preventing marine litter and the discharge of microplastics,
- encouraging resource efficiency,
- increasing collection and recycling rates of plastic waste,
- re-design and re-use of products and materials, and
- avoiding unnecessary use of plastic and plastic containing chemicals of particular concern (para 4c).

The redesign of plastics, with emphasis on source reduction and prevention, will need to transform global markets by enhancing business models to reduce ("doing more with less"), reuse, repair, remanufacture and recycle. The latter may involve decisions to phase-out or eliminate some unsustainable uses of plastic and/or associated chemicals.

To date, the global governance framework of plastics is fragmented, and does not address plastics pollution in a holistic manner, i.e., by taking into account and addressing emissions and releases throughout the life cycle of plastics. The existing global governance landscape includes a mixture of legally binding and voluntary instruments that cover different aspects of the challenge. This study provides the first comprehensive mapping of the existing global governance landscape for plastics and associated chemicals, with the view to identifying opportunities for strengthening the relevant agreement, where feasible and agreed by Parties, or understanding how the new instrument can most effectively address existing gaps.

This section provides an overview of the objective, scope and method of the study, including an interpretation of the life cycle of plastics and an overview of challenges that may need to be addressed. Section 2 discusses identified gaps and complementarities within the existing suite of legally binding global instruments relevant to plastics and associated chemicals. This is supported by detailed mappings in Appendices 2 and 3, with Appendix 1 providing a compilation of the summary tables of relevant measures included in the multilateral instruments reviewed.

Section 3 provides an overview of the main substantial provisions articulated in UNEA Res. 5/14, and those envisaged for the new global instrument to end plastic pollution. Supporting principles and approaches from adopted text in other relevant UNEA resolutions are provided, as are reflections from the results of the mapping exercise. The study concludes in section 4 with a proposal to develop international sustainability criteria for plastics and associated chemicals to help redesign chemicals, plastics, products, and their manufacturing and supply chain systems.

25 UNEA Res. 1/6. Marine plastic debris and microplastics; UNEA Res. 2/11. Marine plastic litter and microplastics; UNEA Res. 3/7. Marine litter and microplastics; UNEA Res. 4/6. Marine plastic litter and microplastics; UNEA Res. 4/9. Addressing single-use plastic products pollution; UNEA Res. 5/14. End plastic pollution: Towards an international legally binding instrument.

Further appendices provide a listing of chemicals of relevance for plastics listed by the Stockholm Convention, Minamata Convention and Montreal Protocol (Appendix 4), a compilation of existing criteria and other requirement for screening or prioritising chemicals under existing multilateral instruments (Appendix 5) and a listing of criteria outlined in the Organisation for Economic Co-operation and Development (OECD) Chemicals Perspective for Sustainable Plastics Design (Appendix 6). Appendix 7 provides a glossary with examples of terms from a selection of global, regional and national instruments.

1.1. Objective of the study

The main objective of the study is to map the global governance landscape of plastics and associated chemicals, identify governance gaps, and identify complementarities with existing multilateral instruments in context of ongoing intergovernmental efforts to end plastics pollution. This is intended to help identify:

1. Areas of coherence and overlaps in the global governance of plastics and associated chemicals, including best practices for each that may help strengthen the governance of the other,
2. Opportunities for strengthening global governance through amending existing instruments or the new global plastics instrument, and
3. The possible role of international sustainability criteria, particularly for chemicals of concern used in plastics, in strengthening global governance across the life cycle of plastics and associated chemicals.

The focus of this study is on governance issues, although the elaboration of the life cycle of plastics and associated chemicals used in the mapping has led to the examination of how plastics and chemicals intersect across the entire life cycle. The study complements UNEP's report on chemicals in plastics, which provides more detailed information on technical matters (UNEP, 2022).[26]

1.2. Linking chemicals and plastics

Plastics are composed of chemicals. Their manufacture begins with the production of chemically bonded atoms, known as monomers, which are then further bonded by chemical processes to form plastic polymers. These are combined with additives to manufacture plastic products. Moreover, manufacturing of plastics requires the use of processing aids that are not intended to be present in the final products. Today, the production of both chemical additives and polymers relies 99% on oil, gas, and coal as feedstocks (Ögmundarson et al., 2020). Petrochemical refineries produce less than a dozen chemical building blocks – in particular short-chain olefins and aromatics – that form the stem of the growing number of polymers and chemicals additives (Zimmerman et al., 2020).

To date, it has been estimated that the production of plastics involves 13,000 chemicals, including monomers, processing aids, additives and non-intentionally added substances (NIAS) (Aurisano et al., 2021; Wiesinger et al., 2021; UNEP, 2022). The number of polymers on the market have not been properly assessed, but could include up to 200,000 different substances, according to one estimate (Bougas et al., 2020). The plethora of plastic products on the market has raised great concern due to the hazard traits of certain chemicals in plastics, the problematic nature of many of the final products (e.g., single-use plastics), and the potential for microplastics emissions from breakdown at the end of life, or abrasion during use.

26 An internal draft (dated 12 May 2022) of the report was made available for the authors. The executive summary of the report can be found in document UNEP/PP/INC.1/INF/7.

1.2.1. Chemicals of concern

Plastics contain many chemicals that are, in most cases, not chemically bound to the polymer matrix. These chemicals can therefore slowly migrate from within the polymer matrix, diffusing out and into the environment (Hahladakis et al., 2018). They can be grouped into two main categories (Groh et al., 2019): 1) intentionally added substances (IAS): monomers, processing aids, and additives, and 2) non-intentionally added substances (NIAS).

The use of many chemicals of concern in plastics has raised grave environmental, health and safety concerns, given they include "persistent, bioaccumulative and toxic substances (PBTs); very persistent and very bioaccumulative (vPvB) substances; chemicals that are carcinogens or mutagens or that adversely affect, among other things, the reproductive, endocrine, immune or nervous systems; persistent organic pollutants (POPs); mercury and other chemicals of global concern; chemicals produced or used in high volumes; those subject to wide dispersive uses; and other chemicals of concern at the national level" (SAICM, 2012). In other words, examples of chemicals of concern are those that are PBT, vPvB, carcinogenic, mutagenic and reprotoxic (CMR) or equivalent concern (see section 4.2.1).

Recently, two comprehensive reviews of industrial, scientific, and regulatory data have been conducted to estimate the number of chemicals used in plastics (Aurisano et al., 2021; Wiesinger et al., 2021). The studies identified 13,000 chemicals that may have been used in plastics as monomers, additives, processing aids and NIAS, from which 3,200 are identified as chemicals of potential concern based on existing hazard types (UNEP, 2022).[27] For 6,000 chemicals used in plastics, no hazard data was found in regulatory databases analysed, thus many of them could also be chemicals of potential concern.[28] The studies identified that 128 chemicals of concern are regulated under MEAs, namely the Stockholm Convention, the Minamata Convention or the Montreal Protocol (See Figure 1).[29] This represents around 4% of all identified chemicals of potential concern and 1% of all chemicals used in plastics. Additionally, 960 of the chemicals of potential concern are subject to national/regional restrictions (Wiesinger et al., 2021). Appendix 4 provides a list of all chemicals of concern regulated globally.

27 The chemicals of potential concern fulfil one or several of the following hazard criteria assessed: vPvB (very persistent and very bioaccumulative), PBT (persistence, bioaccumulation, and toxicity), CMR (carcinogenicity, mutagenicity, or reproductive toxicity), EDC (endocrine-disrupting chemicals), AqTox (chronic aquatic toxicity), and STOT_RE (specific target organ toxicity upon repeated exposure).

28 The number of all chemicals used in plastics (13,000), chemicals used in plastics without hazard data (6,000), chemicals of low concern used in plastics (3,800) and chemicals of potential concern used in plastics (3,200) have been rounded to accommodate the uncertainty related to possible overlaps of chemicals between the two studies (e.g. there could be slight overlap with chemicals due to the use of different CAS numbers and/or slightly different chemical names).

29 Chemicals listed under the Rotterdam Convention have been omitted to specify the number of chemicals that include restrictions to their production/consumption.

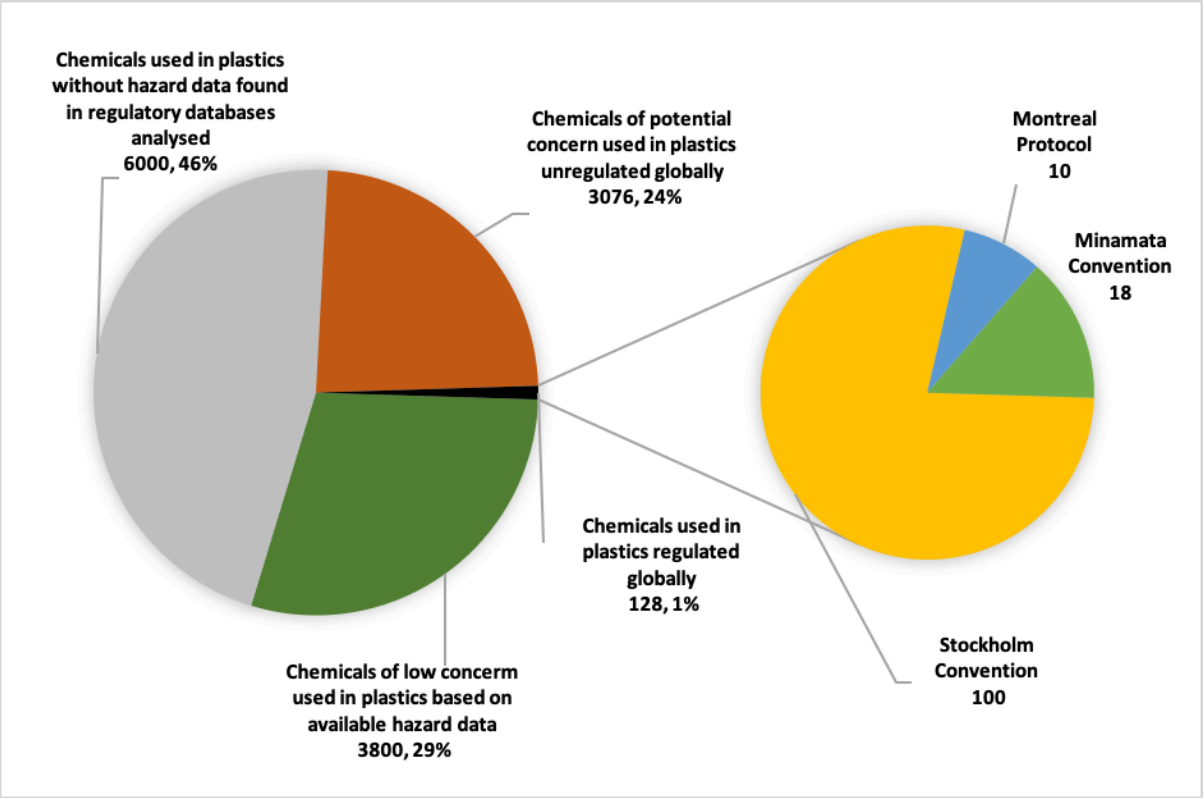

Figure 1: Number of chemicals of concern addressed internationally (data extracted from supplementary material included in studies conducted by Wiesinger et al. (2021) and Aurisano et al. (2021))

1.2.2. Polymers of concern

There is lack of clarity on the number of polymers on the market, and their hazard traits are poorly understood and communicated. A 2020 study estimated that there are numerous polymers placed on the EU market, of which 30,000 are considered potentially hazardous, and suggests that many of these potentially hazardous polymers may have been used in plastics (Bougas et al., 2020). A full assessment of all polymers on the market is needed but may be challenging to undertake as the current Chemicals Abstract Service (CAS) naming system does not provide for unambiguous communication on the identities of polymers (Wang et al., 2021). Knowing the identities of polymers is a fundamental requirement for screening, testing, prioritising, assessing and managing them (Wang et al., 2021). Currently, information is not publicly available for those polymers known to have hazard traits, which weakens possibilities for identification and elimination of polymers of concern.

The OECD has developed criteria to identify polymers of concern that are used selectively by many jurisdictions to identify polymers of low concern (PLCs) that are deemed safe. Hazard classification, molecular weight, residual monomer content are examples of such criteria (Groh et al., 2023). Currently, information is not publicly available for many polymers known to have hazard traits, which weakens possibilities for identification and elimination of polymers of concern. Another challenge is that most countries have regulatory gaps that do not require hazard and risk profiles for polymers. For countries that have polymer assessment and management schemes, they are often outdated, since they do not take into account latest scientific understanding (Groh et al. 2023) (see section 4.2.1).

1.2.3. Problematic and avoidable plastics

Given that plastics are made of chemicals it is relevant to examine macroplastics, as their production correlates with chemical production and use. A first step could include developing a common understanding of unnecessary, avoidable and problematic plastics. This can help catalyse a coordinated international response to eliminate or redesign them, while acknowledging that countries may take different approaches.

Unnecessary and avoidable plastic may include those that:

- contain amounts of plastics that can be reduced, e.g., through development of alternate social and technical solutions to avoid the need for plastic,
- can be substituted with non-plastic fit-for-purpose alternatives, and/or
- can be eliminated entirely without compromising the consumer's access to the intended functionality provided by the original product.

Products considered unnecessary and avoidable (within the local context) should be subject to social and economic viability studies to validate the promotion of alternative practices and materials, as well as life cycle assessments to ensure net environmental benefits. A coordinated approach, supported by funding, for socio-economic studies at the national level should be considered.

Problematic plastics may be considered to include all plastic applications that present known environmental and health concerns at any stage of their life cycle (possibly not meeting health or safety regulations where these exist), as well as those that hinder approaches to circularity. Problematic plastic products may include plastics of any size that ultimately place unnecessary pressure on natural resources due to characteristics such as:

- made using, manufactured with, containing, or has contained chemicals or polymers of concern, or
- difficult to reuse, recycle or compost,[30] or
- a material that hinders, disrupts or obstructs opportunities to recover other materials or resources, or
- a proven contribution to the plastic litter problem.

A specific category of problematic plastics includes single-use plastics, such as cups, wet wipes, tobacco filters, balloons, cutlery, cotton bud sticks, beverage stirrers, bottles, bags, straws, food containers, packets and wrappers. Another category includes multilayer plastics that present a challenge for many recycling systems. Intentionally added microplastics are also deemed problematic but are discussed separately in the following subsection. Certain plastics, such as halogenated and fluorinated plastics, could be harmful during the life cycle.

1.2.4. Microplastics and nanoplastics

Plastic pollution manifests at different scales, including as microplastics (1 nm to <5 mm in size) and nanoplastics (<100nm in size, or <0.0001mm) (GESAMP, 2015; GESAMP, 2016). Methods for microplastics analysis are more advanced than those for nanoplastics due to the complexities of collecting and analysing the latter (Allen, et al., 2022). Here, both are referred to as microplastics.

Microplastics are released into the environment intentionally and unintentionally across the life cycle of plastics. Plastic pellets less than 5 mm in size that are intentionally manufactured and shipped to be used in the production of plastic articles are considered "primary" microplastics. Moreover, plastic particles manufactured less than 5mm in size for applications such as in cosmetic products

30 Difficult technically/technologically or difficult due to lack of policies/enforcement or difficult due to lack of national capacity.

and industrial abrasives, are also referred to as primary microplastics, whereas microplastics produced from fragmentation of larger plastic items are called "secondary" microplastics, e.g., microfibers from textile washing and weathering, irrespective of whether they originate on land or sea.

While the effects of exposure to microplastics on human health is still unclear, a growing body of knowledge suggests that an examination and discussion of microplastics from the following chemical standpoints is warranted:

1) **Microplastics as vectors for chemical contaminants:** microplastics have been reported to act as vectors by containing chemicals of concern as additives or sorbing pollutants, including POPs, heavy metals and PAHs, and contributing to the bioaccumulation of pollutants, particularly in marine ecosystems, organisms, and subsequently the food web (Gallo et al., 2018; Amelia et al., 2021), and
2) **Microplastics as a chemical threat to human health and the environment:** ingested microplastics can cause changes in gene and protein expression, inflammation, disruption of feeding behaviour, decreases in growth, changes in brain development, and reduced filtration and respiration rates (UNEP, 2021a). Some studies suggest that nanoplastics may be more hazardous than microplastics because it is likely their small size will make them more likely to translocate beyond the gut, and their high surface-to-volume ratio enables them to be efficient vectors for chemical contaminants (UNEP, 2021a).

Following a precautionary approach, the elimination of primary microplastics is needed,[31] while design standards and improved mitigative activities can further reduce losses of secondary microplastics into the environment. For further discussion relating to the global governance of microplastics, see the report *Addressing Microplastics under the Global Agreement to End Plastic Pollution* (Rognerud, Hurley et al., 2022).

1.3. Linking plastics and associated chemicals to human rights

Although human rights are not a primary focus of this study and relevant instruments have not been assessed, the link between plastic pollution, human health and human rights is clear, as recognised in UNEA Resolution 5/14. The global governance of plastics could be strengthened to take into account the potential effects on human rights at each life cycle phase resulting from measures adopted. This includes, but is not limited to (HRC, 2021b; OHCHR & UNEP, 2021):

- Transparency and access to information on chemicals associated with the life cycle and value chain of plastics,
- Meaningful and informed public participation in policy development and environmental decision-making, including remediation,
- Access to remedies, including mechanisms for accountability, and
- Ensuring environmental, social and human rights assessments are in place when presenting alternatives to plastics pollution.

The Office of the UN High Commissioner for Human Rights (OHCHR) and UNEP recognise that "exposure to hazardous substances threatens a wide range of rights including the rights to life, bodily integrity, health and a healthy environment" and highlights that "failure to take effective measures to limit the harmful effects of exposure to hazardous substances on human health and wellbeing represents a breach of State obligations to respect, protect, and fulfil all human rights" (OHCHR & UNEP, 2021). A non-toxic environment is generally recognised as one of the elements of the right to a clean,

31 Acknowledging voluntary standards adopted by industry to reduce the loss of these pellets to the environment through Operation Clean Sweep. https://www.opcleansweep.org/about/about-plastics/. Such programmes can be considered for inclusion in the new agreement, together with measures for transparency.

healthy and sustainable environment (GA Resolution 76/300). The move towards a human-rights based approach can further be strengthened by building on the Aarhus Convention and the Escazu Agreement, while promoting Principle 10 of the Rio Declaration.[32]

1.4. The need to define plastic pollution

UNEA Res. 5/14 (para 2) calls for the development of a legally binding instrument based on a comprehensive approach that addresses the full life cycle of plastic but does not specify the scope of the plastics instrument or define the term "plastic pollution" in this context. However, the resolution's preamble highlights the need to "prevent plastic pollution and its related risks to human health and adverse effects on human well-being and the environment." Moreover, the resolution recognises that plastic pollution includes microplastics. Figure 2 shows the different life cycle stages of plastics and the different elements that need to be covered by a legally binding instrument to end plastics pollution (see section 1.4.3 for a detailed description of the life cycle).

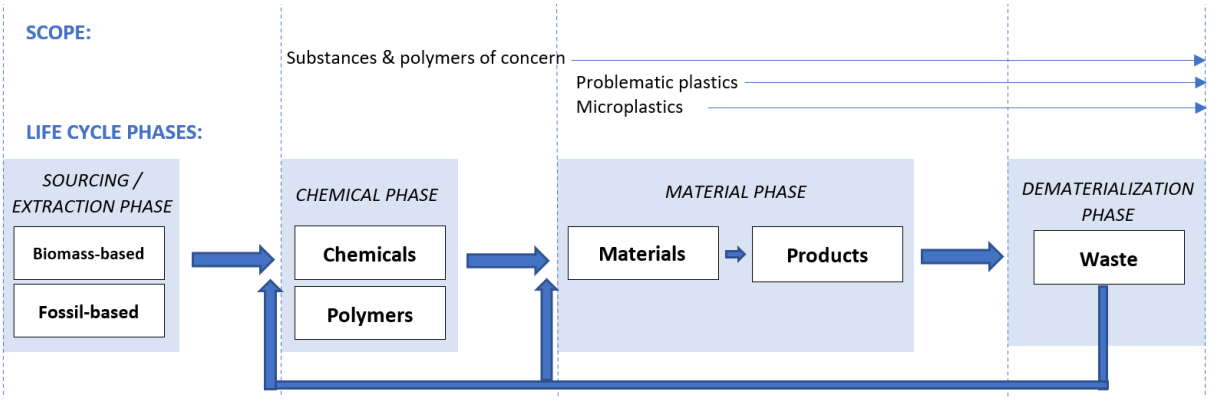

Figure 2: Possible scope of plastic pollution

Table 1 provides a summary of categories that may be considered in defining the term plastic pollution in context of global efforts to end plastics pollution. A comprehensive and holistic approach that takes into account the life cycle of plastics and intends to safeguard both the environment and human health should emphasise preventing and reducing the production and use of **chemicals and polymers of concern** (upstream), which will contribute to improved recovery operations of plastics (downstream) towards safe and non-toxic circularity for plastics. Moreover, restricting and reducing the overall production and use of plastics, in particular **problematic and avoidable plastics**, will help reduce resource use, additive use, and plastic waste generation (UNEP, 2022). Lastly, in accordance with UNEA's recognition that microplastics are a form of plastic pollution, consideration could be given at the global level to minimise the release of **microplastics** that are both intentionally added into products and result from unintentional release during use. However, the promotion of alternatives must ensure environmental, social and human rights assessments are in place.

32 Principle 10 states "Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided."

Table 1: Overview of possible categories to help define the term plastic pollution across the life cycle of plastics

Categories	**Chemicals of concern** PBTs; vPvB substances; chemicals that are carcinogens or mutagens or that adversely affect, among other things, the reproductive, endocrine, immune or nervous systems; POPs; mercury and other chemicals of global concern; chemicals subject to wide dispersive uses; and other chemicals of concern at the national level.				**Polymers of concern** Hazard class, molecular weight, residual monomer content and other relevant criteria can be used to define polymers of concern.	**Microplastics and nanoplastics** Small plastic particles up to 5 mm in diameter composed of mixtures of polymers and additives. They may also contain residual impurities.		**Problematic and avoidable plastics** All plastic applications presenting known environmental and health concerns at any stage of their life cycle, as well as those that hinder approaches to circularity. Problematic plastics may include those that ultimately place unnecessary pressure on natural resources, including micro- and nanoplastics.	
Groups	**NIAS** An impurity in the chemical used, or an intermediate reaction formed during the production process, or a decomposition, or product reaction	**Plastic additive** A substance which is intentionally added to plastics to achieve a physical or chemical effect during processing of the plastic or in the final material or article	**Processing aids** Chemicals used in plastics to enable or ease the production or processing of plastics	**Monomers** A substance undergoing a polymerization process to manufacture polymers	**Polymers** Any macromolecular substance obtained by polymerization of monomers	**Primary** Plastic pellets and plastic particles manufactured for particular applications, such as cosmetic products and abrasives	**Secondary** Microplastics produced as a result of fragmentation from larger items	**Materials** Synthetic material consisting of a mixture of polymers and additives, which can be moulded into different shapes and forms	**Products** Articles made of plastic, whether alone or in combination with another material
Intentionally added	No	Yes	Yes	Yes	Yes	Yes	No	n/a	n/a
Intended in final products	No	Yes	No	No	Yes	Yes	No	n/a	n/a
Intended use	n/a (unintentionally produced)	• Plasticizer • Flame retardant • Fragrance • Antioxidant • Biocide • Colorant • Filler • Impact modifier • Light stabilizer • Nucleating agent	• Antistatic agents • Blowing agents • Catalyst • Crosslinking agent • Heat stabilizer • Initiator • Lubricant • Solvent • Viscosity modifier	• Precursors	• Thermoplastics • Thermosets • Elastomers • Inorganic/ hybrid	• Plastic pellets or equivalent • Plastic particles manufactured for particular applications	n/a (unintentionally produced)	As per design	As per design

1.5. Method for the study

The study consisted of an in-depth literature review, focusing on texts of global and regional multilateral environmental instruments relevant to plastics and associated chemicals. The focus, however, is on global legally binding environmental agreements. The information presented is supplemented by non-binding measures at the global level.

The preparation for the study was supported by the conduct of:

- **Two online workshops:** The first workshop (March 2022) focused on the selection of instruments, governance elements and identification of life cycle phases. The second workshop (June 2022) provided guidance on the first draft of the mapping as well initial concept for the development of international sustainability criteria for plastics and associated chemicals to address the gaps.
- **Two side-events:** Preliminary findings of the study were presented and discussed at the margins of the 12th meeting of the open-ended working group of the Basel Convention organised in April 2022 in Nairobi, Kenya, and the Plastics Forum organised in conjunction with the Basel, Rotterdam, and Stockholm Conventions (BRS) Conference of the Parties (COPs) held in Geneva, Switzerland in June 2022.

Since the study was initiated before UNEA Res. 5/14 was adopted, it was subsequently contextualised around intergovernmental efforts to end plastic pollution, based on feedback from reviewers. The authors have attempted to capture different views expressed, but the study does not represent a consensus view of the reviewers consulted. Instead, the authors have embraced a more inclusive approach to help provide a voice for differing views. Nevertheless, the analysis in section 2 has benefited from the contribution of relevant MEA secretariats.

1.5.1. Overview of multilateral instruments included in the study

In line with the objective of this study to map the global governance of plastics and associated chemicals, the list of global multilateral instruments selected for the literature review was firstly based on the UNEP report titled *Combating marine plastic litter and microplastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches* (UNEP, 2018) and the UNEP report titled *From Pollution to Solution: A global assessment of marine litter and plastic pollution* (UNEP, 2021a). Secondly, the inclusion within instruments of the terms listed in Table 2 was considered, as well as suggestions from the reviewers of the present study.

The global multilateral instruments identified are listed with a description of their relevance to plastics.

Binding multilateral instruments directly addressing aspects of chemicals in plastics[33]

1. *2001 Stockholm Convention on Persistent Organic Pollutants* (Stockholm Convention)
   Prohibits and restricts the use of many POPs used, among others, as additives in plastics (e.g., as flame retardants, plasticizers, or surfactants), as well as restricts releases of unintentional POPs (UPOPs) deriving, inter alia, from open burning of waste and waste incinerators.

2. *1987 Montreal Protocol on Substances that Deplete the Ozone Layer* (Montreal Protocol)
   Prohibits the use of controlled substances, including their use as blowing agents in the production of extruded-polystyrene and polyurethane foams. Provides an exemption for use of controlled substances as process agents and feedstocks.

33 See Section 1.5.2 for explanation of “direct” and “indirect” as used in this study.

3. *2013 Minamata Convention on Mercury* (Minamata Convention)
   Restricts the use of mercury and mercury compounds in the production of polyurethane using mercury containing catalysts and in vinyl chloride monomer production.

4. *1998 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade* (Rotterdam Convention)
   Requires use of Prior Informed Consent procedure in international trade for chemicals listed under the Convention that are used, among others, as monomers, additives, or processing aids in the production of certain plastics.

5. *1990 International Labour Organization (ILO) Chemicals Convention (C170)*
   Aims to prevent or reduce the incidence of chemically induced illnesses and injuries at work. Chemicals used in the manufacture of plastics are not specifically mentioned.

6. *1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (Basel Convention)
   Requires controls on some non-hazardous plastic wastes as covered under Annex II (Y48), and hazardous plastic wastes as covered under Annex I as further elaborated in Annex VIII (A3210) unless they do not possess an Annex III characteristic. This applies to plastic additives as well as to the polymers themselves.

Binding multilateral instruments directly addressing aspects of the plastics life cycle

1. *1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (Basel Convention)
   Specifically regulates the international trade of plastic wastes, categorising wastes containing plastics into three groups, two of which require prior informed consent before they can be exported. It also requires Parties to take measures to prevent and minimise the generation of hazardous and other wastes and to ensure their environmentally sound management.

2. *2011 Regulations for the Prevention of Pollution by Garbage from Ships (Resolution MEPC.201(62))* (MARPOL Annex V, as amended)
   Plastics are included in the definition of garbage. A definition of plastics is provided that includes synthetic fishing nets.

3. *1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* (London Convention)
   Bans the intentional dumping of all wastes, including those generated on land, that contain plastics.

4. *1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (London Protocol)
   Bans the intentional dumping of all wastes, including those generated on land, unless allowed under the Protocol. Plastics and chemicals used in plastics are not included in the list of permissible wastes (whitelist) of Annex I.

Binding framework agreements of relevance

The following global instruments provide broader measures for the protection of the environment and biodiversity that indirectly apply to plastics:

1. *1982 United Nations Convention on the Law of the Sea* (UNCLOS)
   Establishes a duty for States to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source (Art. 194). Plastics and associated chemicals are not explicitly mentioned by the Convention.

2. *1992 Convention on Biological Diversity* (CBD)
   Requires rehabilitating and restoring degraded ecosystems and promoting the recovery of threatened species. Specific measures for plastic waste are detailed in soft law, focusing on downstream solutions, without making reference to chemicals used in plastics.

3. *United Nations Framework Convention on Climate Change* (UNFCCC)
   Restricts greenhouse-gas emissions, including emissions related to production of plastics from fossil raw materials. Plastics and associated chemicals are not explicitly mentioned by the Convention.

4. *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (Kyoto Protocol)
   Sets limitation or reduction GHG emissions targets for industrialised countries and economies in transition. Plastics and associated chemicals are not explicitly mentioned by the Convention. Possible reduction targets for the emission of GHG from the plastics life cycle.

5. *Paris Agreement*
   Plastics and associated chemicals are not explicitly mentioned by the Convention. Possible reporting of contribution of plastics life cycle to national and global targets on GHGs.

Non-binding global frameworks of relevance to chemicals, wastes and plastics

1. Resolutions of the UN Environment Assembly (UNEA)
2. Resolutions of the UN General Assembly (Sustainable Development Goals (SDGs) (contained in A/RES/70/1)
3. The Strategic Approach to International Chemicals Management (SAICM)

Regional instruments have been used to provide inspiration for addressing global governance gaps, although their applicability to the global context would require further research.

1.5.2. Mapping of measures within multilateral instruments

The literature review consisted of a mapping of texts of multilateral instruments to identify binding measures of relevance to the governance of plastics and associated chemicals. The identified measures have been separated into two groupings of "**direct**" and "**indirect**." Table 2 summarises the basis for the grouping of "direct" measures, i.e., those measures that **directly** refer to 1) the term "plastic", 2) products known to be made predominantly of plastics, or 3) specific chemicals known to be used in the manufacture of plastics, and broader groupings of chemicals used in plastics. This distinction is included in the detailed mapping of Appendix 2, with a summary provided in section 2.

Table 2: Primary basis for grouping measures as directly applicable to plastics and associated chemicals

Primary basis	Examples	Reasoning
Plastic	Plastic waste	Plastic waste, provided it is destined for separate recycling of each material[34] and in an environmentally sound manner, and almost free from contamination and other types of wastes.[35] (Basel Convention, Annex IX, Entry B3011). Plastic waste, including mixtures of such waste, containing or contaminated with Annex I constituents, to an extent that it exhibits an Annex III characteristic (note the related entries Y48 in Annex II and on list B B3011). (Basel Convention, Annex VIII, Entry A3210) Plastic means a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. (MARPOL Annex V, Reg. 1.13)
Polymers	Plastic waste almost exclusively consisting of one non-halogenated polymer (Basel Convention, Annex IX, Entry B3011)	Including but not limited to the following: • Polyethylene (PE) • Polypropylene (PP) • Polystyrene (PS) • Acrylonitrile butadiene styrene (ABS) • Polyethylene terephthalate (PET) • Polycarbonates (PC) • Polyethers (Basel Convention, Annex IX, Entry B3011)
Resins	Plastic waste almost exclusively consisting of one cured resin or condensation product (Basel Convention, Annex IX, Entry B3011)	Including but not limited to the following: • Urea formaldehyde resins • Phenol formaldehyde resins • Melamine formaldehyde resins • Epoxy resins • Alkyd resins (Basel Convention, Annex IX, Entry B3011)
Products known to be made predominantly of plastics	Agriculture, Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Hygiene and Medical items, Food-contact plastics, Packaging, Textiles, Toys Fishing gear	For the purposes of this annex, "all plastics" means all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products. (MARPOL Annex V, Reg. 1.13)
	Litter, solid waste	Litter and solid waste are recognised to contain a large or majority fraction of plastics

34 Plastic waste, including mixtures of such waste, containing or contaminated with Annex I constituents, to an extent that it exhibits an Annex III characteristic (note the related entries Y48 in Annex II and on list B B3011). (Basel Convention, Annex VIII, Entry A3210).

35 In relation to "almost free from contamination and other types of wastes", international and national specifications may offer a point of reference.

Primary basis	Examples	Reasoning
Groups of chemicals known to be used in plastics		The following definitions are used in this study to describe chemicals in plastics (UNEP, 2022): - Flame retardants - Per- and polyfluoroalkyl substances (PFASs) - Phthalates - Bisphenols - Nonylphenols - Polyaromatic hydrocarbons (PAHs) - Biocides - UV filters - Toxic metals - Non-intentionally added substances (NIAS) - Monomers
Broader thematic policy areas of relevance to plastics	Additives Endocrine disruptors	Chemicals found in plastics are also found in "Emerging policy issues" and "Other Issues of Concern" identified by SAICM that refer to broader thematic policy areas, including harmful materials and products, as well as specific substances and groups of substances of concern. These include (UNEP, 2022): - Endocrine disrupting chemicals (EDCs), - Hazardous substances within the life cycle of electrical and electronic products - Perfluorinated chemicals and the transition to safer alternatives - Chemicals in Products (CiP) - Nanotechnology and manufactured nanomaterials

Measures that do not fall under the grouping of "direct" but for which plastics, or the chemicals contained in plastics, are indirectly governed by the measure are mapped separately under the grouping of "indirect". For example, such measures may address "waste", "hazardous waste" or "chemicals" more broadly. Where the broader measure can be clearly linked to an "explicit" measure regarding plastics or chemicals in plastics, this has been mapped as an "explicit" measure.

For voluntary measures of relevance to plastics and associated chemicals, the focus is on the global level. Multilateral instruments relevant to SAICM, SDGs and UNEA resolutions were assessed.

Regional instruments (binding and voluntary) were mapped using the same methods as for the global instruments. Where examples are found of measures that are more directly relevant to chemicals in plastics and/or plastics, these have been highlighted under each of the mapping sections as options for strengthening the global framework.

1.5.3. Description of different life cycle phases of plastics

Global and regional measures, both direct and indirect, have been grouped into seven detailed life cycle phases of extraction, production, manufacture, consumption, waste management (collection/sorting), waste management (recovery/final disposal), and remediation. These seven life cycle phases are further clustered into four primary phases. In the dematerialisation phase, the emphasis is on recovery (rather than final disposal) in order to achieve circularity, meaning the promotion of operations to recover waste materials so that they can be used as raw materials or other products, or to recover energy, and lastly as landfilling.

Table 3 provides an overview of the 4 primary life cycle phases, describing the value-chain phases and value-chain users. The table indicates that the extraction of raw materials for both chemicals and polymers relies on hydrocarbons. Emissions (NIAS, microplastics and UPOPs) and leakages (littering and illegal disposal) occur in various stages of the life cycle but are not shown in the table for sake of simplicity.

Table 3: Value chain phases and users across the life cycle of plastics

Life cycle phase	Value chain phase	Actors
Sourcing/ extraction phase	**1. Extraction of raw materials** **A) Organic raw materials (hydrocarbons):** • Fossil raw materials from oil drilling, fracking and mining: crude oil, natural gas and coal • Bio-based raw material: land-based crops, aquatic algae or seaweed, waste and residue oils, etc. **B) Inorganic raw materials** • Many chemicals used in plastics are prepared from inorganic compounds, including fillers (mica, talc, calcium carbonate, etc.), reinforcements (glass fibres, etc.), and pigments	**Oil & gas industry** (fossil fuels are extracted from wellheads or drill pads and then transported by pipeline or rail to refineries and processing plants) **Bio-based raw materials producers** **Mining and smelting industry** (inorganic materials)
Chemical phase	**2. Production** **Step 1: Building block production** • Refining crude oil, natural gas and coal (or bio-based raw materials) through a "cracking"/ "gasification" process and subsequent reactions to produce initial building blocks (e.g., ethylene, styrene, vinyl chloride, etc.)	**Refiners:** • Petrochemical refineries • Biorefineries
	Step 2: Chemical processing **A) Polymer production** • Includes numerous polymers (number to be determined) **B) Production of commodity and speciality chemicals** • Includes up to 13,000 additives, monomers, processing aids used for plastics, as well as NIAS	**Polymer and chemical producers:** • Chemical manufacturers (including polymer manufacturers)
Material phase	**3. Manufacturing** **Step 1: Manufacturing of materials (e.g., compounding)** • Consists of preparing plastic formulations by mixing and/ or blending polymers and additives to achieve the desired characteristics	**Compounders / masterbatchers:** - Companies specialised in this field - Polymer producers and manufacturers also undertake this work
	Step 2: Manufacturing of intermediates and final products • Intermediate moulding, spinning, drawing and cutting • Manufacturing and remanufacturing of final products	**Product producers / brand owners**
	4. Consumption • Use and reuse	**Retailers, transporters, and consumers**
Dematerialisation phase	**5. Waste management** **Step 1: Collection and sorting**	**Waste management companies** **Informal sector (including waste pickers)**
	Step 2: Recovery and final disposal • Mechanical recycling • Chemical recycling • Incineration (with or without energy recovery) • Landfilling • Etc.	**Waste disposal treatment facilities** **Informal sector (informal recyclers)**
	6. Remediation	**Local councils, NGOs, local communities, fishing communities**

In addition to the primary value-chain actors listed in Table 3, trade and transport processes occur at multiple points within and between each of the four primary life cycle phases. Figure 3 illustrates the life cycle phases in greater detail, showing the chemical pathway for production of plastics.

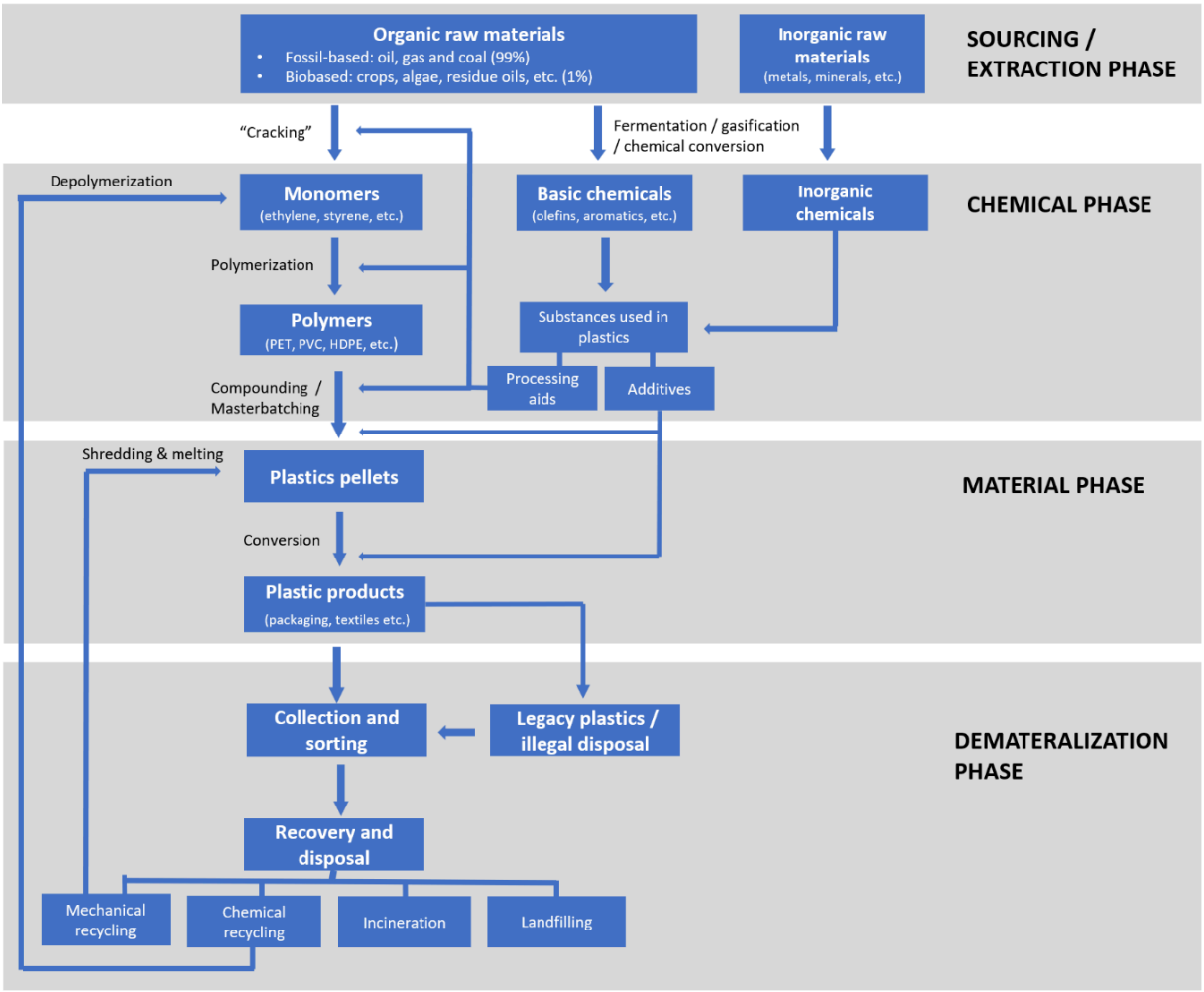

Figure 3: The different life cycle phases of plastics and associated chemicals

For each of the 7 life cycle phases suggested by this study, based on the literature review and feedback from the workshops, the selected global and regional multilateral instruments of relevance to plastics and associated chemicals are assessed against key governance elements to map the inclusion of these elements within the multilateral instrument. These key governance elements considered are listed as follows:

1. Goals and targets
2. Indicators
3. Materials/products/activities phase out
4. Materials/products/activities regulated
5. Emissions/releases prohibited
6. Trade restrictions
7. Reporting requirements
8. National inventories developed and maintained
9. National action plans
10. Transparency and information sharing.

In addition, the objective of each multilateral instrument is highlighted. Section 3 examines requests included in paras 3-4 of UNEA Res. 5/14, which relate to many of the governance elements analysed.

1.6. Overview of challenges across the life cycle of plastics

The triple planetary crisis of climate change, biodiversity and nature loss, and pollution is increasingly affecting people across the globe. Table 4 provides a summary of how chemicals and plastics may harm the environment and human health, and negatively impact on human rights, across the life cycle of plastics. The table takes a broader look at impacts beyond those typically categorised as chemicals-related to help understand linkages and generate co-benefits with other environmental goals, including climate and biodiversity. To close the global governance gaps towards ending plastic pollution, consideration should be given to approaches to best mitigate these challenges, while taking into consideration the specific mandates and activities of existing multilateral instruments. The proposal for development of international sustainability criteria for plastics and associated chemicals is intended to respond to these challenges in a holistic manner (section 4.1). The dematerialisation phase would benefit from an in-depth study to assess the benefits and challenges of each of the treatment alternatives in order to guide the development of the plastics instrument.

Table 4: Non-exhaustive list of key environmental and human health concerns in the life cycle of plastics and associated chemicals (CIEL, 2019; Hahladakis et al., 2018)

Life cycle phase	Environment	Human health
1. Sourcing/ extraction phase (Hydrocarbons, inorganic raw materials)	• Heavy reliance on fossil fuels, including hydraulic fracking, for extraction of hydrocarbons and associated pollution	• Harmful chemicals used in oil and gas extraction, including fracking, can enter drinking water resources from spills, residuals and improper handling of wastewater
2. Chemical phase (Polymers and chemicals)	• High energy intensity of the petrochemical industry and its processes • Emissions and releases of pollutants to surface and ground water negatively affect ecosystems that can include locations far from the source	• Transforming fossil fuels into polymers and chemicals used in plastics may release carcinogenic and other highly toxic chemicals that may cause occupational exposure and may pollute neighbouring communities
3a. Material phase (manufacturing) (Materials and products)	• Production and transportation of plastic pellets, powders and flakes is a source of microplastic releases due to spills and poor handling procedures	• The production of materials and products releases toxic chemicals into the air, jeopardising the health of workers and may pollute neighbouring communities
3b. Material phase: (consumption) (Plastic products)	• Consumption of unnecessary and problematic products (including microplastics in products) leads to unnecessary waste generation and contributes to littering that affects marine, freshwater and terrestrial ecosystems • Toxic chemicals and microplastics may be released from products during their intended use resulting in environmental exposure	• Toxic chemicals are released from products during their intended use resulting in human exposure
4. Dematerialisation phase (Plastic waste)	• Leakage of plastics and associated chemicals of concern to the environment due to improper disposal at end of life (open dumps, burning), inadequate wastewater treatment (including the application of sewage sludge as fertiliser on agricultural fields), and dumping and discharges from shipping • If incinerated at end-of-life, plastics will emit embodied carbon as CO2, may also release pollutants (e.g., UPOPs) and generate toxic ash. If landfilled there is a risk of landfill fires and slow degradation with associated methane emissions, as well as toxic chemicals • Plastics limit the ability of oceans to remove greenhouse gases from the atmosphere	• Chemicals present in plastics may impair recycling processes and the safety and quality of recycled materials • Dumping sites are associated with health risks and open burning releases highly toxic chemicals into the air, water and soil, which may lead to human exposure

2 COMPLEMENTARITIES AND GAPS WITHIN GLOBAL BINDING MULTILATERAL INSTRUMENTS

The production of plastics is energy-intensive and results in emissions and releases of pollutants that negatively affect human health and ecosystems, including those located far from the source of pollution. Photo © Dmytro Balkhovitin. Dreamstime.com

2. Complementarities and gaps within global binding multilateral instruments

This section provides an overview of the legally binding multilateral instruments assessed in this study (see Appendix 2 for a detailed mapping, and Appendix 3 for non-binding multilateral instruments). Areas of coherence and complementarities with instruments relevant to the governance of plastics and associated chemicals, as well as the gaps identified in each multilateral instrument are discussed. These gaps present opportunities for strengthening the relevant agreement, where feasible and agreed by Parties, or addressing them in context of intergovernmental efforts to end plastic pollution.

While framework agreements are outlined more broadly, two aspects that directly address plastics and associated chemicals are discussed for each multilateral instrument. These are:

1. **Complementarities – What is addressed by the multilateral instrument**
   - o based on the four primary life cycle phases and governance elements
   - o highlighting areas of coherence with the plastics instrument

2. **Gaps – What is not covered by the multilateral instrument**
   - o based on the scope of each multilateral instrument, and
   - o highlighting areas where the existing agreements could be strengthened or where the new plastics instrument could fill the gaps.

The section concludes with broader gaps that may not fall within the scope of the multilateral instruments assessed and could therefore be considered as opportunities towards strengthening the global governance of plastics.

2.1. Multilateral instruments addressing chemicals

This subsection discusses multilateral instruments that address chemicals. Although none of the instruments have the purpose of specifically addressing chemicals in plastics, their use is included implicitly since the instruments do not focus on any specific use but on specific chemicals. The relevant instruments list 1) some intentionally added chemicals of concern, namely plastic additives and processing aids, that are used in the production of plastics, among other uses, and 2) some chemicals unintentionally released from burning of plastic waste. Appendix 1 provides a compilation of summary tables included in the multilateral instruments reviewed.

2.1.1. The Stockholm Convention

The objective of the Stockholm Convention is to protect human health and the environment from persistent organic pollutants (Art. 1). The Convention highlights the health concerns, especially in developing countries, resulting from local exposure to POPs, in particular the impacts on women and, through them, upon future generations (Preamble).

The Stockholm Convention includes measures to control certain chemicals of concern by prohibiting and restricting many POPs used, amongst others, as additives in plastics (e.g., as flame retardants, plasticizers, or surfactants). The Convention also restricts the release of UPOPs deriving, inter alia, from open burning of plastic waste and waste incinerators.

Table 5: Summary of governance elements included in the Stockholm Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Indicators included in the effectiveness evaluation	• Indicators included in the effectiveness evaluation	• Indicators included in the effectiveness evaluation
Control measures		• Prohibit the production and use of chemicals listed in Annex A, subject to provisions of that Annex • Restrict production and use of chemicals listed in Annex B in accordance with the provisions of that Annex	• Prohibit the production and use of chemicals listed in Annex A, subject to provisions of that Annex • Restrict the production and use of chemicals listed in Annex B in accordance with the provisions of that Annex	• Work towards elimination of UPOPs listed in Annex C • Safely manage POPs stockpiles • Dispose of POPs wastes, including products/articles upon becoming waste, in such a way that the POP content is destroyed or irreversibly transformed, or otherwise disposed of in an environmentally sound manner • Endeavour to develop strategies to identify contaminated sites • Undertake remediation of sites contaminated with POPs (voluntarily)
Reporting, monitoring & inventories		• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export	• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export	• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export • Develop POPs inventories (voluntarily) • Develop source inventories and release estimates of UPOPs
Trade		• Take measures to ensure chemicals listed in Annex A or Annex B are imported only for a use or purpose permitted for the Party • Take measures to ensure chemicals listed in Annex A or Annex B are exported only to a Party which permitted to use that chemical or under specific conditions for non-Party states	• Take measures to ensure chemicals listed in Annex A or Annex B are imported only for a use or purpose permitted for the Party • Take measures to ensure chemicals listed in Annex A or Annex B are exported only to a Party which permitted to use that chemical or under specific conditions for non-Party states	• Ensure chemicals listed in Annex A or Annex B are imported or exported only for their environmentally sound disposal • International transport of POPs waste to take into account relevant international rules, standards and guidelines
NAPs		• Develop and update a NIP to implement the convention's obligations	• Develop and update a NIP to implement the convention's obligations	• Develop and update a NIP to implement the convention's obligations • Develop an action plan for UPOPs
Transparency & information exchange		• Exchange information on the reduction/elimination of the production, use and release of POPs • Exchange information on alternatives to POPs	• Exchange information on the reduction/elimination of the production, use and release of POPs • Develop strategies to identify POPs in products/ articles • Label certain POPs, e.g., HBCD used in EPS/XPS in buildings	• Exchange information on the reduction/elimination of the production, use and release of POPs • Develop strategies to identify POPs in stockpiles and waste

What is addressed

Control measures

The Convention functions by listing POPs in three annexes, in line with criteria and information in Annexes D and E to the Convention. Different obligations apply to chemicals listed in Annexes A, B and C. First, Parties are generally required to prohibit and/or take the legal and administrative measures necessary to eliminate production, use, import and export of POPs listed in Annex A (Art. 3, para 1a), which includes, as of October 2022, 12 chemicals, chemical mixtures or groups of chemicals used in plastics.[36] Second, Parties are required to restrict the production and use of POPs listed in Annex B (Art. 3, para 1b), which includes one listing that is applicable to plastics.[37] Moreover, in September 2022, the POPs Review Committee recommended the listing of two plastic-related chemicals for consideration at the upcoming meeting of the COP in May 2023.[38] Lastly, Parties are required to pursue the goal of their continuing minimisation and, where feasible, ultimate elimination of UPOPs listed in Annex C (Art. 5). This includes seven listings linked to incomplete combustion of plastics.[39] In accordance with Article 4 or relevant parts of Annex A or B, Parties may seek specific exemptions for chemicals listed in those annexes or acceptable purposes listed in Annex B.

The Stockholm Convention has adopted a life cycle approach to management of POPs starting from the chemical phase. The Convention places emphasis on the upstream phase through listing of chemicals for elimination or restriction in Annexes A and B. Further downstream, the Convention requires Parties to manage stockpiles in a safe, efficient and environmentally sound manner, and ensure that products and articles consisting of, containing or contaminated by POPs are safely disposed (Art. 6, para 1c-d). Lastly, in the post value chain, Parties shall endeavour to develop strategies for identifying sites contaminated by POPs, and to ensure that if remediation is undertaken (voluntarily), it is to be performed in an environmentally sound manner (Art. 6, para 1e).

The requirement to prevent the unintentional formation and release of UPOPs listed in Annex C impacts the downstream phase of plastics (Art. 5, para c). This is to be realised with implementation of best available techniques (BAT) and best environmental practice (BEP) for sources of UPOPs (Art. 5d). Sources relevant for plastics include emissions from waste incinerators and open burning of waste listed in Annex C. The Convention requires Parties to phase in BAT for new sources for unintentional POPs (including waste incinerators) as soon as practicable, but no later than four years after the entry into force of the Convention for that Party (Art. 5, para d).

The Convention's effectiveness evaluation includes indicators for tracking progress of the control measures. The indicators apply to Parties' activities to manage listed POPs. Examples of relevant indicators are listed below:

- Number of Parties that have developed and used appropriate strategies to identify stockpiles.
- Changes in the quantity of stockpiles being managed in an environmentally sound manner.
- Percentage change in the quantity of UPOPs produced unintentionally and released into the environment by each party.
- Number of parties that have identified contaminated sites.
- Number of parties that have voluntarily undertaken remediation activities.

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36 Short-chain chlorinated paraffins (SCCPs), Decabromodiphenyl ether (deca-BDE), Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds, Perfluorohexane sulfonic acid (PFHxS), its salts, and PFHxS-related compounds, Hexabromocyclododecane (HBCD), Polychlorinated naphthalenes (PCNs), Pentachlorophenol (PCP) and its salts and esters, Hexabromodiphenyl ether / heptabromodiphenyl ether, Tetrabromodiphenyl ether / pentabromodiphenyl ether and Polychlorinated biphenyls (PCBs).

37 Perfluorooctane sulfonic acid (PFOS, its salts, and PFOSF).

38 UV 328 is recommended for listing in Annex A and Dechlorane Plus is recommended for listing in Annexes A, B and/or C.

39 Hexachlorobenzene (HCB), hexachlorobutadiene, pentachlorobenzene (PeCB), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF) and polychlorinated naphthalenes (PCNs).

International trade

The Stockholm Convention has specific trade obligations for POPs listed in Annexes A and B: Parties are generally required to ensure that POPs are imported or exported only for the purpose of their environmentally sound disposal, or for a use or purpose which is permitted by the importing Party (Art. 3, para 2a). Moreover, Parties are required to ensure that such wastes, including products and articles upon becoming wastes, are not transported across international boundaries without taking into account relevant international rules, standards and guidelines (Art. 6, para 1d (iv)). Indicators from the effectiveness evaluation of relevance to trade include changes in quantities imported or exported for environmentally sound waste disposal for each chemical listed in Annexes A and B.

Follow-up (reporting, monitoring and inventories)

The Convention requires Parties to provide statistical data on total quantities of production, import and export of each chemical listed in Annexes A and B, and, to the extent practicable, a list of the States from which it has imported and exported each such substance (Art. 15, para 2). While the Convention does not mandate the development of POP inventories, they frequently form an integral part of national implementation plans (NIPs). The Convention also calls for the development of specific strategies, including for identifying products and articles in use, and wastes consisting of, containing or contaminated with POPs and for identifying stockpiles consisting of, or containing POPs (Art. 6, para 1a). Lastly, the Convention states that the action plan for UPOPs shall include source inventories and release estimates of UPOPs (Art. 5, para 1 (i)).

National action plans

The Convention requires Parties to develop and endeavour to implement a plan for the implementation of its obligations under the Convention, transmit its NIP to the COP within two years of the date on which this Convention enters into force for it; and review and update its implementation plan on a periodic basis (Art. 7, para 1). Moreover, the Convention requires to develop an action plan, or a regional or subregional action plan designed to identify, characterise and address the release of UPOPs within two years of the date of entry into force of the Convention and implement it as part of the NIP (Art. 5, para a).

Transparency and information sharing

The Convention requires Parties to facilitate or undertake the exchange of information relevant to the reduction or elimination of the production, use and release of POPs, and alternatives to POPs, including information relating to their risks as well as to their economic and social costs. (Art. 9, para 1). Moreover, Parties are encouraged to use safety data sheets in providing information on POPs and their alternatives (Art. 10, para 4).

What is not addressed

The Convention provides a valuable opportunity to continue listing POPs used in plastics among other uses, but the vast majority of chemicals of concern fall beyond its scope. The POPs Review Committee (POPRC) provides a scientific mechanism for reviewing proposals for listing new chemicals under the Convention as POPs before making recommendations to the COP. The review of chemicals takes at least three meetings/years to conclude as it includes three steps: screening, risk profile, and risk management evaluation (Wang et al., 2022). Promisingly, the Convention can address groups of chemicals as was done in the case of PCBs, PFOS and PFOA. To contribute to avoid regrettable substitution to similar chemicals that are later identified as POPs, further consideration on entire groups of chemicals could be useful. For instance, chlorinated paraffins are a large group of chemicals used as plasticizers and flame

retardants in plastics that have been addressed, in 2017, by listing short-chain chlorinated paraffins (SCCPs) in the Convention. Currently medium-chain chlorinated paraffins (MCCPs) are scrutinised, as they are suspected to be produced in much higher volumes, perhaps being used as a regrettable substitution for SCCPs (ENB, 2022). Given the large number of chemicals of concern used in plastics, a groups of chemicals approach is suggested for addressing chemicals in plastics beyond the scope of existing multilateral instruments, with various possibilities discussed in section 4.

Article 6 of the Stockholm Convention provides that in order to ensure that stockpiles and wastes consisting of, containing or contaminated with POPs, including products and articles upon becoming wastes, are managed in a manner protective of human health and the environment, each Party shall, among other things, develop **strategies for identifying** products and articles in use and wastes consisting of, containing or contaminated with POPs. However, **it does not require labelling** of such POPs, except for PCB and for the applications allowed as specific exemptions[40] for HBCD and PCP. However**, labelling requirements** of products and items containing POPs apply only to specific exemptions relevant to HBCD, PCP and PCB. It is important to consider how a plastics instrument will build on the Stockholm Convention, including with respect to relevant transparency provisions, as well as apply lessons learned to the new plastics instrument to meet acknowledged environmental and safety concerns. Section 4.1 discusses how international sustainability criteria for plastics and associated chemicals may help to increase transparency across the value chain.

The Stockholm Convention requires Parties to work towards elimination of UPOPs. In the realm of efforts to end plastic pollution, consideration could be given to how to specify incineration in the hierarchy of actions to achieve circularity of plastics, as it will lead to eliminating materials that could be recycled, while also generating greenhouse gases, even in optimal conditions when energy can be recovered and UPOPs avoided. Moreover, in line with Article 6 (para 1c–d) the Convention will need to deal with current POPs stockpiles and ensure that products and articles upon becoming wastes are safely disposed, including large volumes of plastics with SCCPs, PFASs and HBCD (IPEN, 2019).

Non-mandatory activities under the Convention have been considered by some Parties and stakeholders to be helpful, such as the development of **POP inventories**. Without such inventories, a weak understanding of POPs present in developing countries has been challenging to the assessment of the financial needs of the Convention (BRS, 2021a).

The Convention restricts the **trade** of POPs used in plastic products, but insufficient Harmonized System (HS) codes may hinder the detection of some POPs in customs control (BRS, 2021b). Moreover, low- and middle-income countries may lack regulations that require importers to secure POPs-free products and /or enforcement of such requirements. For enforcement purposes countries need access to appropriate laboratories to be able to analyse the content of POPs in waste, recyclates or imported goods (BRS, 2021b).

2.1.2. The Minamata Convention

The Minamata Convention aims to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds (Art. 1). In relation to plastics, Article 5 (para 3) requires Parties to take measures to restrict the use of mercury and mercury compounds in processes defined in Annex B (Part II), including vinyl chloride monomer (VCM) production and the production of polyurethane (PUR) using mercury containing catalysts.

40 The Register of specific exemptions has been established in conformity with Article 4 of the Stockholm Convention, for the purpose of identifying the Parties that have specific exemptions listed in Annex A or Annex B. In addition, Registers of acceptable purposes in relation to DDT and PFOS, its salts and PFOSF have been established in accordance with the provisions of Annex B to the Stockholm Convention.

Table 6: Summary of governance elements included in the Minamata Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Reduce the use of mercury containing catalysts in the production of PUR, ideally within 10 years of entry into force of the Convention • Reduce the use of mercury in VCM production by 50% by 2020 using 2010 as a base line		
Control measures	• Reduce reliance on mercury from primary mining for VCM production and the production of PUR using mercury containing catalyst	• Prohibits the use of mercury in VCM production 5 years after mercury-free catalysts have become available, as determined by the COP • Control emissions and releases of mercury		• Manage mercury waste in an environmentally sound manner • Action taken to [voluntarily] remediate contaminated sites needs to be conducted in an environmentally sound manner • Control emissions and releases of mercury
Reporting, monitoring & inventories		• Endeavour to cooperate to develop/improve inventories of use, consumption, and emissions/releases • Report on efforts to develop/ identify alternatives for mercury in VCM/PUR production • Submit information of use of mercury in facilities that produce VCM/PUR • Establish and maintain an inventory of emissions and releases		• Endeavour to identify individual stocks of mercury/mercury compounds exceeding 50 t, and sources of mercury supply generating stocks exceeding 10 t per year • Shall establish inventories or emissions and releases from relevant sources • Endeavour to develop strategies to identify/assess contaminated sites • Endeavour to cooperate to develop/improve modelling and monitoring of levels of mercury/ mercury compounds in vulnerable populations and in environmental media
Trade		• Exporting mercury requires written consent from the importer and only for the purpose of an allowed use or for environmentally sound interim storage		• Take appropriate measures so that mercury waste is, for Parties of the Basel Convention, transported across international boundaries only for environmentally sound disposal. In circumstances where the Basel Convention does not apply, a Party must take into account relevant international rules, standards, and guidelines
NAPs				
Transparency & information exchange		• Facilitate the exchange of information on the reduction/ elimination of the production, use, trade, and emissions/ releases of mercury/mercury compounds and information on alternative manufacturing processes • Reporting on mercury trade and other key provisions		

What is addressed

Targets and indicators

The Convention sets two mitigation targets and associated timelines relevant for plastics (Annex B, Part II):

- Reduce the use of mercury containing catalysts in PUR production aiming at the phase out of its use as fast as possible, within 10 years of the entry into force of the Convention, and
- Reduce the use of mercury in terms of per unit of VCM production by 50% by 2020 using 2010 as a base line.

Control measures

Parties shall reduce the reliance on mercury from primary mining for VCM production, and the production of PUR using mercury containing catalysts (Annex B, Part II). The Convention also prohibits the use of mercury in VCM production five years after the COP establishes the technical and economic feasibility of mercury-free catalysts based on existing processes (Annex B, Part II). The Convention enables registering an exemption for a category listed in Annex A or B or for a sub-category for a period of five years (unless otherwise specified) with a possibility for one additional extension (Art. 6, para 2, 5 and 6).

Parties shall take measures to manage mercury waste in an environmentally sound manner (Art. 11, para 3a). The guidelines developed under the Basel Convention are to be taken into account.[41] The updated guidelines specify relevant sources of mercury waste, including stockpiles of mercury catalysts from PUR production and polyurethane elastomer waste containing mercury compounds.

Parties with relevant sources must take measures to control emissions (Art. 8, para 3) and releases (Art. 9, para 4).

Moreover, any voluntary actions taken to remediate sites contaminated with mercury/mercury compounds need to be conducted in an environmentally sound manner (Art. 12, para 2). This includes sites contaminated from the use of mercury in VCM and PUR production, including from spills.[42]

International trade

Parties to the Minamata Convention shall not allow the export of mercury, except to a Party that provides written consent to the exporting Party, and only for the purpose of a use allowed by the importing Party under this Convention or for environmentally sound interim storage. However, there are exceptions for Parties that provide general notifications, and different provisions address trade with non-Parties (Art. 3, paras 6-10).

Parties shall take appropriate measures so that mercury waste is (for Parties to the Basel Convention) not transported across international boundaries, except for the purpose of environmentally sound disposal in conformity with Article 11 of the Minamata Convention and the Basel Convention. In circumstances where the Basel Convention does not apply to transport across international boundaries, a Party shall allow such transport only after taking into account relevant international rules, standards, and guidelines. (Art. 11, para 3c).

41 Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds (UN Doc. UNEP/CHW.15/6/Add.6/Rev.1).

42 Guidance on the management of contaminates sites (UN Doc. UNEP/MC/COP.3/8/Rev.1).

Follow-up (reporting, monitoring and inventories)

Article 21 sets requirements for national reporting, including mercury trade.

Parties shall report on efforts to develop and/or identify alternatives to help phase out mercury use in VCM production, and production of PUR using mercury containing catalysts (Annex B, Part II).

Parties with one or more facilities that use mercury/mercury compounds in VCM/PUR production shall submit to the Secretariat information on the number and types of such facilities, and their estimated annual use of mercury/mercury compounds (Art. 5, para 5c).

Parties shall establish and maintain an inventory of emissions from relevant sources (Art. 8, para 7), and an inventory of releases from relevant sources (Art 9, para 6). Moreover, Parties shall endeavour to cooperate in developing and improving inventories of use, consumption, anthropogenic emissions, releases of mercury/mercury compounds (Art. 19, para 1a), and endeavour to identify individual stocks of mercury/mercury compounds exceeding 50 tonnes, as well as sources of mercury supply generating stocks exceeding 10 tonnes per year (Art. 3, para 5a).

Parties shall endeavour to develop strategies for identifying and assessing sites contaminated by mercury/mercury compounds, taking into account their respective circumstances and capabilities (Art. 12, para 1). Parties shall also endeavour to cooperate in the development and improvement of modelling and geographically representative monitoring of levels of mercury/mercury compounds in vulnerable populations, and in environmental media (Art. 19, para 1b).

National Action Plans

Parties with relevant sources of emissions or releases may prepare a national plan that details the measures to be taken to control such emissions or releases, together with the expected targets, goals and outcomes (Art. 8, para 3; Art. 9, para 4). The development and updating of implementation plans are also stipulated in Article 20 as a voluntary measure.

Transparency and information sharing

Parties shall facilitate the exchange of information on the reduction or elimination of the production, use, trade, emissions and releases of mercury and mercury compounds and information on technically and economically viable alternatives to manufacturing processes in which mercury or mercury compounds are used (Art. 17, para 1b and 1c.ii). Parties shall also, within their capabilities, promote and facilitate the provision to the public of available information on the health and environmental effects of mercury and mercury compounds, as well as the alternatives to these (Art. 18, para 1).

Parties shall endeavour to cooperate to develop and improve Information on commerce and trade in mercury and mercury compounds and mercury-added products; and information and research on the technical and economic availability of mercury-free products and processes and on BAT/BEP to reduce and monitor emissions and releases of mercury and mercury compounds (Art. 19, para 1f-g).

What is not addressed

The Minamata Convention is a life cycle convention that begins addressing mercury in the sourcing/extraction phase. It focusses attention on plastics in the chemical phase by setting mitigation targets and control measures for using mercury in the production of PUR and VCM, as well as in the dematerialisation phase by requiring environmentally sound management of stockpiles of mercury catalyst used for PUR production and some contaminated end-of-life products. Sectors contributing mercury releases directly to land/soil include VCM production (OECD, 2022b), however, measures targeting the management of sites contaminated with mercury are largely non-mandatory, with no direct obligation to manage or remediate contaminated sites. The Convention does not address microplastics that can sorb pollutants, including mercury, from water, thus contributing to the bioaccumulation of mercury, particularly in marine ecosystems, organisms, and subsequently food web (Amelia, 2021). However, the Convention includes biomonitoring to help track the bioaccumulation of mercury.

2.1.3. The Montreal Protocol

The Montreal Protocol aims to protect human health and the environment against adverse effects resulting, or likely to result from human activities which modify, or are likely to modify the ozone layer (preamble). The Protocol goes further to define "adverse effects" as meaning changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind (Vienna Convention, Art. 1, para 2). The Protocol controls the production and consumption of ozone depleting substances (ODSs) and hydrofluorocarbons (HFCs), including their use as blowing agents in the production of extruded-polystyrene and polyurethane foams. The Protocol provides an exemption for use of controlled substances as process agents and feedstocks for production of other chemicals, including fluoropolymers. In accordance with the scope defined in Art 1 (para 4), the measures listed in the dematerialisation phase refer to controlled substances that exist alone or in a mixture (not to their presence in products).

Table 7: Summary of governance elements included in the Montreal Protocol

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Targets provided for phasing out production and consumption of ODSs listed in Annexes A, B, C, and E • Targets provided for phasing-down the production and consumption of HFCs listed in Annex F		
Control measures		• Controlled measures linked to achieving targets set for production of controlled substances listed in Annexes A, B, C, E and F		• Ensure that HFC-23 emissions generated from manufacture of certain controlled substances are destroyed to the extent practicable
Reporting, monitoring & inventories		• Provide statistical data on annual production of each of the controlled substances • Provide statistical data separately, for each controlled substance regarding amounts used for feedstocks • Provide statistical data separately, for each controlled substance regarding imports/exports		• Provide statistical data separately, for each controlled substances regarding amounts destroyed by technologies approved by parties

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Trade		• Parties shall ban the import/export of all controlled substances from/to any State not party to the Protocol • If a Party is unable to cease production of a controlled substance for domestic consumption (other than for essential uses), it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction		• If, after the phase-out date of a controlled substance, a Party is unable to cease production of that substance for domestic consumption (other than for essential uses), it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction
NAPs				
Transparency & information exchange		• Encourages exchange of information on alternatives to replace ODS feedstocks; systems used for qualifying a specific ODS use as feedstock use; and systems used for monitoring feedstock containers placed on the market		

What is addressed

Control measures

The **Montreal Protocol** defines a "controlled substance" (including ODSs listed in Annexes A, B, C, E and F) as a substance existing alone or in a mixture. It includes the isomers of any such substance but excludes their presence in a manufactured product other than a container used for the transportation or storage of that substance (Art. 1, para 4). Decision I/12A (para 5c) provides examples of such products, including polyurethane prepolymer or any foam containing, or manufactured with, a controlled substance.

The Protocol defines "production" as the amount of controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties, and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled and reused is not to be considered as "production" (Art. 1, para 5). The Protocol defines "consumption" as production plus imports minus exports of controlled substances (Art. 1, para 6). Decision I/12B (para. a) clarifies that "controlled substances produced" is the calculated level of controlled substances manufactured by a party excluding the calculated level of controlled substances entirely used as a feedstock in the manufacture of other chemicals.

Targets and indicators

The Protocol includes time-bound targets for controlled substances, including for phasing out ODS listed in Annexes A, B, C, and E, and for phasing-down the production of HFCs listed in Annex F of the Protocol (Art. 2). The chemicals are used primarily for cooling and refrigeration, but many of them are used as blowing agents in the production of extruded-polystyrene and polyurethane foams. Some of these substances are also used as aerosol propellants, in fire extinguishing and fumigation applications, as well as feedstocks and process agents in the production of other chemicals including fluoropolymers.

Article 6 requires an assessment and review of control measures every four years based on available scientific, environmental, technical and economic information. This enables the informed "adjustment" of the phase-out or phase-down schedule for any given controlled substance.

Moreover, Parties manufacturing Annex C, Group I, or Annex F substances shall ensure its emissions of HFC-23 substances generated are destroyed to the extent practicable using technology approved by the Parties (Art. 2J, para 6).

International trade

Parties shall ban the export of all controlled substances to any State not party to the Protocol (Art. 4). The Protocol states that where, after the phase-out date applicable to it for a controlled substance, a Party is unable, despite having taken all practicable steps to comply with its obligation under the Protocol, to cease production of that substance for domestic consumption, other than for uses agreed by the Parties to be essential. It shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction (Art. 4A, para 1). Parties shall establish and implement a system for licensing the import and export of new, used, recycled, and reclaimed controlled substances listed in Annexes A, B, C, E and F (Art. 4B).[43]

Follow-up (reporting, monitoring and inventories)

Parties shall provide statistical data on annual production of each controlled substance listed in Annexes A, B, C, E and F and, separately, for each substance regarding: amounts used for feedstocks; amounts destroyed by technologies approved by parties; and imports from and exports to Parties and non-Parties respectively (Art. 7, paras 2-3).

Monitoring is included with the requirement to assess the control measures provided for in Article 2 and Articles 2A to 2J based on available scientific, environmental, technical and economic information (Art. 6), every four years.

National Action Plans

The Protocol does not include provisions for national action plans. However, the Protocol encourages the development of national multi-year phase out/phase-down management plans funded in most countries by the Multilateral Fund (MLF) (See section 3.5.2).

Transparency and information sharing

Parties are encouraged to exchange information on known alternatives being applied to replace ODS in feedstock uses (Decision XXIIV/6, para 1). Moreover, the Protocol encourages parties with feedstock uses to exchange information on systems they have in place for qualifying a specific ODS use as feedstock use, and for identification and/or monitoring of containers placed on the market and intended for feedstock uses, for example reporting or labelling requirements (Decision XXIIV/6, para 2).

What is not addressed

The Montreal Protocol provides an exemption for use of ODSs and HFCs as feedstocks and process agents, including for manufacturing of fluoropolymers. This is laid down in decision IV/12 (para 1) that states that a controlled substance does not include "insignificant quantities of controlled substances originating from inadvertent or coincidental production during a manufacturing process, from unreacted feedstock, or from their use as process agents which are present in chemical substances as trace impurities, or that are emitted during product manufacture or handling." Possible emissions from the use of feedstock consist of residual levels in the ultimate products, and fugitive leaks in the production, storage and/or transport processes (UNEP, 2021b).

Scholars suggest that Parties to the Montreal Protocol may consider narrowing the exemption for feedstocks used for production for fluoropolymers with potentially harmful emissions throughout the life cycle of plastics, including bromochloromethane, CFC-11, CFC-12, CFC-113, CTC, HCFC-22, HCFC-

43 Licensing systems are regulatory schemes whereby a license is granted by authorities for a company to produce, export or import controlled substances, supported by a ban on unlicensed production, exports and imports (Grabiel et al., 2022).

142b, HCFC-225ca, HCFC-225cb, HCF-143a and Halon 1301 (Andersen et al., 2021). Furthermore, vinyl chloride is not currently controlled under the Montreal Protocol but may be restricted – along with its principal feedstock, ethylene dichloride – as "associated feedstocks" to help curb production of PVC (Andersen et al., 2021). Narrowing the scope of the exemptions for ODS and HFC feedstocks has the potential to reduce 6% of the total plastics production but increasing to 20% if "associated feedstocks" (i.e., vinyl chloride and ethylene dichloride) are included (Andersen et al., 2021).

2.1.4. ILO Chemicals Convention (C170)

The aim of the Chemicals Convention (C170) is to prevent or reduce the incidence of chemically induced illnesses and injuries at work (preamble). The Convention is relevant for securing occupational safety of workers across the life cycle of plastic, although it does not specifically address plastics.

Table 8: Summary of governance elements included in the ILO Chemicals Convention (C170)

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures		• Prescribes the classification of chemicals by hazards • Employers shall make an assessment of the risks of using chemicals at work, including identify chemicals that can eliminate/minimise risk and limit exposure • Employers shall assess the exposure of workers to hazardous chemicals and ensure they are not exposed to chemicals exceeding limits	• Employers shall make an assessment of the risks of using chemicals at work, including identify chemicals that can eliminate/minimise risk and limit exposure • Employers shall assess the exposure of workers to hazardous chemicals and ensure they are not exposed to chemicals exceeding limits	• Employers shall ensure that unneeded hazardous chemicals are disposed of in a manner that eliminates/ minimises the risk to safety, health and the environment
Reporting, monitoring & inventories				
Trade		• Exporting member States shall communicate to any importing country whether uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it		
NAPs				
Transparency & information exchange		• Suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals • Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets have been provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained	• Suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals • Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets have been provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained	

What is addressed

Control measures

The Convention prescribes the classification of all chemicals by hazards. It defines hazardous chemicals to include any chemical determined hazardous by a competent authority based on systems and specific criteria appropriate for the classification of all chemicals, according to the type and degree of their intrinsic health and physical hazards (Art. 2, Art. 6).

The Convention sets obligations for employers to ensure occupational safety. Employers shall assess the risks arising from the use of chemicals at work, including the choice of chemicals that can eliminate or minimise risk, and limit exposure to hazardous chemicals to protect safety and health of workers (Art. 13). Moreover, employers shall assess the exposure of workers to hazardous chemicals and ensure that workers are not exposed to chemicals exceeding exposure limits or other exposure criteria established by appropriate bodies (Art. 12). Lastly, employers shall ensure that hazardous chemicals that are no longer needed (and their empty containers) are disposed of in a manner which eliminates/minimises the risk to safety, health and the environment (Art. 14).

International trade

Exporting member States shall communicate to any importing country whether all or some uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it (Art. 19).

National Action Plans

The Convention does not prescribe the preparation of NAPs, but Member States shall formulate, implement, and periodically review a coherent policy on safety in the use of chemicals at work (Art. 4).

Transparency and information sharing

The Convention defines detailed responsibilities for suppliers and manufacturers. Suppliers of chemicals (manufacturers, importers, and distributors) shall ensure that all chemicals are marked to indicate their identities, hazardous chemicals are labelled, and employers are provided with safety data sheets for hazardous chemicals (Art. 7–9). Employers shall adhere to same marking and labelling requirements for chemicals used at work and ensure that safety data sheets are provided (Art. 10). Where these are not available, chemicals shall not be used by employers until such labelling and information has been obtained (Art. 10).

What is not addressed

To date, the Convention has been ratified by 23 countries, thus it has a very narrow geographical reach, and is not expected to have a significant role in supporting the plastics instrument from an occupational safety aspect. Therefore, it may be worthwhile to consider how issues related to workers safety, and transparency of hazard information through labelling and other means, can be strengthened at the global level, possibly through international sustainability criteria for plastics and associated chemicals.

2.1.5. The Rotterdam Convention

The objective of the Rotterdam Convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals, in order to protect human health and the environment from potential harm. It promotes the environmentally sound use of such chemicals, by facilitating information exchange about their characteristics, providing for a national decision-making process on their import and export, and by disseminating these decisions to Parties (Art. 1).

Table 9: Summary of governance elements included in the Rotterdam Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets and indicators				
Control measures				
Reporting, monitoring and inventories		• Measures to strengthen national infrastructures/institutions may include the establishment of national registers and databases, including safety information for chemicals		
Trade		• Exports of chemicals listed in Annex III subject to PIC procedure • When a chemical is not listed in Annex III but is banned or severely restricted by an exporting Party, it shall notify the importing Party before the first shipment and annually thereafter		
NAPs				
Transparency & information exchange		• Facilitate the exchange of scientific, technical, economic and legal information concerning the chemicals within the scope of the Convention • Facilitate the provision of publicly available information on domestic regulatory actions relevant to the objectives of the Convention and actions that substantially restrict one or more uses of the chemical		

What is addressed

Control measures

The Convention does not include control measures to restrict production and use of chemicals but provides mechanisms for information exchange and allows for consent of denial or imports of chemicals listed in Annex III (Art. 10, paras 2, 4).

International trade

The Convention allows exports of chemicals listed in Annex III subject to the prior informed consent (PIC) procedure. By providing an Import Response, a State of import can decide to not consent or to consent with conditions to the future import of the specific chemical (Art. 10, para 2 and Art. 11, para 1(b)). When a chemical is not listed in Annex III but is banned or severely restricted by an exporting Party, that Party shall notify each individual importing Party before the first shipment and annually thereafter (Art. 12, paras 1–2).

National inventories

Parties shall take measures necessary to establish and strengthen their national infrastructures and institutions for the effective implementation of the Convention. These measures may include the establishment of national registers and databases, including safety information for chemicals (Art. 15, para 1a).

Transparency and information sharing

Parties shall implement legislative or administrative measures to ensure timely decisions with respect to the import of chemicals listed in Annex III, consistent with the PIC procedure (Art. 10, para 1). To date, the Convention has listed 9 chemicals and chemical mixtures under the industrial category that are relevant for plastics.[44] Moreover, each Party is required to provide information to the Secretariat on the chemicals it has banned or severely restricted, which is compiled and disseminated to all Parties to the Convention (Art. 12.1).

Parties shall facilitate the exchange of scientific, technical, economic and legal information concerning the chemicals within the scope of the Convention, including toxicological, ecotoxicological and safety information; the provision of publicly available information on domestic regulatory actions relevant to the objectives of this Convention; and the provision of information to other Parties, directly or through the Secretariat, on domestic regulatory actions that substantially restrict one or more uses of the chemical (Art. 14, para 1).

What is not addressed

The scope of the Rotterdam Convention is to provide information on the trade of particular chemicals. The PIC procedure is intended to protect human health and the environment by ensuring that countries are fully informed about the hazards associated with chemicals and have the right to make informed decisions about their import and use. However, it was not designed to regulate the production and use of chemicals and does not directly govern or regulate plastics or associated chemicals. This means that chemicals listed in Annex III do not have any restrictions on their production and use under the Convention. However, in some instances chemicals are listed under the Rotterdam Convention that have already been listed under the Stockholm Convention, as elimination under the Stockholm Convention and specific exemptions may still allow their use (e.g., DecaBDE or PFOA) for defined time periods. A listing under the Rotterdam Convention subjects Stockholm Convention listed chemicals to the PIC procedure while they remain in trade. However, the PIC procedure only applies to chemicals and not to chemicals in articles (materials). It may be noteworthy that the Rotterdam Convention has listed several chemicals as pesticides[45] and one as a severely hazardous pesticide formulation[46] that have uses in plastics (Wiesinger et al., 2021).

2.2. Multilateral instruments governing wastes

2.2.1. The Basel Convention

The Basel Convention acknowledges that the most effective way of protecting human health and the environment from the dangers posed by such wastes is the reduction of their generation to a minimum in terms of quantity and/or hazard potential (Preamble).

44 Perfluorooctanoic acid (PFOA), it salts and PFOA-related compounds, Decabromodiphenyl ether (Deca-BDE), Hexabromocyclododecane (HBCD), Perfluorooctane sulfonic acid (PFOS) its salts and perfluorooctane sulfonyl fluoride (PFOSF), Tetrabromodiphenyl ether / Pentabromodiphenyl ether, Hexabromodiphenyl ether / Heptabromodiphenyl ether, Short-chain chlorinated paraffins (SCCPs), polychlorinated biphenyls (PCBs), Tributyltin compounds (tributyltin chloride, tributyltin methacrylate and bis(tributyltin)oxide are of relevance to plastics).

45 Ethylene dichloride, Ethylene oxide, 1,2-dibromoethane, pentachlorophenol and mercury compounds.

46 Thiaram.

Table 10: Summary of governance elements included in the Basel Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				• The strategic framework 2012-2021 provided targets and indicators. The only other targets adopted so far pertain to the overall rate, the timeliness and the completeness of national reports
Control measures	• Generation of wastes minimised	• Generation of wastes minimised	• Generation of wastes minimised	• Ensure the generation of hazardous wastes and other wastes is reduced to a minimum • Ensure availability of adequate disposal facilities • Ensure transboundary movement of hazardous wastes and other wastes is reduced to a minimum • Minimise the consequences of pollution resulting from the management of wastes
Reporting, monitoring & inventories	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Mandatory annual reporting on amounts exported/imported • Voluntary annual reporting on amounts generated • Monitor effects of hazardous wastes management on human health and the environment • Review and evaluate the effective implementation of the Convention
Trade				• Three entries specific to plastic wastes regulated, with two requiring PIC procedure for transboundary movements • Transboundary movement of hazardous wastes prohibited from Annex VII Parties (Parties and other States which are members of the OECD, EC, Liechtenstein) that have ratified the Ban Amendment to non-Annex VII Parties • Illegal traffic to be considered criminal
NAPs				
Transparency & information exchange				• PIC procedure for transboundary movement of wastes subject to the Convention • Information to be provided on notification to include effects of transboundary movement of hazardous and other wastes on human health & environment

What is addressed

Control measures

The Basel Convention requires each Party to ensure the generation of hazardous wastes and other wastes is reduced to a minimum within their jurisdiction, taking into account social, technological and economic aspects (Art. 4, para 2a). This can be interpreted to include waste generated at all life cycle phases. However, no upstream measures are elaborated in this regard except in guidance documents.

Parties are obliged to ensure the availability of adequate disposal facilities for the environmentally sound management[47] of hazardous wastes and other wastes. To the extent possible, these shall be

47 "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 (Art. 2.8).

located within the country (Art. 4. para 2), supporting the principle of proximity and the duty to ensure transboundary movement of hazardous wastes and other wastes is reduced to a minimum, consistent with environmentally sound and efficient management (Art. 4. para d).

International trade

The transboundary movement of plastic waste is explicitly regulated under the Basel Convention, requiring notification by the State of export to the importing State, and State of transit, if applicable, of any proposed transboundary movement of plastic wastes as defined in Article 1.1(b) or captured by entries Y48 and A3210. If the plastic waste is a hazardous waste or other waste, the importing State shall provide consent and issue a movement document, as well as confirmation of disposal, to the exporting State (Art. 6).

Should Parties prohibit the import of hazardous wastes or other wastes for disposal, notification shall be given to other Parties (Art. 4, para 1). This includes changes in the national definition of hazardous wastes (Art. 13, para 1a). Parties shall inform the Secretariat of wastes considered or defined as hazardous under national legislation and which are not listed in Annexes I and II, as well as any requirements the Party has for transboundary movement of these wastes (Art. 3 para 1).

Three entries are provided specific to plastic waste (effective 1 January 2021) with the first category listed below considered a "catch-all" category for wastes that do not fall under the second two categories:[48]

- **Annex II** (Waste requiring special consideration and is subject to the PIC procedure)
  Entry Y48:[49]
  - All plastic waste, including mixtures of such waste, except for the following:
    - Hazardous plastic waste covered by Annex VIII, entry A3210
    - Following plastic waste that is destined for recycling[50] in an environmentally sound manner and almost free from contamination and other types of wastes:[51]
      - Plastic waste almost exclusively[52] consisting of one non-halogenated polymer;
      - Plastic waste almost exclusively consisting of one cured resin or condensation product of certain resins;
      - Plastic waste almost exclusively consisting of one of the five fluorinated polymers listed therein.
    - Mixture of plastic waste, consisting of polyethylene (PE), polypropylene (PP) and/or polyethylene terephthalate (PET), provided they are destined for separate recycling of each material and in an environmentally sound manner and almost free from contamination and other types of wastes.
- **Annex VIII** (Waste considered hazardous and is subject to the PIC procedure)
  Entry A3210:
  - Plastic waste, including mixtures of such waste, containing or contaminated with Annex I constituents, to an extent that it exhibits hazardous characteristics listed in Annex III.

48 Plastic Waste Amendments adopted in decision BC-14/12.

49 Parties can impose stricter requirements in relation to this entry.

50 Recycling/reclamation of organic substances that are not used as solvents (R3 in Annex IV, sect. B) or, if needed, temporary storage limited to one instance, provided that it is followed by operation R3 and evidenced by contractual or relevant official documentation.

51 In relation to "almost free from contamination and other types of wastes", international and national specifications may offer a point of reference.

52 In relation to "almost exclusively", international and national specifications may offer a point of reference.

- **Annex IX** (Waste presumed not to be hazardous and is not subject to the PIC procedure)
  Entry B3011:
  - Plastic waste that it is destined for recycling in an environmentally sound manner and almost free from contamination and other types of wastes:
    - Plastic waste almost exclusively consisting of one non-halogenated polymer;
    - Plastic waste almost exclusively consisting of one cured resin or condensation product;
    - Plastic waste almost exclusively consisting of one of the fluorinated polymers listed therein.[53]
  - Mixtures of plastic waste, consisting of PE, PP and/or PET, provided they are destined for separate recycling of each material and in an environmentally sound manner, and almost free from contamination and other types of wastes.

The Basel Convention has been further amended to include provisions for non-hazardous e-waste (much of which contain plastics). Currently it includes hazardous e-waste which also may contain plastics. The new amendments come into effect on 1 January 2025, including a new numbering for the hazardous e-waste as follows include:[54]

- **Annex II** (Wastes requiring special consideration and is subject to the PIC procedure)
  Entry Y49:
  - All e-wastes, components thereof and wastes resulting from e-waste processing (e.g. fractions from shredding), unless covered by Annex VIII, entry A1181.
- **Annex VIII** (Waste presumed to be hazardous and subject to the PIC procedures)
  Entry A1181:
  - Hazardous e-wastes, components thereof and wastes resulting from e-waste processing (e.g. fractions from shredding).
- **Annex IX** (Waste presumed not to be hazardous and is not subject to the PIC procedures)
  - Entries B1110 and B4030 removed.

Import or export with non-Parties shall not be permitted (Art. 4.5), unless a bilateral, multilateral, or regional agreement or arrangement is in place that meets the requirements set out in the Convention (Art. 11). Any illegal transboundary movement of wastes regulated under the Convention shall be considered a criminal offense at the national level of Parties (Art. 4.3). Where wastes subjected to transboundary movement results in deliberate disposal (e.g., dumping), this shall be considered illegal traffic (Art. 9, para 1.e).

Transboundary movement should only be considered where the exporting country does not have the ability to manage it in an environmentally sound manner, or if the waste is to be used as a raw material for recycling or recovery in the importing country (Art. 4.9a, b).

The transboundary movement of hazardous wastes was strengthened through adoption of the Basel Ban Amendment (Decision III/1), which applies only to Parties who have ratified the Ban Amendment. The amendment prohibits the export of hazardous wastes listed in the Convention from countries listed in Annex VII to the Convention[55] to all other countries not listed in Annex VII. The type of wastes that are prohibited are those that fall under a category listed in Annex I, unless they do not possess any

53 Post-consumer wastes are excluded.

54 E-waste Amendments adopted in decision BC-15/18.

55 Parties and other States which are members of the OECD, EC, Liechtenstein.

of the hazardous characteristics listed in Annex III (Art. 1.1a). Annex I lists some wastes and chemicals related to plastics[56], and Annex VIII (e.g. A3210) further elaborates on this list.

Follow-up (reporting, monitoring and inventories)

The Basel Convention requires parties to periodically review possibilities for the reduction of the amount and/or the pollution potential of hazardous wastes and other wastes which are exported to other States, in particular to developing countries (Art. 4, para 13). They shall also report on national definitions of hazardous wastes and any national policies and control procedures they require that are stricter than those required under the Convention (Article 13). They shall also cooperate in monitoring the effects of the management of hazardous wastes on human health and the environment (Art. 10, para 2b) and keep under continuous review and evaluation the effective implementation of this Convention (Art. 15, para 5).

Parties to the Basel Convention shall report each year on the previous year regarding:

- The amount of hazardous wastes and other wastes exported and imported, their category, characteristics, destination, any transit country and disposal method.
- Disposals which did not proceed as intended.
- Efforts to achieve a reduction of hazardous wastes or other wastes subject to transboundary movement.
- Information on available qualified statistics, which have been compiled by them on the effects on human health and the environment of the generation, transportation and disposal of hazardous wastes or other wastes.
- Information on accidents occurring during the transboundary movement and disposal of hazardous wastes and other wastes, and on the measures undertaken to deal with them.
- Information on disposal options operated within the area of their national jurisdiction.
- Information on measures undertaken for development of technologies for the reduction and/or elimination of production of hazardous wastes and other wastes (Art. 13, para 3).

Parties to the Basel Convention also have the possibility to report each year on the amount of wastes generated.

Transparency and information sharing

States shall take measures for the proper exchange of information on, and control of the transboundary movement of hazardous wastes and other wastes (Preamble). The Convention requires that information provided to States concerned in a transboundary movement of hazardous wastes and other wastes clearly state the effects of the proposed movement on human health and the environment (Art. 4, para 2f). The notification document whereby a transboundary movement of wastes is proposed contains information on the designation, quantity and nature of the wastes, its hazardous characteristic, and any special handling requirement (Annex V). This is in addition to the movement document required from the point at which a transboundary movement commences to the point of disposal. (Art. 4, para 7c).

Parties shall also cooperate in the dissemination of information to improve the environmentally sound management of such wastes, and to achieve the prevention of illegal traffic (Art. 4, para 2h). Any information regarding illegal traffic shall be provided by the Secretariat to concerned Parties (Art. 16, para 1i).

56 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs) (entry Y10); Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives (entry Y13); Wastes resulting from surface treatment of metals and plastics (entry Y17).

Hazardous wastes and other wastes to be subjected to transboundary movement shall be labelled in conformity with generally accepted and recognised international rules and standards for labelling (Art. 4, para 7b), and accompanied by a movement document from the point at which a transboundary movement commences to the point of disposal. (Art. 4, para 7c).

Should an accident occur during the transport of such wastes, which is likely to present risks to human health and the environment in other States, those States are to be immediately informed (Art. 13, para 1). Where a Party considers the movement of such wastes to be a risk to their environment and has notified the exporting Party, a copy of the notification shall be sent to the Secretariat should that Party request it (Art. 13, para 4).

Parties are required to report any decisions taken by them to limit or ban the export of hazardous wastes or other wastes (Art. 13.2d).

As per decision BC-14/13, a Plastic Waste Partnership (PWP) was established under the Basel Convention with the goal of improving and promoting "the environmentally sound management (ESM) of plastic waste at the global, regional and national levels and to prevent and minimise its generation so as to, among other things, reduce significantly and in the long-term eliminate the discharge of plastic waste and microplastics into the environment, in particular the marine environment."[57]

Remediation

Should pollution occur during the management of hazardous wastes and other wastes, those persons involved in these processes shall minimise the consequences of such pollution for human health and the environment (Art. 4.2c). This may include remedial activities.

What is not addressed

The Basel Convention includes provisions related to reducing hazardous wastes and other wastes to a minimum. However, most of the Convention is focused on the waste management phase, and the aspects related to prevention are not present in the hard law provisions of the Convention. This requires strengthening at the global level to address waste generation across all phases of the life cycle. The development of targets and indicators for the transition to alternative materials or to plastics that can be safely and effectively reused, re-manufactured and recycled will assist in reduction of plastic waste.

The Basel Convention does not require Parties to develop and implement national action plans, and although inventories of imports and exports of plastic wastes are mandatory and to be reported on an annual basis, the inclusion of the generation and disposal of wastes in inventories is voluntary. Guidance on the development of comprehensive plastic waste inventories is available under the Convention[58], and progress is being made by Parties to the Convention on the development of national waste inventories, which could provide a foundation for global monitoring programmes, mandatory comprehensive national inventories and national action plans.

The Basel Convention lists disposal operations that may lead to resource recovery, recycling, reclamation, direct reuse or alternative uses (Annex IV B, usually referred to as "recovery operations"), and lists those that do not lead to such outcomes (Annex IV A, usually referred to as "final disposal operations"). Guidance is provided on which may be considered environmentally sound and the Convention allows Parties to consent to proposed transboundary movements of wastes for all types of operations, subject to PIC requirements, the Ban Amendment, or other control measures imposed by individual Parties.

57 See http://www.basel.int/Implementation/Plasticwaste/PlasticWastePartnership/tabid/8096/Default.aspx

58 See the Practical guidance on the development of inventories of plastic waste (UNEP/CHW.15/INF/19/Rev.1).

Because the scope of the Convention is the transboundary movement of plastic wastes, it does not regulate domestic disposal operations, beyond a duty to not allow the transboundary movement of wastes to proceed if there is reason to believe that it will not be managed within the importing country in an environmentally sound manner (Art. 4.2e), and the duty of the exporting state to re-import the wastes if the transboundary movement is not completed according to the contract (Art. 8). Numerous voluntary guidelines have been developed to assist countries in achieving environmentally sound waste management practices, and Parties to the Basel Convention are currently updating the Technical guidelines for the identification and ESM of plastic wastes and for their disposal.[59] Global governance of plastics could be strengthened by ensuring safe and non-toxic circularity of plastics, building on the obligations of the Basel Convention and the Stockholm Convention.

Transparency and information sharing applies only to the transboundary movement of wastes under the Basel Convention. Greater transparency is needed across all aspects of waste management at the national level, including waste generation, waste management processes and minimisation of the consequences of pollution resulting from such processes, including remediation. Importantly, the tracking of the full life cycle of plastics, including extraction of raw materials from the environment, material flows within the plastics value chain, and emissions of plastics and associated chemicals to all environmental compartments is needed.

2.2.2. MARPOL Annex V

MARPOL Annex V prohibits the discharge of garbage into the sea. Plastics are included in the definition of garbage[60] and a definition of plastics is provided that includes synthetic fishing nets.[61]

Table 11: Summary of governance elements included in MARPOL Annex V

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Discharge of plastics from ships into the sea is prohibited, including fishing gear • Provision of adequate garbage reception facilities at ports & terminals
Reporting, monitoring & inventories				• Require recording of each discharge to a reception facility and completed incinerations for larger ships (Garbage Record Book) and smaller ships (ship's official logbook) • In addition, any discharge provided for under the exemptions on the ban of plastic discharge shall also be recorded either in the Garbage Record Book or the ship's logbook, providing details of the items discharged or lost, the location, circumstances of, and the reasons for the discharge or loss. Where such discharge is fishing gear that poses a significant threat to the marine environment or navigation, it mut be reported to the flag State and the coastal State, if applicable

59 http://www.basel.int/Implementation/Plasticwaste/Technicalguidelines/Overview/tabid/7992/Default.aspx

60 *Garbage* means all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention (Reg. 1.9).

61 *Plastic* means a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. For the purposes of this annex, "all plastics" means all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products (Reg. 1.13).

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Trade				
NAPs				
Transparency & information exchange				• Right to inspect and make a copy of ship records regarding each discharge into a reception facility or a completed incineration, as well as exempted discharges[62] or accidental losses

What is addressed

Control measures

The discharge of all plastics into all maritime jurisdictions is prohibited (Reg. 3.2), with exemptions provided (Reg. 7). Should garbage be mixed or contaminated by plastics, it is also prohibited from discharge (Reg. 4.4). Each Party shall ensure adequate facilities are available at ports and terminals for the reception of garbage (Reg. 8.1). Regional arrangements may be used by SIDS in this regard (Reg. 8.2).

Follow-up (reporting, monitoring and inventories)

Parties shall require the recording in a Garbage Record Book of each discharge to a reception facility, as well as completed incinerations (Reg. 10.3.1). In addition, any discharge provided for under exemptions on the ban of plastic discharge shall also be recorded either in the Garbage Record Book or the ship's logbook, providing details of the items discharged or lost, the location, circumstances of, and the reasons for the discharge or loss (Reg. 10.3.4). Where such discharge is fishing gear that poses a significant threat to the marine environment or navigation, it shall be reported to the Flag State and the Coastal State, if applicable (Reg. 10.6).

Transparency and information sharing

MARPOL Annex V provides a level of transparency in giving the government of the port or offshore terminal that a ship is visiting, the right to inspect and make a copy of the applicable Garbage Record Book or logbook regarding each discharge into a reception facility or completed incineration, exempted discharges or accidental loss in terms of plastics. (Reg 10.3 and Reg. 10.5).

What is not addressed

The requirements for a Garbage Record Book may be waived by the Administration for vessels engaged in shorter voyages of one hour or less and for fixed/floating platforms.

2.2.3. The London Convention

Parties to the London Convention shall take effective measures individually, according to their scientific, technical and economic capabilities, to promote the effective control of all sources of pollution of the marine environment. They shall pledge to take all practicable steps to prevent the pollution of the sea

62 Exception clauses: (1) The discharge of garbage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or (2) The accidental loss of garbage resulting from damage to a ship or its equipment, provided that all reasonable precautions have been taken before and after the occurrence of the damage, to prevent or minimise the accidental loss; or (3) The accidental loss of fishing gear from a ship provided that all reasonable precautions have been taken to prevent such loss; or (4) The discharge of fishing gear from a ship for the protection of the marine environment or for the safety of that ship or its crew (Reg 7.1).

by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea (Art. I). They shall also pledge to promote measures to protect the marine environment from pollution caused by other noxious or hazardous matter transported by vessels for purposes other than dumping (Art. XII).

Table 12: Summary of governance elements included in the London Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Dumping of persistent plastics & other persistent synthetic materials • Includes some chemicals used in plastics life cycle • Permit required to dump sewage sludge and dredged material (can contain plastics) • Collaborate on mitigation of pollution caused by dumping upon request
Reporting, monitoring & inventories				• Keep records of all matter permitted to be dumped • Cooperate to develop reporting procedures for illegal dumping
Trade				
NAPs				
Transparency & information exchange				

What is addressed

Control measures

The London Convention **prohibits the dumping** of wastes or other matter listed in Annex I (Art. IV). This includes persistent plastics and other persistent synthetic materials (e.g., netting and ropes) which may float or may remain in suspension in the sea in such a manner as to interfere materially with legitimate uses of the sea (Annex I, para 4).

Annex I also lists some chemicals used in the plastics life cycle. These include organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, although these are allowed where they are contained in dumped waste or other materials as trace contaminants. These are then subject to Annex II and Annex III provisions (Annex I, para 9). Waste containing significant amounts of organosilicon compounds and fluorides (Annex I) require special care when issuing permits (Art. VI.1) as per exceptional circumstances listed in Article V(2).

For wastes not prohibited from dumping and incineration at sea or those listed under Annex II to the Convention, a prior permit is required (Art. IV, para 1b-c, Annex I, para 10b). This includes dredged material and sewage sludge (Annex I). These wastes are known to contain microplastics (Khan et al., 2022), and can lead to the unintentional application of microplastics to agricultural lands when sewage sludge is used as a soil improver (FAO, 2021). The incineration of sewage sludge and dredged material at sea is prohibited.

Follow-up (reporting, monitoring and inventories)

Parties are required to co-operate in the development of procedures for reporting vessels and aircraft observed dumping in contravention of the Convention (Art. VII.3).

Parties shall keep records of the nature and quantities of all matter permitted to be dumped and the location, time, and method of dumping (Art. VI, para 1c), and shall monitor the condition of the seas for the purposes of this Convention. (Art. VI, para d).

Remediation

Should countries request support, Parties shall promote collaboration for the mitigation of pollution caused by dumping (Art. IX).

What is not addressed

The London Convention could be interpreted as only prohibiting the dumping of persistent plastics if they "float or remain in suspension in the sea in such a manner as to interfere materially with fishing, navigation or other legitimate uses of the sea." This excludes many types of plastics that sink quickly, as well as microplastics. This gap is closed in the London Protocol which prohibits all plastics from being dumped in the ocean.

2.2.4. The London Protocol

Parties to the London Protocol shall, according to their scientific, technical and economic capabilities, protect and preserve the marine environment from all sources of pollution, and take effective measures to prevent, reduce, and where practicable, eliminate pollution caused by dumping or incineration at sea of wastes or other matter (Art. 2). Priority shall be given to environmentally preferable alternatives over dumping (Art. 4, para 1.2).

Table 13: Summary of governance elements included in the London Protocol

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Dumping of plastics and substances used in plastics is prohibited (not included in whitelist) • Provides for development of procedures on liability for environmental damage resulting from dumping or incineration of wastes or other matter at sea
Reporting, monitoring & inventories				• Establish procedures for assessing & promoting compliance • Continually evaluate effectiveness of the Protocol • Develop National Action Lists for screening of wastes that may be considered for dumping permits
Trade				• Trade of wastes or other matter for the purpose of dumping or incineration at sea shall be prohibited
NAPs				
Transparency & information exchange				• Promote availability information on scientific & technical activities & measures undertaken, and impacts observed from monitoring and assessment

What is addressed

Control measures

The London Protocol bans the intentional dumping of all wastes with some exceptions. Plastics and the substances used in plastics are not included in the list of permissible wastes (whitelist) of Annex I and are therefore prohibited from dumping (Art. 4.1.1). All wastes and other matter are prohibited from being incinerated at sea (Art. 5).

The London Protocol also promotes prevention over remediation. The sources of contamination in sewage sludge and dredged material, which include microplastics, shall be prevented from point and non-point sources (Annex 2).

To Note: The Meeting of Contracting Parties to the London Protocol at its 17th session in October 2022 adopted the amendments to Annex 1 and Annex 2 to the London Protocol to remove sewage sludge from the list of wastes or other matter that may be considered for dumping as resolution LP.6(17), as set out in Annex 4 to the report of the Meetings. The amendment has been communicated to all national focal points, in accordance with Article 22.3 of the London Protocol, by way of circular LC/LP.1/Circ.103 (dated 20 October 2022), and the amendment will enter into force for each Contracting Party immediately on notification of its acceptance to the Organization or 100 days after the date of their adoption, i.e. on 15 January 2023, if that is later, except for those Contracting Parties which before the end of the 100 days make a declaration that they are not able to accept the amendment at that time.

International trade

The trade of wastes or other matter to other countries for the purpose of dumping or incineration at sea shall be prohibited by Parties (Art. 6).

Follow-up (reporting, monitoring and inventories)

Procedures and mechanisms shall be established for assessing and promoting compliance with this Protocol and with a view to allowing for the full and open exchange of information, in a constructive manner (Art. 11, para 1).

Parties shall keep records of the nature and quantities of all wastes or other matter for which dumping permits have been issued and where practicable the quantities actually dumped and the location, time and method of dumping (Art. 9, para 1.2).

National Action Lists shall be developed as a mechanism for the screening of wastes that may be considered for dumping permits. These should specify an upper level aimed at avoiding acute or chronic effects on human health or sensitive marine organisms. Lower levels may also be specified. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bioaccumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons). An Action List can also be used as a trigger mechanism for further waste prevention considerations (Annex 2(9)).

A national Action List shall also be developed for screening candidate wastes according to upper and lower levels and for which three possible categories of waste could be applied:

- wastes which contain specified substances, or which cause biological responses, exceeding the relevant upper level shall not be dumped, unless made acceptable for dumping using management techniques or processes,
- wastes which contain specified substances, or which cause biological responses, below the relevant lower levels should be considered to be of little environmental concern in relation to dumping, and

- wastes which contain specified substances, or which cause biological responses, below the upper level but above the lower level, require more detailed assessment before their suitability for dumping can be determined (Annex 2, para 10).

Parties shall monitor the condition of the seas for the purposes of this Protocol (Art. 9, para 1.3), and collaborate in assessments of the state of the marine environment (Art. 19, para 3.1).

The implementation of the Protocol and evaluation of its effectiveness shall be kept under continuing review (Art. 18, para 1).

The London Protocol extends the geographic scope of the London Convention to include marine internal waters (Art. 7). Parties should report on a voluntary basis a summary of the type and nature of the materials dumped in marine internal waters (Art. 7, para 3), as well as a summary of administrative, legislative and enforcement measures taken to implement the Protocol and their effectiveness.

Transparency and information sharing

Parties shall promote the availability of relevant information to other Contracting Parties who request it on 1) scientific and technical activities and measures undertaken in accordance with this Protocol, and 2) the impacts observed from monitoring and assessment (Art. 14, para 2).

Remediation

The Protocol provides for the development of procedures regarding liability resulting from dumping or incineration of wastes or other matter at sea, in accordance with the principles of international law regarding State responsibility for damage to the environment of other States, or to any other area of the environment (Art. 15).

What is not addressed

The Protocol prohibits the dumping of plastics into the ocean but allows for dredged material (included in Annex 1) to be considered for dumping, ensuring that permit conditions comply with provisions of Annex 2. For these wastes, the sources of contamination shall be controlled through implementation of waste prevention strategies, stating "until this objective is met, the problems of contaminated dredged material may be addressed by using disposal management techniques at sea or on land" (Annex 2).

In the past, this has allowed microplastics to be dumped into the oceans in sewage sludge and dredged material. Measures to reduce contamination of sewage sludge can include washing machine filters to capture microfibres before they enter sewage treatment plants, and elimination of intentionally added microbeads in household products. Material dredged from near the coastline (including harbours) may contain macro- and microplastics, including from multiple land-based sources. Unnecessary and avoidable sources of microplastics should be identified and phased out through efforts to end plastic pollution, with "essential uses" exempted, but promoted for innovative alternative materials and practices to reduce waste generation and emissions.

2.3. Framework agreements of relevance

2.3.1. The Law of the Sea Convention (UNCLOS)

UNCLOS addresses the introduction of substances or energy into the marine environment, implying a need to strengthen the **waste management** phase of the plastics life cycle, as well as waste minimisation more broadly. States have the obligation to protect and preserve the marine environment

(Art. 192) and to take all measures necessary to prevent, reduce and control such pollution from any source (Art. 194), as well as measures to minimise substances of concern. A precautionary approach is promoted, whereby the definition of pollution refers to substances that "result" or are "likely to result" in deleterious effects (Art. 1). Where releases are of toxic, harmful or noxious substances, especially those which are persistent, measures are required to be designed to minimise such pollution to the fullest possible extent (Art. 194 para 3a). This includes substances originating from land-based sources, the atmosphere or dumping.

Two primary sea-based sources are included, namely pollution by discharges from vessels during normal operations (Art. 211) and intentional dumping into the ocean of wastes generated on land (Art. 210). These articles are given effect in MARPOL Annex V, and the London Convention and the London Protocol (refer to section 2.2).

UNCLOS is the only binding global instrument that provides for management of land-based sources (Art. 207) of marine pollution, but also recognises air pollution (Art. 212) as a source of marine pollution. The latter could apply to microplastics transported through the air. This, however, only applies to regulations addressing vessels and aircraft as sources.

In addition, global and regional instruments shall be established that minimise the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment (Art. 207, paras 4, 5).

Opportunities for strengthening global governance of plastic pollution

There is a need at the global level to promote prevention of land-based sources of marine pollution, elaborating on Article 207, while complementing MARPOL Annex V, the London Convention and the London Protocol that give effect to Articles 210 and 211 of UNCLOS.

Microplastics can be transported to remote areas through the air (Evangeliou et al, 2020). Air pollution could, therefore, also be included to address all sources and pathways of microplastics and chemicals used in plastics, beyond the rivers, estuaries, pipelines and outfall structures listed in Article 207. Articles 213 and 222 discuss enforcement of these two sources of marine pollution, and could be strengthened at the global level, expanding measures to include protection of all environmental compartments.

In addition, UNCLOS mandates the establishment of global and regional rules, standards and recommended practices and procedures that minimise the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment (Art. 207, paras 4, 5). There is a need to strengthen the global governance of the full life cycle of plastics, expanding this to include all land-based activities.

2.3.2. Convention on Biological Diversity (CBD)

The objectives of the CBD are the conservation of biological diversity, the sustainable use of various aspects of it, and the fair and equitable sharing of benefits arising from commercial and other utilisation of genetic resources (Art. 1).

Parties are required to protect ecosystems and natural habitats, as well as maintain viable populations of species in natural surroundings (Art. 8, para d). In so doing, at least 30% globally of land areas and sea areas shall be conserved, according to Target 3 of the Kunming-Montreal Global Biodiversity Framework (GBF). More importantly, the GBF refers to the need to reduce pollution risks and the negative impact of pollution from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem

functions and services, including reducing the overall risk from highly hazardous chemicals by at least half and by preventing, reducing, and working towards eliminating plastic pollution (Target 7).[63]

Concrete measures to tackle plastics pollution are undertaken through decisions adopted since COP-13 focusing on the marine environment, and downstream solutions targeting plastic waste, without any reference to chemicals in plastics. Parties are urged to develop and implement measures, policies and instruments to prevent the discard, disposal, loss or abandonment of any persistent, manufactured or processed solid material in the marine and coastal environment (Decision 13/10, para 8).

The adoption of EPR schemes is encouraged where there is damage or sufficient likelihood of damage to marine and coastal biodiversity and habitats caused by marine debris (Decision 13/10, para 7). Moreover, Parties are urged to increase efforts to avoid, minimise, and mitigate the impacts of plastic pollution on marine and coastal biodiversity and habitats (Decision 14/10, para 1a).

The CBD indirectly addresses the final phase of the life cycle of plastics, namely **remediation** post emission. The CBD provides a general obligation to rehabilitate and restore degraded ecosystems (Art. 8, para f). Decision 14/10 (para 4) emphasises the need for the clean-up and removal of marine debris, where appropriate and practical, and emphasises the urgency of such efforts where marine debris poses a threat to sensitive marine and coastal biodiversity and habitats. The Convention uses SDG indicator 14.1.1 on Floating Plastic debris Density (Decision 13/28, Annex). Following an invitation from the COP (Decision 14/30, para 39), the UN General Assembly adopted Resolution 73/284 proclaiming 2021–2030 as the Decade on Ecosystem Restoration. The initiative does not refer directly to plastics, but the removal of contaminants, pollutants, and other threats–referred to as remediation–is one of its four main work areas.

The CBD also invites **reporting** by Parties on the impacts of marine debris on marine and coastal biodiversity and habitats (Decision 13/10).

Opportunities for strengthening global governance of plastic pollution and biodiversity loss

The global legal framework could be strengthened to elaborate on the duty established by the CBD to rehabilitate and restore degraded ecosystems by including an obligation for the removal of legacy plastics in all environmental compartments, where appropriate, practical, and safe for the environment.

The CBD Ocean Health Index incorporates data on coastal chemical pollution and global marine plastic pollution (Decision 13/28, Annex) that could serve as a basis for global targets related to plastics.

2.3.3. UNFCCC, Kyoto Protocol and Paris Agreement

The UNFCCC, Kyoto Protocol and Paris Agreement apply indirectly to the reduction of GHG emissions across the life cycle of plastics. GHGs are known to be emitted at all phases of the life cycle of plastics: in particular, extraction and production, which are carbon-intensive activities. Without disruptive change, GHG emissions from fossil production of chemicals and plastics will double by 2050 (Zibunas et al., 2022). However, no obligation is established for the disaggregation of data related to emissions from the plastics life cycle.

The Kyoto Protocol requires Parties to implement measures that encourage appropriate reforms in relevant sectors. This is aimed at limiting or reducing emissions of GHGs not controlled by the Montreal Protocol, including by the transport sector (Art. 2.a.vi, vii). The Paris Agreement requires Parties to regularly provide a national inventory report of anthropogenic emissions by sources, as well as

63 Kunming-Montreal Global biodiversity framework. Draft decision submitted by the President (CBD/COP/15/L.25). Available at: https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf

information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4 (Art. 13, para 7). National determined contributions (NDCs) shall also be communicated every 5 years (Art. 4, para 9), representing a progression on the previously reported NDC (Art. 4, para 3).

Opportunities for strengthening global governance of plastic pollution and climate change

It will be important to define the role of UNFCCC and Paris Agreement vis-à-vis the prevention of plastic pollution and its role in mitigating GHG emissions. Strengthening measures to prevent plastic pollution across the life cycle of plastics can function as an important ally in the fight against climate change, yet a new plastics instrument may not be best positioned to address GHG emissions associated with the oil and gas industry (EIA, 2022). It may be practical to consider that emissions generated by the energy and fossil feedstock consumption to generate plastics are addressed under the UNFCCC, where applicable to plastics and associated chemicals, whereas the global governance of plastics could focus on minimising emissions directly related to plastics as materials, products and waste.

It needs to be ensured that negative externalities related to climate change are effectively covered, and global governance gaps do not remain. Countries need to have the necessary tools to address GHG emissions early in the life cycle of plastics, including by eliminating fossil-fuel subsidies. Moreover, it is important to ensure that transitioning to biomass-based hydrocarbons for production of plastics does not repeat the same challenges as the production of first-generation biofuels that led to industrial-level deforestation and that could compete with food staples for the population. The development of necessary safeguards for extractive activities could be incorporated in the sustainability criteria for plastics and associated chemicals (see section 4.1). Also, the possible removal of legacy plastics from existing landfills and diversion from future landfilling is closely linked to achieving climate goals under the UNFCCC and Paris Agreement, given it helps to mitigate landfill fires and methane leaks. For instance, landfill mining could provide an opportunity to prevent remediation costs and recover valuable resources.

Data on greenhouse gas emissions across the life cycle of plastics could be disaggregated from mandatory inventories for greenhouse gas emissions and removals under the UNFCCC and Paris Agreement. To close gaps in data and improve global understanding of the contribution of GHG emissions from the plastics life cycle, there is a need for closer cooperation with the UNFCCC and Paris Agreement to develop and refine definitions, indicators and modelling methodologies for the collection of such data, building on the existing greenhouse gas inventories. As for the Paris Agreement, national targets could be communicated through national action plans with periodic updates that present a progression on the previous targets.

2.4. Opportunities to address the plastics life cycle

This section discusses opportunities to close global governance gaps in plastics and associated chemicals, beyond those listed above that are relevant to each multilateral instrument.

There is a need to better understand and address the harmful impact of plastics on human health, human rights and the environment during the full life cycle of plastics at the global level, with the aim of reducing the use of natural resources (renewable and non-renewable), establishing safe and non-toxic circularity of materials in the economy, and protecting human health and the environment from emissions across the life cycle and value chain. Setting global indicators in this regard could assist in determining harmonised methods for collecting data, and reporting on trends towards global goals and targets to end plastic pollution.

Opportunities relevant to each of the four primary life cycle phases are discussed below.

2.4.1. Sourcing/extraction phase

The **extraction of hydrocarbons** to produce plastics and associated chemicals is not regulated by existing multilateral instruments. Petrochemical feedstocks used for the production of plastics account for 10.5% of global oil demand, which is equivalent to 10 million barrels per day (mb/d) (IEA, 2022).[64] The global annual production of plastics is projected to double by 2040, thereby serving as a main driver for future petrochemical feedstock demand (Lau et al., 2020; IEA, 2022). These figures demonstrate that the linear use of hydrocarbons, with its associated impacts on the environment and human health, is not sustainable particularly from a climate standpoint.

Targets could be considered to reduce extraction of fossil raw materials (e.g., oil, gas and coal) used to produce plastic, including the generation of electricity to power facilities and fuel transportation. Feedstocks for plastic production can also be sourced from bio-based matter. To promote the use of residuals from agriculture and forestry, food waste, wastewater sludge, etc., targets may be possible to cap land coverage of crops dedicated for use as plastics feedstock to protect food-producing cropland. Further knowledge of the use of agricultural crops and their residues for plastics production would be needed to balance this source against the need for animal feed and other uses of the same by-products.

SDG **targets and indicators** for GHG emissions apply broadly to this life cycle phase, with none that are specific to the feedstocks of plastics. However, working towards achieving sustainable consumption and production practices for plastics as per SDG12 would contribute to reducing emissions related to the plastics life cycle. Such emissions could be considered for tracking, including tracking progress towards safe circularity for plastics.

Moving forward, decoupling production of plastics and associated chemicals from use of fossil resources is key. There is a need to positively influence implementation of systems for reduction, reuse, repair, remanufacture and recycling, and supply will then change accordingly. To this end, reduction in the use of fossil-based raw materials for use in plastics can be partially achieved through effective implementation of control measures in the chemical, material and dematerialisation phases. This will facilitate a safe and sustainable circular economy, including through recycled content standards and a shift from incentives for virgin plastic to incentives for recycled plastic. More ambitiously, a global cap on virgin plastic production can be considered to close the gap but must apply to all types of virgin feedstocks (oil, gas, bio-based). Controls could also be considered for chemicals used in extractive processes as well as the generation of bio-based feedstocks.

Traceability of plastic products is limited across the life cycle and does not extend to the extraction phase. To this end, consumers and retailers are not aware of the environmental and societal impacts of the sourcing/extraction phase. The importance of traceability arises also for the use of non-residual biomass-based sources increases in terms of ensuring that production does not threaten biodiversity or compete with food production. Independent third-party certification schemes may provide a partial solution, learning from the outcomes achieved, for instance, through the Forest Stewardship Council (FSC) certification that aims to ensure products are sourced from responsibly managed forests. Moreover, due diligence schemes may allow for extending traceability to the extraction phase, but also recovery and final disposal operations. A model is provided by the European Union Timber Regulation (EUTR) of 2010 that requires traders who place timber products on the EU market to exercise due diligence, namely, to ensure that the timber is sustainably harvested.

64 The World Energy Outlook 2022 estimates that the chemical sector accounts for around 15% of global oil demand (IEA, 2022). The chemical sector was the only sector in which oil use increased in 2020, and it is set to account for a rising share of oil use in each scenario analysed by the report. Around 70% (10 mb/d) of oil used as a petrochemical feedstock is currently used to produce plastics. Similarly, an earlier estimate shows that petrochemicals accounts for 8% of primary demand for gas that is predominantly used to produce plastics (IEA, 2018).

Possible high-level indicators suitable for follow-up of the sourcing/extraction phase includes:

- Share of sustainably sourced raw materials for production of plastics.
- The production of plastics and associated chemicals decoupled from use of fossil resources.

2.4.2. Chemicals phase

The chemicals conventions begin to address certain chemicals used in plastics from the chemical phase starting from their production.[65] The use of mitigation **targets and time schedules** for controlled substances is limited to the Montreal Protocol and the Minamata Convention. The successful phase-out of ODSs is often credited to the use of such targets. However, the introduction of similar targets may not be directly applicable to the plethora of chemicals and polymers of concern in plastics–unless a grouping of chemicals approach is adopted (See section 4.2).

The control measures included in the chemicals conventions form key obligations in the chemicals phase. However, the chemicals conventions were not designed to specifically address **chemicals of concern** in plastics in a holistic manner and do not take into account the number of chemicals of concern used in commerce, and the need for a life cycle perspective. The Rotterdam Convention functions as a mechanism for information exchange in exports and imports of listed chemicals. Moreover, each Party is required to provide information to the Secretariat on the chemicals it has banned or severely restricted, which is compiled and disseminated to all Parties to the Convention. While the Stockholm Convention provides a mechanism to prohibit and restrict chemicals of concern in plastics, as its name implies, its strict focus on POPs may not lend itself well to address plastics more broadly.

An important governance gap relates to **polymers of concern** that remain unaddressed by existing multilateral instruments. National/regional policies may provide helpful guidance, such as K-REACH that requires registration of polymers unless they meet criteria for polymers of low concern (ChemSafetyPRO, 2022). Steps have also been taken to introduce similar requirements for polymers under EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation. The Minderoo-Monaco Commission encourages regulating some plastic polymers, suggesting that one possible avenue could be to use existing mechanisms such as the Stockholm Convention, as certain plastic polymers meet many of the criteria for listing POPs, including persistence (P), adverse effects (T), and long-range environmental transport potential (LRTP) (Landrigan et al. 2023). While microplastic and nano plastic particles that are smaller than 10µm may have the potential for bioaccumulation (B), it cannot yet be reliably measured. Currently, the industry is working through the New Plastic Economy Global Commitment on voluntary elimination of select problematic polymers with high production volumes, namely expanded polystyrene (PS), polyvinyl chloride (PVC), expanded polystyrene (EPS), and polyvinylidene dichloride (PVDC) that may also help guide efforts at the global level (EMF, 2021). Similarly, the **production of monomers** is not restricted by any global instrument.

In future, more recognition needs to be given to the fact that safe and **sustainable design** of plastic products begins in the chemical phase. To this end, chemical design is centrally featured in the proposal to develop international sustainability criteria for plastics and associated chemicals (see section 4.1). Moreover, it may be necessary to directly control chemicals and polymers of concern with different approaches presented in section 4.2.2. Table 14 presents an overview of possible factors that can be considered in the sustainability criteria for plastics and associated chemicals.

65 An exception to this is the Minamata Convention, which addresses extraction of mercury through the phasing out of primary mining.

Trade restrictions apply to chemicals listed under the Stockholm Convention and Montreal Protocol. The control of trade under the Montreal Protocol includes mandatory requirement to establish and implement a system for licensing the import and export of controlled substances (Art. 4B, para 3), which may provide useful guidance for strengthening the global governance of plastics.

Both the Stockholm Convention and Montreal Protocol include quantitative **reporting** obligations on the production, export and import of listed substances. This enables to track control measures for prohibiting and restricting the use of chemicals under these conventions.

Requirement for countries to develop and update **NAPs** is confined to the Stockholm Convention.

Transparency and information exchange in the chemicals phase is centred around efforts to reduce the production, use and release of restricted chemicals and the identification of alternatives, as well as the safety of workers and their (risk of) exposure to harmful substances (as per ILO Convention 170). This could be strengthened at the global level, ideally aiming to close the knowledge gaps in providing publicly accessible information on identities, occurrence and hazard traits of chemicals and polymers of concern used in plastics to enable their safe management (see section 4.3.2). In this context, it will be important to also consider how to promote hazard and risk assessment of chemicals associated with plastics, including sharing of such data. Risk reduction is articulated as a voluntary measure under SAICM, but the independent evaluation of SAICM raised concern of insufficient capacity to conduct hazard and risk assessment in many middle- and low-income countries. This may partly explain why there are 6,000 chemicals used in plastics which could be potentially hazardous (Aurisano et al, 2021; Wiesinger et al., 2021; UNEP, 2022). It is possible for industry to conduct risk assessments in a regulated and transparent manner and share results across countries, taking into consideration that chemical properties may remain constant across jurisdictions, but exposure will vary (see section 4.3.2).

Possible high-level indicators suitable for follow-up of the chemical phase includes:

- Production volumes of plastics and associated chemicals, including chemicals of concern.
- Share of marketed chemicals with safety data sheets and appropriate labels made available.
- Share of chemicals used in plastics with hazard data.
- Information on plastic composition, chemical content and environmental and health hazards posed by chemicals of concern in plastics is available.
- Percentage of products and production processes sustainably replaced.

2.4.3. Material phase

The current suite of international instruments provides limited measures specific to the governance of the manufacturing and consumption of plastics in the material phase.

The **control measures** do not address **emissions** of pellets, powders and flakes. Moreover, intentionally added microplastics are also not regulated at the global level. This includes microbeads and plastic-coated slow-release fertilizers. Ongoing national and regional efforts may help guide global efforts in this regard, such as the draft Commission regulation aiming to amend EU REACH legislation to restrict the placing on the market of microplastics, which is expected to prevent the release of 500,000 tonnes of microplastics over 20 years (European Commission, 2022a).

Sustainable **design** of plastic products is not addressed in the global governance landscape for plastics. However, the UNEA resolutions provide aspirational language on design, but the absence of tools for its operationalisation and a mechanism for follow-up hampers progress in this regard. Moreover, SAICM has recognised emerging policy issues/other issues of concern that emphasise the role of design that are of

relevance to plastics, although this is only inferred, and action is expected to occur on a voluntary basis: hazardous substances within the life cycle of electrical and electronic products (HSLEEP), chemicals in products (CiP) and PFCs, and the transition to safer alternatives. The design of plastic products begins in the chemical phase and design criteria must therefore address the chemical component of materials and products, building on the example of the CiP programme developed under SAICM that encourages the development and implementation of tools and methods for the assessment and management of chemicals in products throughout their life cycle.

The **trade of plastic products** is not regulated at the global level, weakening the control of products traded internationally.

The consumption phase could include measures to promote formal[66] **reuse, repair** and **remanufacture** systems. Such systems will require appropriate collection systems to be developed in the waste management phase, or economic incentives for the return of products, such as a deposit scheme and other types of EPR schemes.

Reporting, national monitoring programmes, national inventories and national action plans are essential for improved information gathering in both the manufacture and consumption phases, as well as for transparency and information sharing, particularly on plastic products.

Transparency and information sharing of chemicals in plastic products is limited only to isolated examples in binding multilateral frameworks, such as the obligation under the Stockholm Convention to label new building insulation plastics containing HBCD. Also, the Chemicals Convention C-170 sets obligations to ensure transparency of chemical hazards in the workplace with labelling and other means. However, transparency is most prominently featured in SAICM, which highlights the need to make information on chemicals available across the life cycle, although on a voluntary basis (OPS, paras 15 b-c). The CiP programme developed under SAICM aims to extend chemical transparency to products, to help complement the Global Harmonized System of Classification and Labelling of Chemicals (GHS). However, weak enforcement due the lack of globally agreed obligations to ensure the availability and accessibility of information on chemicals of concern in plastics throughout the product life cycle leads to continued contamination of the supply chain (Johansen et al., 2022; Speranskaya et al., 2022). Developing a set of harmonised transparency requirements for plastics would be an important step forward, as elaborated in section 4.1.

For **sea-based sources** of plastic pollution, MARPOL Annex V bans the discharge of operational waste, while the London Convention and Protocol regulate the intentional dumping of wastes. The loss of shipping containers during transport is not within the scope of these instruments unless it can be shown to fall under "other noxious or hazardous matter transported by vessels for purposes other than dumping" as per Article XII of the London Convention. For such circumstances, Contracting Parties shall pledge to promote measures to protect the marine environment from pollution caused by such matter, including with relevant agencies and bodies. The IMO *Action Plan to address marine plastic litter from ships*[67] includes an action to consider the establishment of a compulsory system of formatted declarations for the loss of containers and the means on board to easily identify the exact number of losses, as well as establishing an obligation to report the loss of containers. The Sub-Committee on Carriage of Cargoes and Containers (CCC) of IMO has agreed draft amendments to SOLAS and MARPOL with respect to mandatory reporting of lost/observed freight container(s), which are expected to be finally adopted by MSC 107 and MEPC 80 in 2023.

66 Many of the current reuse, repair and remanufacture activities are conducted by end-users and not formally initiated by the manufacturer.

67 Resolution MEPC.310(73), Action 10.

Possible high-level indicators suitable for follow-up of the material phase include:

- Share of marketed plastic materials and products that meet performance criteria developed at the global level.
- Share of marketed plastics materials and products that meet transparency criteria developed at the global level.
- Information regarding the chemical content of plastic products and potential health hazards is available to consumers and retailers.

2.4.4. Dematerialisation Phase

The dematerialisation phase is the most comprehensively governed phase of the plastics life cycle, yet gaps remain. **Goals, targets** and **indicators** with relevance to some aspects of waste management, final disposal or recovery operations and remediation exist under the SDG framework, the CBD, the Basel Convention and the Stockholm Convention. However, these indicators are limited in scope.

The Basel Convention calls for minimising the generation of wastes (hazardous and others), the provision of adequate disposal facilities and reducing the need to export wastes (including e-waste), thereby promoting the environmentally sound management of wastes within the country of generation and embodying the proximity principle. **Transparency in trade** of plastic waste is promoted through PIC procedures, covering 2 of the 3 listed categories of plastic wastes. Similar measures have been adopted for e-waste. Parties have adopted an ESM toolkit, which includes, amongst others, guidance on addressing ESM in the informal sector, self-assessing national ESM capacity, and options for extended producer responsibility (EPR) and financing, as well as other private sector incentives.[68] It should be noted that the Basel Convention has no financial mechanism for the implementation of environmentally sound waste management.

The updated (draft) Technical guidelines on the **environmentally sound management of plastic wastes**[69] developed under the Basel Convention promote design as the first step in preventing waste. They provide guidance on a) waste prevention and minimisation, b) identification of plastic wastes sources, c) identification of hazardous and non-hazardous plastic wastes (including by resin type), d) contaminants other than those covered by the Convention's Annex I constituents, e) developing national inventories, f) establishing monitoring programmes, g) handling, separation, collection, packaging, compaction, transportation and storage, and h) environmentally sound disposal and operations that lead to the valorisation of the waste as well as its elimination.

The Stockholm Convention provides guidance for the development of POP **inventories**, as well as for developing, reviewing and updating national implementation plans (including lessons learned and best practices).[70] When implementing Article 6 of the Stockholm Convention on measures to reduce or eliminate **releases from stockpiles and wastes**, Parties to the Convention are invited to take into account the General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants, developed under the Basel Convention.[71] These guidelines follow a similar format to the guidelines on ESM of

68 http://www.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/ESMToolkit/Overview/tabid/5839/Default.aspx

69 http://www.basel.int/Implementation/Plasticwaste/Technicalguidelines/Draftoftechnicalguidelines(versionJun2021)/tabid/8881/Default.aspx. See also draft Technical guidelines on the environmentally sound management of plastic wastes (UNEP/CHW.15/6/Add.7) available at: http://www.brsmeas.org/20212022COPs/MeetingDocuments/tabid/8810

70 http://chm.pops.int/Implementation/Publications/GuidanceManuals/tabid/3071/Default.aspx

71 http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/TechnicalGuidelines/tabid/8025/Default.aspx

plastic wastes, and include **remediation** of contaminated sites, high- and low-risk situations, as well as emergency response.

Similar to the arrangement under the Stockholm Convention, Parties to the Minamata Convention are to use the Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds, developed under the Basel Convention.[72] The Minamata Convention also provides Guidance on best available techniques and best environmental practices, aimed at assisting Parties in meeting their obligations under Article 8 regarding emissions,[73] and the guidance on management of contaminated sites.[74]

The London Protocol provides examples that may be appropriate for strengthening the global governance of plastics, particularly in the dematerialisation phase. The Protocol promotes a **hierarchy of waste management options**, and applications to dump wastes or other matter are required to demonstrate that this hierarchy has been considered, namely: 1) re-use, 2) off-site recycling, 3) destruction of hazardous constituents, 4) treatment to reduce or remove the hazardous constituents, and 5) disposal on land, into air and in water (in Annex 2, para 5). In addition, a permit to dump wastes or other matter shall be refused if appropriate opportunities exist for re-use, recycling or treating the waste without undue risks to human health or the environment or disproportionate costs (Annex 2, para 6).

Should any wastes be considered for dumping, a permit shall comply with Annex 2 provisions (Art. 4.1.2). Annex 2 includes a **waste prevention audit** as a first step to assessing alternatives before permitting the dumping. This includes an evaluation of 1) the details of the production process and the sources of wastes within that process, and 2) the feasibility of waste reduction/prevention techniques of:

- product reformulation,
- clean production technologies,
- process modification,
- input substitution, and
- on-site closed-loop recycling.

As per Annex 2 of the London Protocol, if the audit reveals that opportunities exist for waste prevention at source, the permit applicant shall formulate and implement a waste prevention strategy which includes specific **waste reduction targets**, with further audits to ensure these targets are met. For dredged material and sewage sludge, Annex 2 also sets a goal for waste management to identify and control sources of contamination, which would include microplastics from point and non-point sources.

In the realm of efforts to end plastic pollution, consideration could be given to promoting **incineration as the least preferable option** as per the hierarchy of actions to achieve circularity of plastics, as it will generate large volumes of hazardous bottom ash and always lead to GHG emissions, even in optimal conditions when energy can be recovered and UPOPs avoided. In addition, the export of plastic waste as refuse-derived fuel could be discouraged.

Action on the ground regarding **remediation** of plastic emissions appears to be sporadic, or at least not tracked at the global level beyond the efforts of the International Coastal Cleanup. Thus, there is no overview of actors in this field or of concrete results achieved. Given the absence of mandatory obligations for remediation, this should be promoted at the global level, where such actions are

72 http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/TechnicalGuidelines/tabid/8025/Default.aspx

73 https://www.mercuryconvention.org/sites/default/files/documents/forms_and_guidance_document/BAT_BEP_E_interractif.pdf

74 https://www.mercuryconvention.org/sites/default/files/documents/forms_and_guidance_document/Guidance_Contaminated_Sites_EN.pdf

appropriate, practical and safe for the environment. Citizen science can provide a valuable means to increase collaboration between volunteers and scientists in efforts to expand and increase clean-up activities. However, it is necessary to recognise the limitations of remediation, and that it is the least cost-effective solution, in contrast to preventing leakage from occurring in the first place and designing plastics to be reused and recycled.

The duty to **report** on the impacts of plastic pollution in all environmental compartments from chemicals used in plastics and plastic products (expanding on the duty established by the CBD) could be linked to a global monitoring programme, as well as indicators. This would assist in closing the current data gaps and hesitancy to release information.

Reporting on non-compliance is provided in the London Convention, offering considerations for the scope of a more comprehensive reporting mechanism for the dematerialisation phase. This could include reporting on the actions taken to avoid contamination of plastics waste streams, as well as remediation.

Possible high-level indicators suitable for follow-up of the dematerialisation phase includes:

- Reduction of plastic residual wastes generated.
- Volume and share of plastics waste that is sorted, collected and recycled.
- Marine, terrestrial and freshwater ecosystems remediated from plastic litter.
- Investment to train and appropriately equip waste pickers and informal recyclers to ensure safe and healthy work conditions.

Philippines, Luzon, Baguio city – men but mostly women are working among the garbage in landfill. They look for recyclable items which they get from the waste. The recycling stuff they sell to traders in the recycling industry. These people living in extreme poverty, get income and existence from the dirt of others. The air is blue with smoke because the waste mountain, available day and night, is on fire. Unhealthy work circumstances, the smell is enormous and swarming with flies. Photo © Sjors737. Dreamstime.com

3 OPPORTUNITIES TO STRENGTHEN GOVERNANCE OF PLASTICS BASED ON GLOBALLY AGREED PRINCIPLES AND APPROACHES

Studies show that vast areas of agricultural land have been contaminated by the unintentional application of microplastics in sewage sludge used as a soil improver. Photo © Luchschen. Dreamstime.com

3. Opportunities to strengthen governance of plastics based on globally agreed principles and approaches

Addressing the full life cycle of plastics could complement existing multilateral instruments. Importantly, the gaps between the current suite of global instruments must be closed, while allowing for future innovation of plastics, as well as associated processes and alternatives that fall within its scope. A mechanism to update and "future-proof" a strengthened global governance framework will be necessary (see section 4 for possible options in this regard).

UNEA Res. 5/14 underlined the importance of retaining products and materials in the economy for as long as possible through design that enables reuse, remanufacture or recycling. The intended outcomes are improved resource efficiency and minimised waste generation. UNEA Res. 5/14 was adopted alongside other resolutions that complement the global governance of chemicals and plastics. Relevant paragraphs of these resolutions are subsequently discussed.

This section closely follows the requests of UNEA Res. 5/14, paras 3–4. It incorporates text in previous and related UNEA resolutions where they relate to priorities outlined in Res. 5/14. This highlights the priorities and text previously adopted by Member States that may support the development of global measures in response to paragraphs 3 and 4 of UNEA Res. 5/14. Where no relevant text could be found in the UNEA resolutions, additional opportunities are presented for consideration, based on the findings of the mapping presented in Section 2.

3.1. Objectives and scope of the plastics instrument

> In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to specify the objectives of the instrument"* (UNEA Res. 5/14, para 3a)

A broad overarching ambition is implied in the title of UNEA Res. 5/14 to "end plastic pollution." The resolution reaffirms the importance of preventing risks to human health, and the adverse effects on human well-being and the environment related to plastic pollution (preamble) through complementarity with existing multilateral instruments. The sustainable consumption and production of plastics and associated chemicals aims to address resource efficiency and pollution across the full life cycle of plastics from extraction to recovery and final disposal operations. Thus, protecting human health and the environment through sustainable production, consumption and waste management practices are important considerations.

In working towards the ambition of ending plastic pollution, global control measures could address the proposed scope of plastic pollution through:

- Global elimination of **chemicals and polymers of concern** across the life cycle of plastics.
- Global elimination of **problematic and avoidable plastics**.
- Global elimination of leakage/discharge of **macroplastics** and global reduction of emissions and releases of **microplastics and nanoplastics**, as well as chemicals of concern across the life cycle of plastics.

Other examples of possible control measures include:

- Global reduction in the use of virgin feedstocks (e.g., oil, gas, plant).
- Global reduction in the use of chemicals across the life cycle of plastics.
- Global reduction in the generation of residual wastes across the life cycle of plastics and the environmentally sound management thereof (including remediation).
- Global reduction in environmental stocks of plastics and associated chemicals from environmentally unsound waste management and legacy residual wastes.
- Sustainable product design, material flows (including trade) and waste management.

It will be important to clearly define the different categories for control measures. A key mechanism to effective implementation of the control measures could be the development of criteria against which plastic materials and products could be certified or measured to assess their full potential in delivering on the desired reduction and elimination goals (see section 4.1 on the role of sustainability criteria for plastics and associated chemicals).

3.2. Obligations, measures and voluntary approaches across the full life cycle

The INC is to consider the following: *"obligations, measures and voluntary approaches in supporting the achievement of the objectives of the instrument"* (UNEA Res. 5/14, para 4a)

It will be important to determine the vision and expected outcomes to help determine the obligations, measures, and voluntary approaches to fulfil the goal of ending plastic pollution. In determining obligations, it will be important to consider the full life cycle of plastics considering existing governance gaps. The following outcomes may provide guidance to this end:

- Safe and non-toxic circularity of plastics achieved, including leakage/discharge of plastics ended.
- Elimination of problematic and avoidable plastics achieved.
- Safety of consumers, workers and surrounding communities secured.
- Co-benefits with other environmental goals generated, including climate and biodiversity.

More specifically, the Ministerial Declaration adopted by UNEA-4 encourages countries to address the damage to our ecosystems caused by the unsustainable use and disposal of plastic products, including by significantly reducing the manufacturing and use of single-use plastic products by 2030. It is therefore important to adopt a holistic approach to broaden and deepen current action, and more specifically, target the root causes upstream to bring positive outcomes for the environment and human health/well-being.

3.2.1. Product and material design

"Underlining the importance of promoting sustainable design of products and materials so that they can be reused, remanufactured or recycled and therefore retained in the economy for as long as possible, along with the resources they are made of, and of minimising the generation of waste, which can significantly contribute to sustainable production and consumption of plastics" (UNEA Res. 5/14, preamble)

The following UNEA resolutions provide previously adopted text as a starting point and possible guidance for articulating measures for product and material design:

UNEA Res. 4/1[75] acknowledges that products and materials should be designed in such a way that they can be reused, remanufactured recycled or recovered and thus **maintained in the economy** for as long as possible, along with the resources from which they are made, and the generation of waste, especially hazardous waste, is avoided or minimised, and greenhouse gas emissions are prevented or reduced (preamble).

UNEA Res. 5/11[76] invites Member States to take measures, in cooperation with the private sector, to enhance the design of products, taking into account **life cycle assessments**, to favour product lifetime extension, repair, re-use and easier recycling in the context of a circular economy, to contribute to resource efficiency (para 2).

Sustainable design that addresses the life cycle of plastics is supported by UNEA Res. 4/6, which promotes collaboration with the private sector to foster innovation in product design, to **reduce secondary microplastic releases** from land- and sea-based sources (para 4b).

UNEA Res. 4/7 invites Member States to set **standards for food-grade plastics** to minimise the risk of toxins getting into food (para 1l). In addition, UNEA Res. 4/8 highlights the importance of minimising and preventing the use of hazardous substances in material cycles, and managing chemicals in products throughout their life cycle, from design to waste, in order to adapt production and consumption models to achieve sustainable consumption and production (para 3).

UNEA Res. 4/9 encourages Governments and the private sector to promote more resource-efficient design, production, use and sound management of plastics across their life cycle (para 5).

The **sustainable design** of plastic materials and products begins in the chemical phase and is not addressed in the current suite of global instruments. This study outlines options for developing international sustainability criteria for plastics and associated chemicals. A binding commitment for Parties to integrate these criteria in national legal and policy frameworks within their local context could be established.

Section 4 discusses the possible role of sustainability criteria for plastics and associated chemicals as an option towards addressing the design of plastics and achieve outcomes across the full life cycle of plastics, including extraction (section 4.1.2). In addition, section 4.1.3 provides options for consideration to operationalise such sustainability criteria both at the global and at the national level.

See section 3.3.4 on discussion of the role of the scientific and socio-economic assessments in supporting design.

3.2.2. Prevention, reduction, and elimination

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to promote national action plans to work towards the prevention, reduction and elimination of plastic pollution, and to support regional and international cooperation"* (UNEA Res. 5/14, para 3e)

75 UNEA Res. 4/1. Innovative pathways to achieve sustainable consumption and production.

76 UNEA Res. 5/11. Enhancing circular economy as a contribution to achieving sustainable consumption and production.

To strengthen the global governance of plastics and associated chemicals, emphasis needs to be on addressing prevention, reduction and/or elimination, by recognising these are the first steps in the waste management hierarchy. A number of UNEA resolutions provide previously adopted text as a starting point and possible guidance for articulating measures to realise this.

UNEA Res. 4/7 invites Member States to promote integrated approaches to solid waste management through sustainable consumption and production. These include a circular economy and other sustainable economic models, and other innovative means such as the **removal of hazardous substances from waste before recycling**, special attention to **preparing waste for reuse and recycling**, a reduction in landfill use, and the application of the "waste hierarchy" set of priorities for all waste (para 1a).

The approaches of **reuse**, **remanufacture** and **recycling** are also promoted in **UNEA Res. 5/14** (preamble). Prevention of pollution by plastics and associated chemicals can be achieved through these approaches and can be preceded in the hierarchy by the right to repair. These approaches require related infrastructure for collection and sorting to ensure the product is returned to the intended scheme.

UNEA Res. 3/7 encourages Member States to develop integrated and source-to-sea approaches to combat marine litter and microplastics from all sources, considering that plastic litter and microplastics are transported to the oceans from land-based sources by rivers and run-off or wind from land. It also highlights the fact that plastic litter is an important source of microplastics and includes the land/sea and freshwater/sea interface in action plans for **preventing** marine litter, including microplastics (para 4e). In addition, Member States are encouraged to step up measures to **prevent** marine litter and the discharge of microplastics from sea-based sources, such as fisheries, aquaculture, off-shore installations and shipping, including through the promotion of accessibility and use of port reception facilities (para 4f). The resolution encourages measures to **prevent** marine litter and discharge of microplastics, particularly from land-based sources, in plans to prevent and reduce damage from natural disasters and severe weather events (para 4g).

UNEA Res. 4/6 promotes collaboration with the private sector to prevent losses of primary microplastics, in particular pre-production pellets (flakes and powders), to prevent spillage into the environment across the whole manufacturing and supply chain (para 4c). Operation Clean Sweep[77] is a voluntary industry-led initiative that could be made mandatory for all manufacturers globally. The plastics instrument could provide a target of **elimination** for this point source of emissions, mandating all Member States to implement mandatory measures in line with Operation Clean Sweep at a minimum.

Intentionally added (primary) microplastics are a source of pollution that can be considered "avoidable" and targeted for **elimination** (UNEA Res. 4/6, para 4a; UNEA Res. 4/7, para 1n). The inclusion of microbeads in cosmetics has been banned in some countries, with voluntary industry phase-outs agreed in others. There is a need to prohibit diffuse source of emissions, thereby also preventing contamination of sewage sludge used as fertilizer (an unintended application of microplastics to agricultural soils).

To address the trade within the global life cycle of plastics, global sustainability criteria for plastics and associated chemicals could be adopted within domestic standards and legislation. These criteria can then be elaborated as needed in national legislation and applied to imported products, as well as products manufactured locally for domestic markets and for export. The latter would assist countries that have no/little manufacturing, and therefore, no ability to influence the design of products placed on their markets other than regulating their import. By including the obligation to apply sustainability criteria for plastics and associated chemicals to exported products, these design criteria can also be applied to international online sales.

77 See https://www.opcleansweep.org, https://www.opcleansweep.eu, https://www.opcleansweep.org.au as examples.

3.2.3. National action plans for the prevention, reduction and elimination of plastic pollution, including measures and targets

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to develop, implement and update national action plans reflecting country-driven approaches to contribute to the objectives of the instrument"* and "*to promote national action plans to work towards the prevention, reduction and elimination of plastic pollution, and to support regional and international cooperation"* (UNEA Res. 5/14, paras 3d-e)

The development of national action plans could be a binding commitment for all countries. These action plans could aim to stimulate national implementation of the control measures agreed at the national level, and towards achieving the global goals within specified timeframes.

Possible guidance on the elements to be included in national action plans is provided by the text included in a number of UNEA resolutions.

UNEA Res. 3/7 (para 4c) encourages all Member States to develop and implement action plans for

- encouraging resource efficiency (upstream),
- re-design and re-use of products and materials (upstream),
- avoiding the unnecessary use of plastic and plastic containing chemicals of particular concern where appropriate (midstream),
- increasing collection and recycling rates of plastic waste (downstream), and
- preventing marine litter and the discharge of microplastics (downstream).

UNEA Res. 2/11[78] recognises the work of the FAO, and regional fisheries bodies and management organisations to mitigate and clean up abandoned, lost or discarded fishing gear, and encourages Member States and Governments at all levels to include such measures in national and regional action plans to combat marine litter (para 14).

UNEA Res. 5/11[79] invites Member States to integrate circular economy approaches into national and regional strategies and action plans, including those related to relevant multilateral environmental agreements, taking into account national circumstances and capacities (para 1). The resolution also promotes the achievement of sustainable consumption and production by inviting Member States to engage, as appropriate and in line with national circumstances and policies, with sub-national, national and regional entities to strengthen policies, legal and regulatory frameworks, such as those concerning:

- sustainable public procurement,
- technological innovation,
- extended producer responsibility,
- material life cycle and
- industrial symbiosis to support the uptake of circular economy approaches (para 5).

UNEA Res. 4/9 (para 1) encourages Member States to develop and implement national or regional actions to address the environmental impact of single-use plastic products.

78 Marine plastic litter and microplastics.

79 UNEA Res. 5/11. Enhancing circular economy as a contribution to achieving sustainable consumption and production.

In addition to the suggested elements, national action plans can elaborate strategies to operationalise sustainability criteria for plastics and associated chemicals to incentivise product design for reuse, repair, remanufacture and recycling. For further details, see Section 4 on the role of such sustainability criteria.

Where Parties have already developed action plans of relevance (e.g., for waste, plastic, circular economy, POPs, biodiversity, climate), it will be important that national action plans of relevance allow for comparability and consistency over time.

Comparability can be achieved through:

1) Agreeing a minimum set of elements for inclusion in national action plans.
2) Developing a reporting template for national action plans.
3) Agreeing on headline indicators against which progress can be tracked and reported (with agreed statistical calculations).

3.2.4. National reporting

> In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to specify national reporting, as appropriate"* (UNEA Res. 5/14, para 3f)

Definitions are important for harmonising data collection methods, as well as reporting, assisting Parties in providing comparable national reports. This can be further strengthened by establishing a statistical framework for calculating quantitative results. A solid foundation for such a framework can be found in the System of Environmental Economic Accounting (SEEA) Central Framework.[80] This is a well-established and advanced international statistical standard adopted by the United Nations.

A reporting scheme will help to collect information from countries and understand the collective performance of parties. The main components of national reporting for the plastics instrument could focus on:

1. Progress towards general commitments and targets, including implementation of international sustainability criteria for plastics and associated chemicals and national action plans.
2. Inventories of controlled material flows (extraction, production, consumption, disposal, and trade), as well as emissions, leakage and contamination (sources, pathways, and sinks).

Methods for collecting data required for reporting should also be established, including addressing the issues of ownership and transparency in data collection for 1) material flows, including trade, 2) waste generation and 3) health risks and impacts. This can be achieved through a working group post-adoption of the plastics instrument particularly where quantitative data is desired. Multilateral agreements established decades ago, such as the Basel Convention, did not develop such methodologies and suffer from incomparability when requesting country data on import/export of wastes.

For further discussion on monitoring, refer to section 3.3.2 on assessment of effectiveness.

80 https://seea.un.org/content/seea-central-framework

3.3. Assessment

3.3.1. Assessment of progress

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to periodically assess the progress of implementation of the instrument"* (UNEA Res. 5/14, para 3g)

The development of a periodic global assessment of progress should be considered to track collective progress against obligations and targets of the plastics instrument, and to reveal remaining action gaps. The following UNEA resolutions provide previously adopted text as a starting point and possible guidance for articulating measures for assessment of progress:

UNEA Res. 4/6[81] requested UNEP to gather information with a view to informing policies and action on environmentally sound technological innovations, options and measures for reducing the risk of discharges of litter, including plastic litter and microplastics into the marine environment, taking into account the whole life cycle of plastics, in support of local, national, regional and global action (para 2d).

UNEA Res. 4/6[82] requested of UNEP to recommend indicators to harmonise monitoring, reporting and assessment methodologies, taking into account key sources of marine litter, including plastic litter and microplastics, in cooperation with relevant international organisations (para 2c).

3.3.2. Assessment of effectiveness

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to periodically assess the effectiveness of the instrument in achieving its objectives"* (UNEA Res. 5/14, para 3h)

The following UNEA resolutions provide previously adopted text as a starting point and guidance for developing measures on effectiveness:

UNEA Res. 2/11 encourages "the establishment of harmonised international definitions and terminology concerning the size of, and compatible standards and methods for the monitoring and assessment of, marine plastic debris and microplastics, as well as the establishment of and cooperation on cost-effective monitoring, building as far as possible on ongoing related monitoring programmes and considering alternative automated and remote sensing technology where possible and relevant" (para 19).

UNEA Res. 3/7[83] encourages all Member States to cooperate to establish common definitions, harmonised standards, and methodologies for the measurement and monitoring of marine litter and microplastics (para 4b).

An effectiveness evaluation aggregates information on outcomes and impacts to help inform treaty design and review. The UNEA resolution paragraphs listed above reflect the need to monitor plastics in the environment. This, however, is only one method for evaluating the effectiveness of an instrument

81 Marine plastic litter and microplastics.

82 Marine plastic litter and microplastics.

83 Marine plastic litter and microplastics.

in achieving its objectives. There is a need to improve monitoring of policy and measures adopted at the global, regional and national levels. The following examples provide differing models for the development of an effectiveness evaluation:

- The **Effectiveness Evaluation of the Stockholm Convention** aims to assess how the convention has succeeded in achieving its objectives, and identify ways to improve effectiveness, drawing from national reports, monitoring information, national implementation plans, and non-compliance information (Art. 16).
- Similarly, the **Minamata Convention** requires the periodic evaluation of effectiveness of the Convention based on comparable monitoring data on the presence and movement of mercury and mercury compounds in the environment, biotic media and vulnerable populations; national reports and; information on financial assistance, technology transfer and capacity building arrangements (Art. 22). Reports from the Implementation and Compliance Committee are also to be used in the effectiveness evaluation of the Minamata Convention.
- The **Global Stocktake of the Paris Agreement** aims to assess collective efforts of parties every five years, based on information from various sources (Art. 14). The first global review sets the "minimum baseline" for global action and ambition that will need to be surpassed consecutively.
- The Montreal Protocol's **Implementation Committee** reviews the parties' compliance with their production and consumption obligations in accordance with the Protocol's Non-Compliance procedure under the Protocol.

3.3.3. Compliance

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to address compliance"* (UNEA Res. 5/14, para 3p)

Reporting is a key component of compliance. For reports from Parties to be comparable, it is important to provide clear definitions that are applied at the national level. Where appropriate, these could link to existing reporting structures under other fora. Consideration should also be given to options for addressing non-compliance, possibly in a facilitative manner.

3.3.4. Scientific and socio-economic aspects

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to provide scientific and socioeconomic assessments related to plastic pollution*" and consider *"the possibility of a mechanism to provide policy-relevant scientific and socioeconomic information and assessment related to plastic pollution"* (UNEA Res. 5/14, paras 3i and 4f) and to consider the following: "*the best available science, traditional knowledge, knowledge of indigenous peoples and local knowledge systems*" and *"lessons learned and best practices, including those from informal and cooperative settings"* (UNEA Res. 5/14, paras 4d-e)

The following UNEA resolutions provide previously adopted text as a starting point and guidance for scientific and socio-economic assessments:

UNEA Res. 4/8[84] calls on governments and all other stakeholders to address the importance of the **product, chemicals and waste interface** in relevant legislation and regulatory frameworks, where appropriate (para 12(c)).

84 UNEA Res. 4/8. Sound management of chemicals and waste.

UNEA Res. 5/8[85] decided on the establishment of a science-policy panel (SPP) to contribute further to the sound management of chemicals and waste and prevent pollution (para 1). The principal functions of the panel include undertaking "horizon scanning" to identify issues of relevance to policymakers (para 2a), conducting assessments of current issues (in particular those of relevance to developing countries) (para 2b), providing up-to-date and relevant information, identifying key gaps in scientific research, encouraging and supporting communication between scientists and policymakers (para 2c), and facilitating information-sharing with countries (para 2d). The resolution calls for avoiding overlap and duplication of work, and for promoting coordination and cooperation between the SPP and other bodies and instruments (para 5c).

Should a global governing body be established for plastics and associated chemicals, it will need advice on several scientific and technical matters relating to implementation and follow-up. An initial framework for the sustainability criteria for plastics and associated chemicals could be developed at the global level with the support of a possible **subsidiary scientific and technical body**. This body could develop guidelines to promote and guide implementation and provide technical assistance for integrating the criteria into national legislation and policies, including through bans and product stewardship schemes. It could be also commissioned to periodically review and update the sustainability criteria to ensure their timely operationalisation and ongoing relevance, providing a mechanism to "future-proof" a strengthened global governance framework.

Alternatively, sustainability criteria could be established through an **independent scientific body** guided by suitable terms of reference, such as the SPP that aims to support countries in their efforts to take action, including to implementing MEAs (UNEA Res. 5/8, preamble). The advantage of an independent body (SPP or another body) is that it could develop, maintain and implement certification schemes to verify claims by manufacturers in meeting the sustainability criteria. This is of particular importance for countries that do not have the capacity to verify manufacturer and retailer claims.

Lastly, there is a need to draw from industry expertise through a **separate existing technical body** to help develop the sustainability criteria**,** while ensuring that no conflict of interest arises. This body can also provide the link to existing voluntary industry initiatives at the global level, e.g., the Golden Design Rules of the Consumer Goods Forum.[86] These initiatives target reduction in plastic packaging based on nine voluntary and time-bound rules that businesses commit to achieving by 2025. The Global Commitment is an Ellen MacArthur Foundation initiative in which over 500 companies have committed to 2025 targets for plastic packaging, representing 20% of all plastic packaging produced globally. This may provide an avenue to engage this sector in further harmonising design goals with the sustainability criteria for plastics and associated chemicals, as well as reporting on implementation and accountability.[87]

A working group could be established to identify gaps in scientific and technical data needed to fulfil the objective and targets of the plastics instrument, including investigate possible linkages with the SPP (UNEA Res. 5/8). The working group could further engage with traditional knowledge, knowledge of Indigenous Peoples and local knowledge systems to meet requirements set by paras 4d-e of UNEA Res. 5/14. Possible topics could include:

85 UNEA Res. 5/8. Science-policy panel to contribute further to the sound management of chemicals and waste and to prevent pollution.

86 The Golden Design Rules for Plastic Packaging were developed by The Consumer Goods Forum's Plastic Waste Coalition of Action. They outline specific design changes aligned with globally recognised technical guidelines and targets laid out in the Ellen MacArthur Foundation's New Plastics Economy Global Commitment. In Canada, the implementation of the Golden Design Rules is being led by the Canada Plastics Pact, which is part of the Ellen MacArthur Foundation's Global Plastics Pact Network. See https://www.theconsumergoodsforum.com/wp-content/uploads/2021/07/2021-Plastics-All-Golden-Design-Rules-One-Pager.pdf

87 https://ellenmacarthurfoundation.org/global-commitment/overview

- Data
  - What information is needed to track progress at the global level towards safe, non-toxic inclusive circularity of plastics?
  - Overview of what information is currently possible to collect at a global scale, including trade.
  - What global baselines are possible to be set based on this information?
  - Which potential global baselines are currently supported by regular data collection?
- Transparency
  - Identify existing transparency issues in data collection for 1) material flows, including trade, 2) waste generation, 3) emissions and releases, and 4) health risks and impacts.
  - Transparency issues that need to be addressed at the global level.
- Solutions, including from traditional knowledge, knowledge of Indigenous Peoples and local knowledge systems
  - Safeguard and protect traditional knowledge, systems, practices and innovations and nature-based solutions from Indigenous Peoples, when researching and scaling up alternative and new materials
  - Social solutions – what behaviour changes and practices should be promoted at the global level?
  - Business models – what alternate business models should be promoted and the requirements to scale these models, e.g., reuse, repair, remanufacture?
  - Technical solutions – what alternatives, design changes and final treatments options that should be scaled?

3.4. Cooperation and coordination

3.4.1. Conventions, instruments and organisations

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to promote cooperation and coordination with relevant regional and international conventions, instruments and organisations, while recognising their respective mandates, avoiding duplication and promoting complementarity of action"* (UNEA Res. 5/14, para 3k)

The following UNEA resolutions provide previously adopted text as a starting point and guidance to promote cooperation and coordination:

UNEA Res. 5/11[88] underlines the need for **partnerships,** and invites Member States, the private sector, non-governmental organisations, the scientific community, relevant **international institutions** and other relevant stakeholders to promote and enhance circular economy approaches as well as business models, innovations and investments to contribute to, among other things, the sustainable management, use and consumption of natural resources and materials.

UNEA Res. 4/7[89] requested to strengthen UNEP's International Environment Technology Centre and its role in the provision of technological advice and capacity-building related to environmentally sound waste management. It further sought to enhance cooperation with the regional centres of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, and the Stockholm Convention on Persistent Organic Pollutants (para 2a).

88 UNEA Res. 5/11. Enhancing circular economy as a contribution to achieving sustainable consumption and production.

89 Environmentally sound management of waste.

Plastics are pervasive to our society and cannot be considered in isolation. Thus, strengthening the global governance of plastics and associated chemicals can help to generate co-benefits with many other environmental goals that are set in existing multilateral instruments. The mapping reflected in this study shows that:

1. The Basel Convention explicitly addresses significant aspects of the plastics life cycle, while the Rotterdam and Stockholm Conventions are relevant to aspects of the plastics life cycle and the global governance of plastics.
2. Only a fraction of chemicals associated with the plastics life cycle are restricted under existing multilateral instruments, including the Stockholm Convention, Montreal Protocol and Minamata Convention.
3. There is great potential to complement activities under the BRS conventions in the chemicals, material and dematerialisation phases, while building on these efforts to address the full life cycle of plastics and associated chemicals.
4. Strengthening the global governance of chemicals and plastics can significantly benefit the climate and biodiversity agendas through safe, non-toxic, and sustainable circularity of plastics, making it highly relevant for the CBD, UNFCCC and Paris Agreement.

3.4.2. Stakeholders, including private sector

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions*: "to encourage action by all stakeholders, including the private sector, and to promote cooperation at the local, national, regional and global levels"* (UNEA Res. 5/14, para 3l)

UNEA Res. 5/14 also recognises the significant contribution made by workers in informal and cooperative settings to the collecting, sorting and recycling of plastics in many countries (preamble) and requests the INC to consider their best practices and lessons learned (para 4.e).

The following UNEA resolutions provide previously adopted text as a starting point and guidance for stakeholder engagement:

UNEA Res. 4/1[90] recognises that achieving sustainable consumption and production is only possible with the active support and participation of all stakeholders, in particular those who extract and manage raw materials and natural resources (preamble).

UNEA Res. 4/9 invites Member States to work together with industry to encourage the private sector to innovate and find affordable and environmentally friendly alternatives to single-use plastic products, and to promote business models that take into account the full environmental impact of their products (para 4). This resolution also notes the important role of key sectors such as plastics producers, retailers and the consumer goods industry, as well as importers, packaging firms, transport firms, and recyclers to contribute to the reduction of plastic waste, arising from their products and activities, as well as to provide information on the impacts arising from their products. The resolution encourages innovative approaches such as the use of extended producer responsibility schemes, deposit refund schemes and other initiatives (preamble).

UNEA Res. 2/11 encourages product manufacturers and others to consider the life cycle environmental impacts of products containing microbeads and compostable polymers, including possible downstream impacts that may compromise the recycling of plastic waste. Further, the resolution encourages the elimination or reduction of primary microplastic particles in products such as personal care

90 UNEA Res. 4/1. Innovative pathways to achieve sustainable consumption and production.

products, industrial abrasives and printing products. Any replacement products are required to be environmentally sound. Cooperation in the environmentally sound management of such plastic waste is also encouraged (para 18).

UNEA Res. 5/5[91] recognises the potential of sustainable and environmentally sound bio-based products, innovation and technologies that result from nature-based solutions. These can contribute to sustainable consumption and production, and be beneficial to nature, consistent with international commitments and relevant multilateral agreements on biodiversity, climate, environment and sustainable development. The resolution also recognises the potential associated risks, including for local communities and indigenous peoples (para 3).

To support a transparent, participatory and enforceable governance framework for plastics an example can be drawn from the Aarhus Convention. The Convention grants certain rights to the public and imposes on Parties and public authorities obligations regarding effective access to environmental information, including on chemicals, products and wastes (Art. 2 para 3, Art. 4 and Art. 5), public participation in decision-making on projects, plans, programmes, policies and legislation (Art. 6, 7 and 8) and access to justice to challenge flaws in access to information and public participation or illegal decisions, acts or omission of public authorities and private persons (Art. 9). Following this, consideration could be given to ensuring effective and inclusive public participation during the preparation of national action plans for plastic pollution. The Aarhus Convention also requires Parties to promote public participation in international decision-making processes (Art. 3, para 7) and protect environmental defenders exercising the above rights from penalisation, persecution or harassment for their involvement (Art. 3, para 8). Building on this, consideration needs to be given to empowering people, particularly those most at risk, to exercise their rights to information, participation in decision-making and access to justice in plastic-related matters, including by ensuring protection of environmental defenders.

Worth considering is the establishment of an accreditation process that is open and simple so that technical or strictly procedural requirements do not limit stakeholder participation post adoption of the instrument. Moreover, it must be ensured that participating stakeholders have the right to intervene and engage in discussions in an inclusive way (CIEL, 2022).

3.4.3. Multi-stakeholder action agenda

> In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions*: "to initiate a multi-stakeholder action agenda"* (UNEA Res. 5/14, para 3m)

The following UNEA resolutions provide previously adopted text as a starting point and guidance for developing a multi-stakeholder action agenda:

UNEA Res. 4/6[92] decided to strengthen coordination and cooperation by establishing, subject to the availability of resources and building on existing initiatives, a multi-stakeholder platform within the UNEP to take immediate action towards the long-term elimination, through a life cycle approach, of discharges of litter and microplastics into the oceans. This may include the following functions (para 3):

a) Serving as a forum for enabling governments, industry, academia, civil society and other stakeholders to share experiences and coordinate action on a regular or ad hoc basis,
b) Serving as a repository for assessments of the ways in which land- and sea-based sources of marine litter, including plastic litter and microplastics, are addressed at the national, regional and international levels; conceptual and practical guidance materials to help governments, organisations

91 Nature-based solutions for supporting sustainable development.

92 Marine plastic litter and microplastics.

and private entities address aspects of marine litter; and current action plans, management practices and guidelines for enabling, enhancing and supporting action to prevent the discharge of litter, including plastic litter and microplastics, into the marine environment,

c) Raising global awareness of the issue with a wide variety of audiences, including governments, policymakers, resource managers, educators, private-sector entities and the public,

d) Establishing and maintaining a database of technical and scientific information related to marine litter, such as inventories of discharges into the marine environment, scientific studies and innovations to address marine litter,

e) Promoting collaboration among relevant scientific mechanisms to facilitate access to scientific data and information in order to disseminate sound scientific practices, such as guidelines for the sampling and analysis of marine macroplastics and microplastics, and to improve the policy relevance of research,

f) Promoting action within the framework of regional seas conventions and programmes, subject to the availability of resources, to address marine litter through action plans, protocols, partnerships and other activities.

A multi-stakeholder action agenda could be based on sound multilateral instruments (Aarhus Convention and Escazu Agreement) and consider working under three pillars, namely access to information, effective participation and access to justice. The agenda could also be modelled on existing action agendas also referred to as "global commitment platforms" (Urho, 2021). They are intended to spur voluntary commitments that are initiatives undertaken voluntarily by states, sub-nationals, intergovernmental organisations, international financial institutions, NGOs, academic and research institutions, the scientific community, the private sector, philanthropies, and other actors either individually or in partnership to help fulfil environmental or sustainability goals. Since 2014, such voluntary commitments have become a significant part of the climate regime with the emergence of the Global Climate Action Agenda and, since 2018 of the biodiversity regime with the announcement of the Action Agenda for Nature and People. These platforms provide a space to explore innovative ideas and develop cooperative approaches that spur world-wide concrete action. A mechanism for articulation of multistakeholder voluntary commitments, actions and deliberations could feed the implementation of global commitments towards eliminating plastic pollution.

3.5. Financing and capacity building

3.5.1. Capacity building

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: "*to specify arrangements for capacity-building and technical assistance, technology transfer on mutually agreed terms, and financial assistance, recognising that the effective implementation of some legal obligations under the instrument will depend on the availability of capacity-building and adequate financial and technical assistance*" (UNEA Res. 5/14, para 3n)

The following UNEA resolutions provide previously adopted text as a starting point and guidance for capacity building:

UNEA Res. 2/11 stresses that prevention and environmentally sound management of waste are keys to long-term success in combating marine pollution, including marine plastic debris and microplastics. It calls on Member States to establish and implement necessary policies, regulatory frameworks and measures consistent with the waste hierarchy, and stresses the importance of providing capacity-building. It also suggests that Member States could consider financial assistance to developing countries, least developed countries and in particular small island developing States for the realisation of these objectives (para 7).

UNEA Res. 4/6 requested the development, through UNEP's 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns, of guidelines for the use and production of plastics in order to inform consumers, including about standards and labels, to incentivise businesses and retailers to commit themselves to using sustainable practices and products, and to support governments in promoting the use of information tools and incentives to foster sustainable consumption and production (para 5).

UNEA Res. 4/7[93] invites Member States to engage the private sector, civil society, waste producers, local authorities and the public in the sound management of solid waste. It encourages public-private initiatives and alliances, including through market mechanisms and capacity-building, to promote sustainable consumption and production, including, but not limited to, a circular economy and other sustainable economic models (para 1c). In addition, inventories of environmentally sound waste management technologies and practices are to be maintained, including those introduced in the global and regional waste management outlooks, and share those inventories and practices with Member States. In addition, Member States should be assisted in the use of best available techniques and best environmental practices in solid waste management (para c) and continue to foster the sharing of experience, lessons learned and success stories among Member States and key stakeholders through existing regional and global platforms (para d). Developing countries and countries with economies in transition, in particular, shall be assisted in their efforts to strengthen and enhance national and local implementation of the environmentally sound management of waste through the regional waste management outlooks, improving information on environmentally sound technologies to integrate waste management (para f).

Through the Multilateral Fund, the Montreal Protocol provides capacity building and institutional strengthening to Article 5 parties (147 developing countries) to assist them in implementing their phase-out and phase-down plans including their obligations related to reporting of data. A number of regional networks of national officers, managed by regional coordinators, also promote the development and enforcement of national policies, and adoption of environment-friendly technologies.[94] The Multilateral Fund's support for capacity building activities and training of Ozone Officers has led to improvements in national phase-out plans, reporting and policy making.

3.5.2. Financial mechanism

> The INC is to consider the following: "*the need for a financial mechanism to support the implementation of the instrument, including the option of a dedicated multilateral fund*" (UNEA Res. 5/14, para 4b)

The following UNEA resolutions provide previously adopted text as a starting point and guidance for financing:

UNEA Res. 2/11 stresses that prevention and environmentally sound management of waste are keys to long-term success in combating marine pollution, including marine plastic debris and microplastics. It calls on Member States to establish and implement necessary policies, regulatory frameworks and measures consistent with the waste hierarchy. Further, it stresses the importance of providing capacity-building and encourages Member States to consider financial assistance to developing countries, least developed countries and in particular small island developing States for the realisation of these objectives (para 7).

93 Environmentally sound management of waste.

94 For more information, see https://www.unep.org/ozonaction/networks

The scope and obligations of the plastics instrument will determine the funding needs that could include institutional strengthening (i.e., multi-sectoral coordination bodies), enabling activities (i.e., national action plans, international sustainability criteria, and reporting), and/or implementation of control measures (i.e., mitigation targets). Deferring the development of terms of reference and other specificities of the possible financial mechanism to post-adoption can allow for in-depth discussion on the scope and obligations that will, subsequently, help to determine the financial needs and the most suited mechanism to meet them. Existing models can guide the development of the financial mechanism, acknowledging that they were developed to meet specific needs that may not be directly applicable to plastics. Two existing mechanisms are briefly discussed below, but the need for a financial mechanism to support implementation of the plastics instrument requires further analysis, building on existing studies.[95]

The **Global Environment Facility (GEF)** is a designated financial mechanism that supports MEAs relevant to plastics, including the Stockholm Convention, the Montreal Protocol (when it comes to countries with economies in transition), the Minamata Convention (as one of the two components of the financial mechanism), CBD and UNFCCC. The GEF could be designated as the financial mechanism for the plastics instrument in order to ensure strong linkages with relevant MEAs and institutional efficiency by taking advantage of its governance structure. One issue that may need consideration is that the Basel Convention lacks a financial mechanism, although it caters for many downstream activities relevant to plastics. It could also be expected to benefit from funding through the plastics instrument, as it has benefited from funding through GEF projects that address the objectives of the Basel and Stockholm Conventions. Nevertheless, given that waste management is, until subject to trade, a national/local concern, it will be essential to engage the industry at the national level using economic instruments (e.g., development of EPR schemes) and through the effective implementation of international sustainability criteria for design (see section 4.1). To this end, consideration needs to be accorded to the manner in which the financial mechanism could catalyse such industry engagement.

The approach adopted by the Montreal Protocol may also be considered. The financial mechanism of the Montreal Protocol, stipulated in Article 10 (see Box 1), includes **the Multilateral Fund (MLF)** which has been an effective instrument in assisting developing countries to implement the Protocol, particularly in developing and implementing national phase-out and phase-down plans for ODSs and HFCs, respectively. However, the MLF model is not directly applicable to plastic pollution as it relies solely on public financing. Considering the magnitude of the global plastic pollution crisis, it may fall short in meeting financial needs. Studies conducted prior to the adoption of the Paris Agreement showed that funding capacity of the public sector cannot fill the needs of climate financing, and that a large portion of financial flows need to be mobilised from the private sector with adequate policies and incentives for "green investments" (SCF, 2014). Moreover, the MLF model implies the creation of a dedicated fund with its own governance and management structure that would steer a portion of financial resources from implementation to the governance of the fund itself.

In order to meet needs for domestic research and innovation, as well as technology transfer to developing countries, experience could be drawn from the UN Climate Technology Center & Network (CTCN) of the UNFCCC that promotes the accelerated transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries. The Regional Centres of the Basel and Stockholm Convention might also provide an avenue to work more closely on plastics, given their expertise in environmentally sound management of wastes.

95 See Busch, et al. (2022). Global agreement to prevent plastic pollution. Exploring financing needs and opportunities, available at https://pub.norden.org/temanord2022-514/; Overview of existing funding currently available for addressing plastic pollution through international funding arrangements, including from other processes, programmes, multilateral funds, development banks and private sector initiatives (UNEP/PP/INC.1/9), available at https://wedocs.unep.org/bitstream/handle/20.500.11822/40768/UNEP-PP-INC.1-9%20Existing%20funding.pdf

Box 1: Article 10 of the Montreal Protocol on the establishment of a financial mechanism

Montreal Protocol, Article 10: Financial mechanism

1. The Parties shall establish a mechanism for the purposes of providing financial and technical co-operation, including the transfer of technologies, to Parties operating under paragraph 1 of Article 5 of this Protocol to enable their compliance with the control measures set out in Articles 2A to 2E and Article 2I, and any control measures in Articles 2F to 2H that are decided pursuant to paragraph 1 bis of Article 5 of the Protocol. The mechanism, contributions to which shall be additional to other financial transfers to Parties operating under that paragraph, shall meet all agreed incremental costs of such Parties in order to enable their compliance with the control measures of the Protocol. An indicative list of the categories of incremental costs shall be decided by the meeting of the Parties.
2. The mechanism established under paragraph 1 shall include a Multilateral Fund. It may also include other means of multilateral, regional and bilateral co-operation.
3. The Multilateral Fund shall:
    a) Meet, on a grant or concessional basis as appropriate, and according to criteria to be decided upon by the Parties, the agreed incremental costs;
    b) Finance clearing-house functions to:
        i. Assist Parties operating under paragraph 1 of Article 5, through country specific studies and other technical co-operation, to identify their needs for co-operation;
        ii. Facilitate technical co-operation to meet these identified needs;
        iii. Distribute, as provided for in Article9, information and relevant materials, and hold workshops, training sessions, and other related activities, for the benefit of Parties that are developing countries; and
        iv. Facilitate and monitor other multilateral, regional and bilateral co-operation available to Parties that are developing countries;
    c) Finance the secretarial services of the Multilateral Fund and related support costs.
4. The Multilateral Fund shall operate under the authority of the Parties who shall decide on its overall policies.
5. The Parties shall establish an Executive Committee to develop and monitor the implementation of specific operational policies, guidelines and administrative arrangements, including the disbursement of resources, for the purpose of achieving the objectives of the Multilateral Fund. The Executive Committee shall discharge its tasks and responsibilities, specified in its terms of reference as agreed by the Parties, with the co-operation and assistance of the International Bank for Reconstruction and Development (World Bank), the United Nations Environment Programme, the United Nations Development Programme or other appropriate agencies depending on their respective areas of expertise. The members of the Executive Committee, which shall be selected on the basis of a balanced representation of the Parties operating under paragraph 1 of Article 5 and of the Parties not so operating, shall be endorsed by the Parties.
6. The Multilateral Fund shall be financed by contributions from Parties not operating under paragraph 1 of Article 5 in convertible currency or, in certain circumstances, in kind and/or in national currency, on the basis of the United Nations scale of assessments. Contributions by other Parties shall be encouraged. Bilateral and, in particular cases agreed by a decision of the Parties, regional co-operation may, up to a percentage and consistent with any criteria to be specified by decision of the Parties, be considered as a contribution to the Multilateral Fund, provided that such co-operation, as a minimum:
    a) Strictly relates to compliance with the provisions of this Protocol;
    b) Provides additional resources; and
    c) Meets agreed incremental costs.
7. The Parties shall decide upon the programme budget of the Multilateral Fund for each fiscal period and upon the percentage of contributions of the individual Parties thereto.
8. Resources under the Multilateral Fund shall be disbursed with the concurrence of the beneficiary Party.
9. Decisions by the Parties under this Article shall be taken by consensus whenever possible. If all efforts at consensus have been exhausted and no agreement reached, decisions shall be adopted by a two-thirds majority vote of the Parties present and voting, representing a majority of the Parties operating under paragraph 1 of Article 5 present and voting and a majority of the Parties not so operating present and voting.
10. The financial mechanism set out in this Article is without prejudice to any future arrangements that may be developed with respect to other environmental issues.

Box 2: Article 13 of the Minamata Convention on the establishment of a financial mechanism

Minamata Convention, Article 13: Financial resources and mechanism

1. Each Party undertakes to provide, within its capabilities, resources in respect of those national activities that are intended to implement this Convention, in accordance with its national policies, priorities, plans and programmes. Such resources may include domestic funding through relevant policies, development strategies and national budgets, and bilateral and multilateral funding, as well as private sector involvement.
2. The overall effectiveness of implementation of this Convention by developing country Parties will be related to the effective implementation of this Article.
3. Multilateral, regional and bilateral sources of financial and technical assistance, as well as capacity-building and technology transfer, are encouraged, on an urgent basis, to enhance and increase their activities on mercury in support of developing country Parties in the implementation of this Convention relating to financial resources, technical assistance and technology transfer.
4. The Parties, in their actions with regard to funding, shall take full account of the specific needs and special circumstances of Parties that are small island developing States or least developed countries.
5. A Mechanism for the provision of adequate, predictable, and timely financial resources is hereby defined. The Mechanism is to support developing country Parties and Parties with economies in transition in implementing their obligations under this Convention.
6. The Mechanism shall include:
   a) The Global Environment Facility Trust Fund; and
   b) A specific international Programme to support capacity-building and technical assistance.
7. The Global Environment Facility Trust Fund shall provide new, predictable, adequate and timely financial resources to meet costs in support of implementation of this Convention as agreed by the Conference of the Parties. For the purposes of this Convention, the Global Environment Facility Trust Fund shall be operated under the guidance of and be accountable to the Conference of the Parties. The Conference of the Parties shall provide guidance on overall strategies, policies, programme priorities and eligibility for access to and utilisation of financial resources. In addition, the Conference of the Parties shall provide guidance on an indicative list of categories of activities that could receive support from the Global Environment Facility Trust Fund. The Global Environment Facility Trust Fund shall provide resources to meet the agreed incremental costs of global environmental benefits and the agreed full costs of some enabling activities.
8. In providing resources for an activity, the Global Environment Facility Trust Fund should take into account the potential mercury reductions of a proposed activity relative to its costs.
9. For the purposes of this Convention, the Programme referred to in paragraph 6 (b) will be operated under the guidance of and be accountable to the Conference of the Parties. The Conference of the Parties shall, at its first meeting, decide on the hosting institution for the Programme, which shall be an existing entity, and provide guidance to it, including on its duration. All Parties and other relevant stakeholders are invited to provide financial resources to the Programme, on a voluntary basis.
10. The Conference of the Parties and the entities comprising the Mechanism shall agree upon, at the first meeting of the Conference of the Parties, arrangements to give effect to the above paragraphs.
11. The Conference of the Parties shall review, no later than at its third meeting, and thereafter on a regular basis, the level of funding, the guidance provided by the Conference of the Parties to the entities entrusted to operationalise the Mechanism established under this Article and their effectiveness, and their ability to address the changing needs of developing country Parties and Parties with economies in transition. It shall, based on such review, take appropriate action to improve the effectiveness of the Mechanism.
12. All Parties, within their capabilities, are invited to contribute to the Mechanism. The Mechanism shall encourage the provision of resources from other sources, including the private sector, and shall seek to leverage such resources for the activities it supports.

3.6. Supporting measures

3.6.1. Awareness raising, education and information exchange

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to increase knowledge through awareness-raising, education and the exchange of information"* (UNEA Res. 5/14, para 3j)

The need for greater transparency was raised in **UNEA Res. 4/8**,[96] which called for improvements in **information provided** by all stakeholders, including industry and the private sector, **about chemicals in consumer goods** and throughout the **supply chain** (para 12(d)). It also encouraged all stakeholders involved in the sound management of chemicals and waste to seek the establishment of **permanent information programmes** directed at consumers and the general public, highlighting the risks generated by chemicals and **raising awareness of the responsibilities** related to the management of chemicals and waste (para 12(f)).

The need for transparency is supported in para 15.c of SAICM's Overarching Policy Strategy, which states that the objectives of SAICM with regard to knowledge and information are to ensure that in making information available in accordance with paragraph 15(b), confidential commercial and industrial information and knowledge are protected in accordance with national laws or regulations or, in the absence of such laws or regulations, are protected in accordance with international provisions. In the context of this paragraph, information on chemicals relating to the health and safety of humans and the environment should not be regarded as confidential.[97]

UNEA Res. 3/7 recognises that the private sector and civil society, including non-governmental organisations, can contribute significantly to preventing and reducing marine litter and microplastics, including through **information sharing**, **awareness-raising**, developing new environmentally sound technologies, capacity-building and clean-up actions. It encourages cooperation between Governments, regional bodies, the private sector and civil society, including through the Global Partnership on Marine Litter and its regional nodes, to that end (para 5).

UNEA Res. 4/9 encourages member states to carry out environmental education actions on the impact of plastic pollution, promote sustainable consumption patterns, and on sustainable alternatives to single-use plastic products (para 5).

Regional Activity Centres have been established by some of the Regional Seas Conventions and Action Plans that could serve as an example of platforms for awareness raising, education and information exchange. These centres provide support to participating countries in meeting their commitments through regular contact with appropriate scientific and technical bodies and institutions, promoting scientific and technical cooperation and disseminating relevant data and information, amongst others.[98] Similarly, the Basel Convention and the Stockholm Convention have established regional centres.[99] In addition, the Global Partnership on Marine Litter is developing a Digital Platform that will promote awareness raising, education and information exchange at the global level. UNEA Res. 5/14 also calls for the consideration of including traditional knowledge, knowledge of indigenous people and local

96 UNEA Res. 4/8. Sound management of chemicals and waste.

97 http://www.saicm.org/Portals/12/Documents/saicmtexts/New%20SAICM%20Text%20with%20ICCM%20resolutions_E.pdf

98 See for example UNEP/COBSEA IGM 24/7 - Guidance on the Establishment and Operation of COBSEA Regional Activity Centres. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/34294/Guid.pdf

99 See for example Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean Region, Trinidad and Tobago (BCRC Caribbean) at http://www.basel.int/?tabid=4841

knowledge systems (para 4(d)) in the plastic instrument. These populations should be given access to participate in the development and implementation of plans and actions to restore landscapes and ecosystems, as well as addressing plastic pollution. Access to information is well established in international law, as discussed in this study.

3.6.2. Research and development

In developing a legally binding instrument to end plastic pollution, the INC is expected to include the following provisions: *"to promote research into and development of sustainable, affordable, innovative and cost-efficient approaches"* (UNEA Res. 5/14, para 3o).

UNEA Res. 2/11 underlines that, while research already undertaken provides sufficient evidence of the need for immediate action, more research is needed on marine plastic debris and microplastics, including associated chemicals. Further research is also required to be conducted on environmental and social impacts – including on human health – and on pathways, fluxes and fate, including fragmentation and degradation rates in all marine compartments and especially in water bodies and sediment deposits of the coastal and open ocean, as well as on impacts on fisheries, aquaculture and economy. The resolution urges Governments at all levels and Member States in a position to do so to support such research (para 20).

UNEA Res. 4/9 encourages Member States to promote the identification and development of environmentally friendly alternatives to single-use plastic products, taking into account the full life cycle implications of those alternatives (para 2). The resolution also invites Member States, intergovernmental organisations, the scientific community, non-governmental organisations, the private sector and other stakeholders to promote and enhance cooperation in scientific research and the development of environmentally sound alternatives to the single-use plastic products, where appropriate, as well as to tackle plastic pollution within local, national and regional voluntary and regulatory frameworks, as appropriate (para 7).

The **Basel Convention** is an example of legal text that promotes international cooperation in research and development. Article 10 requires parties to cooperate subject to their national laws, regulations and policies, in the development and implementation of new environmentally sound low-waste technologies and the improvement of existing technologies with a view to eliminating, as far as practicable, the generation of hazardous wastes and other wastes and achieving more effective and efficient methods of ensuring their management in an environmentally sound manner, including the study of the economic, social and environmental effects of the adoption of such new or improved technologies (para c). A similar approach could be taken at the global level, potentially broadening the scope to include development of technologies and approaches across the life cycle of plastics and associated chemicals. In addition, a subsidiary body, similar to the Technology and Economic Assessment Panel of the Montreal Protocol could be established. The scope could also include social aspects, which could provide information on new and alternate technologies (including life cycle assessments), social and environmental impacts/benefits and economic costs and benefit assessments.

4 POTENTIAL MECHANISMS FOR CLOSING THE GOVERNANCE GAPS ACROSS THE FULL LIFE CYCLE OF PLASTICS AND ASSOCIATED CHEMICALS

The plastics instrument can promote sustainable design, such as increasing the lifespan of plastics placed on the market, including through reusability and repairability, towards minimising waste generation and preventing litter. Photo © Nataliaderiabina. Dreamstime.com

4. Potential mechanisms for closing the governance gaps across the full life cycle of plastics and associated chemicals

This section, firstly, outlines possibilities for developing international sustainability criteria for plastics and associated chemicals to be adopted at the global level. These could be developed in parallel with other components of the plastics instrument, addressing the governance gaps identified in section 2, particularly in the midstream and upstream phases of the plastics value chain.

Thereafter, this section discusses possibilities for developing and adopting modalities at the global level for prioritising chemicals of concern used in plastics that fall beyond the scope of existing agreements. The two issues addressed in this section complement and reinforce each other but may be discussed separately or together. Both encourage shifting from a focus on plastic waste, to the production and design phases. It is in these upstream phases that the level of hazard within plastic products is determined, and such focus can benefit the entire value chain, including end of life management of plastics. Lastly, other possible mechanisms for closing the governance gaps are discussed.

4.1. Developing international sustainability criteria for plastics and associated chemicals

This sub-section provides some examples of areas where sustainability criteria have been employed to achieve various desired outcomes. It is followed by a proposal for international sustainability criteria for plastics and associated chemicals that may assist in addressing the beginning of phases of the life cycle of plastics, with outcomes in the downstream phases and providing greater opportunity for non-toxic circularity of plastics.[100] This is supported by a discussion on how these sustainability criteria may be operationalised.

4.1.1. Examples of existing design principles and criteria

The need for the development of design principles and criteria has surfaced in policy and academic spheres before. Figure 4 provides examples of approaches for the development of design principles and criteria to address the life cycle of plastics and/or chemicals.

A comprehensive approach is provided by the EU's Safe and Sustainable by Design (SSbD) Principles for chemicals and materials that extends beyond chemicals safety to increasing energy and resource efficiency and reducing all emissions and waste (Patinha Caldeira et al., 2022). The SSbD Principles build on relevant existing principles, including the 12 Green Chemistry Principles, but aims to go further by capturing the environmental burdens of chemical production in a more holistic manner (Patinha Caldeira et al., 2022). Moreover, the OECD has developed design principles for plastics that takes sustainability, particularly from a chemicals perspective, into account, focusing on maximising resource efficiency; eliminating and minimising hazards and pollution; and designing systems holistically using life cycle thinking (OECD, 2021a).

100 This sub-section builds on and complements the work done by the Nordic Council of Ministers in conceptualizing International Sustainability Criteria for plastics and associated chemicals (Rognerud et al., 2022), with the concept first introduced in the report titled Possible Elements of a New Global Agreement to Prevent Plastic Pollution (Raubenheimer & Urho, 2020).

Sustainable design principles can be effectively implemented with legislation as showcased by the EU's Ecodesign Directive that sets environmental and energy performance criteria for products, including outlining generic ecodesign parameters (without setting limit values) and requirements for the supply of information (EU, 2012). While the Directive's primary aim is to reduce energy use, it is also aimed at enforcing other environmental considerations, such as materials use, water use, polluting emissions, waste issues and recyclability. The Commission has prepared a proposal for revised legislation (Ecodesign for Sustainable Products Regulation, ESPR) to replace the directive with the intention to set the ecodesign requirements to promote product durability, reliability, reusability, upgradability, reparability, ease of maintenance and refurbishment, as well as to restrict the presence of chemicals that inhibit the circularity of products and materials, among others (European Commission, 2022b). It also sets requirements to provide information on the environmental sustainability of products.

Scholars have developed a set of five sustainability principles – minimisation, durability, reusability, recyclability and transparency – that could be considered in discussions regarding the plastics instrument (Rognerud, Steindal et al., 2022; Simon et al., 2021). The principles focus primarily on promoting sustainability of plastics as materials providing various environmental and safety benefits across the value-chain, including phasing out chemicals of concern (through recyclability, transparency and minimisation) and reducing greenhouse gas emissions (through minimisation, reusability and durability), as a few examples. Moreover, Johansen et al. (2022) have identified principles to follow, to extend and close resource loops focusing on design for 1) sustainable sourcing, 2) optimised resources use, 3) environmentally sound and safe product use, 4) prolonged product use, and 5) recycling.

Chemicals provide the basic building blocks for plastics, mostly originating from the extraction of non-renewable oil and gas. UNEA Resolution 5/14 promotes the "sustainable production and consumption of plastics, including, among others, product design, and environmentally sound waste management, including through resource efficiency and circular economy approaches." Photo © Industryviews. Dreamstime.com

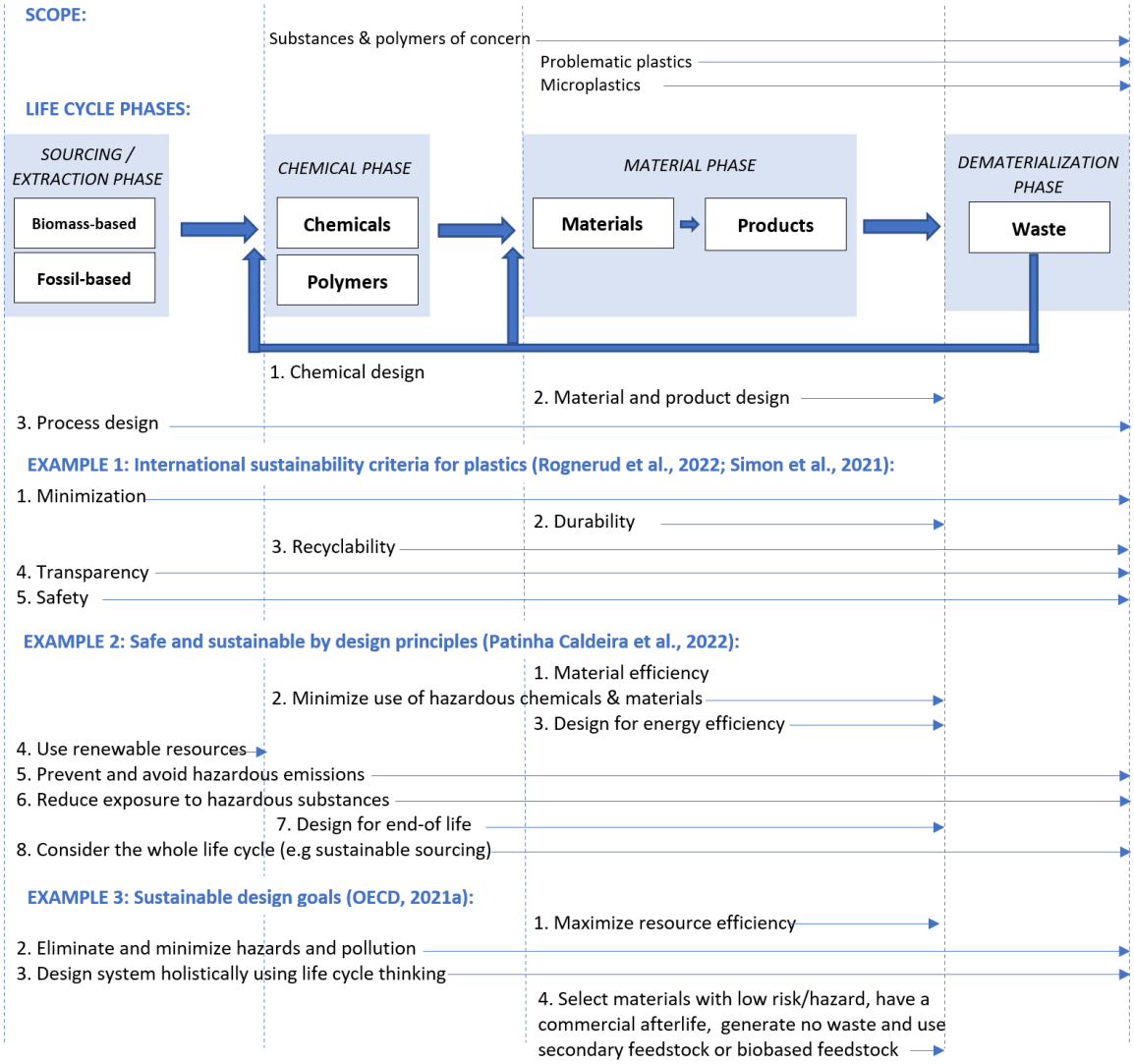

Figure 4: Illustration of how different approaches for the development of design principles address the life cycle of plastics and/or chemicals

4.1.2. Proposal for sustainability criteria for plastics and associated chemicals

Based on existing examples for design principles from both policy and academic spheres, a proposal for international sustainability criteria for plastics and associated chemicals has been developed to address the entire life cycle of plastics. These sustainability criteria are intended to fulfil the requirement to address resource efficiency (or minimisation), sustainable production and consumption, and design, as per UNEA Res. 5/14.

The aim of the criteria is to enhance performance and transparency of the plastic value chain by defining parameters applicable to all relevant sectors and applications–without setting limit values–needed to redesign chemicals, materials and their manufacturing and supply chains. This is intended to:

- **Provide governments and industry a level playing field** needed to transform the global plastics value chain to effectively address safety and sustainability considerations across the life cycle of plastics and, ultimately, to prevent negative impacts on human health and the environment.
- **Generate system-thinking and to empower Parties** to catalyse a transformative shift across the value chain of plastics by helping to address design in its broadest sense, including chemical design, process design and product design.

Table 14 lists possible factors that can be considered in the international sustainability criteria for plastics and associated chemicals, including environmental, safety and transparency parameters thereof. The proposal is intended to inspire the international community to define a limited set of criteria that encompasses the entire value chain of plastics.

Table 14: Overview of possible factors that can be considered in the sustainability criteria for plastics and associated chemicals

Life cycle phase	**Environmental criteria** (performance)	**Safety criteria** (performance)	**Transparency criteria** (information)
1. Sourcing/ extraction phase (Hydrocarbons)	• Minimise impacts of sourcing of raw materials (climate, biodiversity, etc.) • Prevent use of restricted chemicals related to environmental hazards		• Ensure availability of information on raw materials • Ensure availability of information of alternatives (e.g., life cycle analyses for replacement technologies/ materials) and socio-economic impacts
2. Production phase (Polymers and chemicals)	• Prevent production and use of restricted chemicals related to environmental hazards • Decrease emissions and releases of pollutants to air, water and soil (including greenhouse gases)	• Prevent production and use of chemicals and polymers of concern • Prevent exposure of production workers to chemicals of concern	• Ensure availability of identities, occurrence and toxicity data on chemicals and polymers produced
3a. Material phase (manufacturing) (Plastic materials and products)	• Increase durability • Increase repairability and repair in practice • Increase reusability and reuse in practice • Increase remanufacture • Increase recyclability • Increase recycled material content • Prevent use of restricted chemicals related to environmental hazard • Prevent use of intentionally added microplastics	• Prevent use of chemicals and polymers of concern in manufacturing processes • Prevent exposure of manufacturing workers to chemicals of concern	• Ensure availability of hazard information on chemicals and polymers used in manufacturing • Ensure availability of information on industry releases (e.g. chemicals, polymers, microplastics) through public mechanisms such as national and global portals
3b. Material phase (consumption) (Plastic products)	• Prevent microplastics releases during use • Minimise waste generation • Prevent hazardous chemicals in products	• Minimise exposure to chemicals of concern released during intended use	• Ensure availability of information on chemical and polymer content of products • Ensure availability of information on performance in accordance with international sustainability criteria for plastics and associated chemicals
4. Dematerialisation phase (Plastic waste)	• Ensure availability of relevant facilities and infrastructure to enable recycling in practice • Minimise emissions from waste disposal	• Detect presence of possible chemicals of concern in recycling streams and ensure that appropriate action is taken • Minimise exposure to chemicals of concern in the recycling phase, in particular vulnerable communities	• Ensure availability of Information on chemical and polymer content of plastic waste

The **performance criteria** are intended to minimise harm to the environment and human health by influencing product and material design, such as toxicity, composition, chemical and polymer stability/integrity, size, longevity and (bio)degradability. The aim is not to develop new and improved plastics alone, but to simultaneously reduce volume, size, dynamics, and diversity at all levels of plastics and at all stages of its life cycle. From a chemical standpoint, the expected outcome would lead to "chemical simplification" that facilitates a grouping of chemicals approach in chemical assessments, as well as a leads to a reduced number of chemicals in plastics (Fenner and Sheringer, 2021). Given the large variety and volume of plastics on the market, at the global level, it may be necessary to identify areas where urgent action is needed, and gradually increase the level of ambition. Problematic plastics may be identified based on the following non-exhaustive and preliminary list of qualities:

- Toxicity (e.g., toxic monomers, flame retardants and plasticizers),
- Chemical and polymer stability/integrity (e.g., phthalates and secondary microplastics),
- Product longevity (e.g., single-use plastics and packaging),
- Size (e.g., primary microplastics and nanoplastics),
- Composition (e.g., multilayer plastics, colours), and
- (Bio)degradability (e.g., oxo-degradable).

By defining material and product performance parameters for the above qualities, it could be possible to develop a framework for designing sustainable plastics. Moreover, the development of clear definitions will be important, for instance terms such as "bioplastics" and "biodegradable plastics" are often used incorrectly and interchangeably (e.g. oxo-degradable plastics should not be considered or confused with biodegradable plastics).

A sector specific approach may also be taken, focusing on the most plastic-intensive sectors and applications, including packaging (45%), building and construction (19%), consumer and institutional goods (12%), transportation (7%), electrical and electronic products (4%) and others (14%) (Geyer et al., 2017). Recently, increasing attention has been given to agriculture with an estimated use of 12.5 million tonnes of plastics, with a forecast annual growth rate of 5.6% for 2022-2028 (Agricultural Plastics Market, 2022). This could include the development of sector-specific guidelines that may include white and/or grey lists for plastics and associated chemicals to be favoured and/or avoided, respectively, in material and product design, including proposals for non-chemical alternatives, taking into account the full life-cycle implications of those alternatives. For instance, in the case of single-use plastics, a positive list could be developed for items considered essential (e.g. medical blood bags, medical masks), whereas a grey list would list non-essential items (e.g. single-use plastic bags)

The **transparency criteria** are intended to ensure the flow of information in the supply chain of plastics, including for workers, retailers, consumers and recyclers. Transparency is a prerequisite to make circularity reality, as one of the main challenges today for recycling is to identify polymer type and chemical contaminants (Getor et al., 2022). Increased product transparency is intended to ease the burden of all importing countries that struggle to get access product information, in particular low-income countries many of which are net importers of products (Speranskaya et al., 2022). This could be realised by developing a globally harmonised system for accessing key information on product content taking advantage of modern digital tools. For instance, EU's revised ESPR legislation will introduce the use of "Digital Product Passports" to enable all actors along the product value chain to scan a tag (e.g., QR code) to access information associated with products to effectively track and manage sustainability. Conformity with the sustainability criteria for plastics and associated chemicals could also be proven with a label, for instance, following the example of "CE marking" used in the European Economic Area to signal that products sold have been assessed to meet high safety, health and environmental protection requirements (EU, 2022).

4.1.3. Operationalising international sustainability criteria for plastics and associated chemicals

None of the existing multilateral instruments have the needed scope to accommodate the sustainability criteria. Therefore, ongoing efforts to strengthen the global governance of plastics and associated chemicals could provide an opportunity for defining the parameters for the sustainability criteria for plastics and associated chemicals that have been described in this study. The breadth of the envisaged criteria suggests including them in in the plastics instrument possibly as an annex, which could function as a **living document** to be updated on a regular basis, covering sustainability of the full life cycle of plastics towards a circular economy. It is recommended the INC start the development of the initial sustainability criteria to avoid delays in their operationalisation.

A **technical body** could be established to ensure that the criteria can be easily translated to national legal and policy frameworks. This could also include the development of the relevant **tools and instruments**, such as:

- A glossary of definitions and terms.
- Guidelines specific to the criteria (e.g., based on categories or sectors).
- BET/BAP across the value chain of plastics.

Parties could be requested to regularly submit **plans** to help specify categories and sectors identified as priorities nationally, including policies and requirements developed thereof, in conjunction with their **national action plans**. Countries could opt to develop legislation and other policies that are best suited to their national context. The sustainability criteria for plastics and associated chemicals can provide a foundation for procurement policies, regulatory and economic incentives, including product stewardship schemes, and, under some domestic regulatory regimes, may possibly be used to underpin the prohibition of products that do not meet the criteria. Taxes and take-back schemes, for example, could place the externalised responsibility back on manufacturers and importers that do not meet the criteria. The role of civil society organisations can be elaborated in national action plans, as well as the improvement of working conditions and the establishment of a framework for just transition of waste pickers into safer roles.

Industry engagement in elaborating and reporting on the implementing of the sustainability criteria for plastics and associated chemicals may be integrated and promoted through initiatives such as the Ellen MacArthur Foundation's Global Commitment[101], the Consumer Goods Forum's Golden Design Rules[102] and Operation Clean Sweep[103]. Other potential areas include, the tourism, agricultural, building and construction, and the automotive sectors. Other potential avenues could engage a greater range of stakeholders and activities through best practices than what the plastics instrument may be able to achieve.

The plans could also articulate activities planned to increase **compliance** with policies and requirements in place, including inspections of imported goods and market surveillance. More ambitiously, the products that meet the sustainability criteria for plastics and associated chemicals could be accompanied by a certification scheme that is verified by an independent third party. The operationalisation at

101 https://ellenmacarthurfoundation.org/global-commitment/overview

102 The Golden Design Rules for Plastic Packaging were developed by The Consumer Goods Forum's Plastic Waste Coalition of Action. They outline specific design changes aligned with globally recognised technical guidelines and targets laid out in the Ellen MacArthur Foundation's New Plastics Economy Global Commitment. In Canada, the implementation of the Golden Design Rules is being led by the Canada Plastics Pact, which is part of the Ellen MacArthur Foundation's Global Plastics Pact Network. See https://www.theconsumergoodsforum.com/wp-content/uploads/2021/07/2021-Plastics-All-Golden-Design-Rules-One-Pager.pdf

103 Industry has adopted voluntary standards to decrease the accidental loss of plastic pellets during transit in a program called Operation Clean Sweep. See https://www.opcleansweep.org/https://www.opcleansweep.org/

the national level, including the development of a certification scheme, would benefit from further research and piloting.

A technical body may be established to develop a **framework of indicators** to gather the metrics necessary to track progress towards achieving stated goals. To this end, the criteria could be complemented with quantitative indicators to help benchmark progress, and institute accountability. Parties could be requested to report on activities taken in conjunction with **national reporting**, to ensure tracking of global progress and effectiveness of actions taken to increase product sustainability across the global markets. If deemed useful, the criteria could specify progress levels against which countries are expected to advance (e.g., from 1 to 5), which could help in tracking global progress, including identifying countries and regions in need of capacity support and funding.

The **financial sector** could include the sustainability criteria for plastics and associated chemicals in Environmental, Social, Governance (ESG) reporting, driving the systematic transition envisioned.

Lastly, for the sustainability criteria for plastics and associated chemicals to be successful, they will need to be able to target a broader set of **drivers of plastic consumption** that may lead to unwanted and/or unnecessary use of chemicals in plastics such as building codes and fire-safety regulations. Embedded in a legally binding instrument with the necessary breadth of scope, the sustainability criteria for plastics and associated chemicals are also expected to greatly influence the development of standards under existing international (including ISO-standards) and national standard-setting bodies. This includes, building codes and fire-safety standards that are important for the use of chemicals in plastics, but have a long history of leading to regrettable substitution. For instance, for EPS and XPS fire-safety demands was a primary driver for the use of the harmful flame retardant HBCDD in EPS/XPS**.** Similarly, toxic harmful flame retardants have been used in plastic parts including wires and cables in motor vehicles and machinery. Research suggests that some of these flammability standards should be updated, which can reduce the use of flame retardants while maintaining, or even increasing, fire safety (Charbonnet, 2020).

4.2. Identifying and addressing chemicals and polymers of concern

A common understanding of what constitutes chemicals and polymers of concern is needed to increase performance and transparency of the product life cycle, in accordance with the sustainability criteria for plastics and associated chemicals. This information will enable manufacturers to substitute chemicals of concern with safer alternatives in the product design phase, and make sure that information on chemical content is passed along the value chain. All countries and private entities alike will benefit from a common understanding of chemicals of concern as it will level the playing field, helping to expedite progress on creating non-toxic global markets for plastics. This subsection explain how chemicals of concern are identified based on their intrinsically unacceptable hazardous qualities to human health and the environment, and finally presents approaches on how to address them in context of ongoing efforts to enhance global governance of plastic and associated chemicals.

4.2.1. Understanding chemicals and polymers of concern from a hazard viewpoint

A binding definition for substances of concern has not been internationally agreed. SAICM defines chemicals of concern in relation to their (eco)toxicological properties (hazard) and their use patterns (exposure). Hazard criteria used for toxicological and ecotoxicological testing for identification of harmful chemicals is continuously evolving. The following, non-exhaustive list of criteria is used to assess hazardous properties of chemical substances:

- P = persistent
- B = bioaccumulation potential
- T = toxicity

- Adverse effects = Evidence of adverse effects or indication of potential for damage to human health or to the environment
- EDC = endocrine disrupting chemical
- C = carcinogenicity
- M = mutagenicity
- R = reproductive toxicity
- RespSens = respiratory sensitization
- STOT_RE = specific target organ toxicity upon repeated exposure
- AqTox = chronic aquatic toxicity

Various hazard criteria for identification of POPs, PBTs or CMR substances have been established internationally (KemI, 2020; OECD 2021b).[104] Persistent, mobile and toxic (PMT), and very persistent and very mobile (vPvM), are criteria introduced relatively recently by German authorities, and efforts are ongoing to include them as hazard classes in EU chemical regulation (GEA, 2017). Moreover, the EU has identified EDCs and is developing legally binding hazard identification criteria (i.e., classification, labelling and packaging of substances and mixtures (CLP) classification) for EDCs, based on the definition of the WHO (EU, 2021). A revised regulation on CLP has been proposed by the EU Commission which introduced new hazard classes for EDCs and other harmful chemicals.[105] The Stockholm Convention addresses chemicals of global concern based on certain criteria (i.e. persistence (P), bioaccumulation (B), adverse effects (T) and long-range environmental transport potential (LRTP)) that are defined by the text of the Convention (Annex D), and based on the likelihood of significant adverse human health and/or environmental effects (Annex E). The Convention adopts a precautionary approach (Article 1), and states that lack of full scientific certainty shall not prevent a proposal for listing a new substance from proceeding.

In considering chemicals of concern for possible restrictions, it will be important to move from a substance-specific approach to addressing **groups of chemicals of concern** to ensure that restriction does not lead to regrettable substitution. For instance, Bisphenol A (BPA) is a monomer that has been in the spotlight due to its endocrine disrupting properties. This has encouraged many countries to restrict its use in polycarbonate plastics materials, such as baby bottles, but in many cases, this has led to regrettable substitution, such as the use of Bisphenol S (BPS) that may be as harmful as BPA (Thoene, et al., 2020; UNEP, 2019).

Assessing chemicals in groups makes it faster to identify those that require regulatory action or more data, or those for which no further action is currently needed (ECHA, 2022). Chemsec's SIN list groups harmful chemicals into 15 groups based on chemicals' similarities, such as structure, toxicological properties and technical functions (ChemSec, 2022). UNEP has identified the following ten most relevant groups of chemicals of concern used in plastics due to their toxicity and potential to migrate from plastics (UNEP, 2022)[106]:

- **Bisphenols** mainly used to manufacture polycarbonates (e.g., plastic bottles and boxes) and epoxy plastics (e.g., protective coating in cans and bottles)
- **Halogenated compounds** and **organophosphorus compounds** used as flame retardants
- **Phthalates** used as plasticizers in PVC plastic found in products for flooring, wallpapers, electricity cables and foil

104 While there are established international and national criteria, there are significant differences in numeric criteria, definitions and interpretation/application of criteria by national or regional regulatory programmes (see section 4.3.2).

105 See https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7775

106 At that at the time of submission, the draft UNEP report was still subject to possible revisions.

- **PFAS** used as surface treatment on plastic fibres on carpets, furniture, and other textiles
- **UV filters** used to prolong the lifespan of plastics by protecting them from photo-degradation
- **Toxic metal(loid)s, i**ncluding cadmium, chromium, lead, mercury, cobalt, tin, and zinc
- **Polycyclic aromatic hydrocarbons (PAHs)** found in direct-contact consumer goods made of rubber or elastomers, including children's toys
- **Nonylphenols (NPs)** and other alkylphenols used mainly as antioxidants and plasticizers in plastics
- **Biocides** applied to plastic materials to protect it from attack and degradation by microorganisms
- **NIAS** that are present in plastic but were not added intentionally for a technical reason during the production process

A number of academic publications relevant to human health risks by source and by harm focus predominantly on four groups: bisphenols (2,269), flame retardants (1,065), PFAS (1,855) and phthalates (2,135) (Merki and Charles, 2022). Scientific consensus on harm caused by plastic-related exposure is high for bisphenols, flame retardants and phthalates, and medium for PFAS (Merki and Charles, 2022).

Similarly, **polymers of concern** could be identified and grouped based on chemical identities (e.g., molecular weight, reactive functional groups, presence of cationic groups, etc.), physico-chemical properties and/or indication of hazard. OECD has developed criteria to identify polymers of concern that are used selectively by many jurisdictions to identify polymers of low concern (PLCs): molecular weight, oligomer content, reactive functional groups, metal content, extractivity/solubility in water, cationic charge density, stability/degradability, chemical structure classes, hazard classifications, fluorinated polymers, water absorption, unreacted monomers and surface activity. Other PLC criteria that have, so for, not been used include lipophilicity, particle size/respirability, production volume, and intended uses. A major challenge is that information on the identities and hazardous properties of polymers is generally not readily available, and when hazard data is available it is limited to short-term toxicity of virgin substances without considering environmental fate and the uptake and chronic toxicity of polymers (Groh et al., 2023). There is an urgent need to undertake comprehensive assessment of the environmental hazards of polymers, including the effects of degradation and weathering and taking into account the actual uptake, long-term toxicity, and geophysical impacts (Groh et al., 2023). Academics have developed an integrated multi-criteria framework that establishes a systematic approach to identify polymers of concern based on 21 criteria (Senathirajah et al., 2022). Moreover, there is an urgent need for greater public transparency on chemical identities of polymers by providing an accurate, publicly accessible overview of all commercial polymers (Wang et al., 2021).

Strengthening the global governance of plastics and associated chemicals could include prioritising groups of chemicals and polymers of concern used in plastics and developing necessary guidelines to help countries to restrict their use. For instance, the European Chemicals Agency (ECHA) has assessed a group of 148 bisphenols and recommended that more than 30 bisphenols need to be restricted due to their potential hormonal or reprotoxic[107] effects (ECHA, 2022). In addition, a strengthened framework could facilitate the development of a comprehensive international hazard assessment database for chemicals and polymers used in plastics. See, for example, the Plastic Additive Initiative under ECHA which aimed to "characterise the uses of plastic additives and the extent to which the additives may be released from plastic articles."[108]

At the same time, it will be important to catalyse research for identification of **safe alternatives** through green and sustainable chemistry, green engineering, as well as non-chemical methods. Many safe alternatives to additives and processing aids used in plastics have already been identified but have not

107 Reprotoxic chemicals can damage the reproductive process (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Carcinogenic,_mutagenic_and_reprotoxic_(CMR))

108 https://echa.europa.eu/sv/plastic-additives-initiative

necessarily reached the market. The use of sustainability criteria for plastics and associated chemicals is expected to help direct resources for redesign of plastics and chemicals to find safe alternatives through chemical substitution (including use of safe and non-toxic bio-based chemicals), engineering, and use of non-chemical alternatives. When replacing plastics in use, the life cycle and carbon footprint of alternatives need to be considered (UNEP, 2022).

4.2.2. Possible approaches for controlling chemicals and polymers of concern used in plastics

There are various approaches for strengthening the global governance of chemicals and polymers of concern. Some of these options are presented briefly below as thought starters for further discussion. The approaches presented here will target the chemicals phase. Both approaches (negative list and positive list) discussed in this subsection can be used for chemicals of concern and polymers of concern. However, as discussed earlier, the criteria developed and used for prioritisation of chemicals of concern versus polymers of concern vary significantly and will need careful consideration, building on most recent scientific understanding on hazard and risk assessment. Existing knowledge gaps in particular regarding the identities of polymers will need to be resolved as a matter of urgency to enable such prioritisation. To deliver on the stated goal of achieving non-toxic circularity of plastics and for fulfilling the precautionary approach, all chemicals of concern should be phased out and replaced with safer alternatives, including non-chemical alternatives. However, at the global level, this may not be feasible to achieve this in the short-term. Thus, initially both hazard and exposure could be used as basis for prioritisation. For instance, chemicals of concern that easily leach from plastics (low chemical integrity) and those used extensively in plastics (high production volume) could be possible candidates for strengthened global governance. However, the scarcity of exposure data is problematic, as it will allow the continued use of numerous known chemicals of concern until a risk evaluation has been completed, after an oftentimes lengthy process.

Approach 1: Global negative list based on selection criteria

Selection criteria could be developed and used for prioritising chemicals or group of chemicals of concern. The identification of chemicals of concern using hazard data provides a valuable starting point, which also aligns with the precautionary principle. Moreover, hazard data could be complemented with exposure data, enabling the narrowing down and targeting of chemicals of concern for international action.

One option could include developing a hazard grade score. For instance, Groh et al. (2018) has developed science-based criteria for scoring additives used in food contact materials. Similarly, the U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) includes a scoring system for the most significant potential threats to human health due to their known or suspected toxicity, and potential for human exposure at these National Priorities List sites (ATSDR, 2022). A scientific scoring system could help in setting priorities for international support.

This approach would resemble the model provided by the Stockholm Convention. Appendix 5 includes a compilation of existing prioritisation criteria under multilateral instruments.

Limitations under the first approach include:

- An assessment of the chemicals that fulfil the criteria will have to be undertaken. Unless it is decided otherwise, the assessment of chemicals will need to be undertaken under a binding instrument and may require the establishment of a subsidiary scientific body that requires technical/ scientific expertise and funding to include new chemicals on the list. This option could lead to a duplication in efforts and could, depending on the criteria, in a worst case undermine the work of existing scientific bodies that conduct risk assessment. Alternatively, this task could be outsourced to the Science-Policy panel on Chemicals, Waste and Pollution Prevention, developed in response to UNEA Res. 5/8.

- Data on exposures is very scarce and incomplete. While there is some data available on production volumes, this data is not always easily accessible and will only provide very rough estimates of exposure. However, models exist that enable risk assessors to estimate exposure
- While data on hazard traits is becoming increasingly available, data gaps remain. This may set limitations for prioritisation.
- Prioritisation of chemicals of concern under a binding instrument would assumably not apply to uses in materials other than plastics (e.g., paper and cardboard). Nevertheless, their restriction would provide a strong signal for producers, manufacturers and retailers to also phase out their use in other materials.

Approach 2: Global negative list based on existing regulatory lists of chemicals of concern

It is possible to identify and prioritise chemicals of concern using existing knowledge on substance properties/hazards, such as lists of chemicals of concern that have been developed at subnational, national, regional and global levels for restricting the use of chemicals of concern. The CAS registry lists 151 "authoritative lists" or "regulatory lists" developed by authorities, IGOs, NGOs, multilateral instruments and private sector entities (CAS, 2021)[109]. Examples of national and subnational authoritative lists are listed below:

- Five lists developed by the EU (Candidate list of Substances of Very High Concern, Restricted Substances List, Authorisation List, PBT Assessment List, and Endocrine Disruptor Assessment List) restricting the use of 670 chemicals.
- The 1986 Safe Drinking Water and Toxic Enforcement Act of California (known as The California Proposition 65) requires the state to maintain and update a list of chemicals known to cause cancer, birth defects or other reproductive harm. The list includes 1009 chemicals.
- Chinese Prioritized List of Substances Subject to Control includes 40 entries for chemicals.

An example of a private sector list includes the Global Automotive Declarable Substance List (GADSL) developed by the automotive industry. It aims to facilitate exchange of information on certain substances in automotive products across the supply chain and that are expected to exist in a vehicle at the point of sale.[110]

Lists developed by governmental bodies could form the basis for identifying chemicals of concern. Moreover, more than one list should contain the chemicals in question to help show that it is beyond local or regional concern. To this end, a process similar to that used by the Chemical Review Committee (CRC) under the Rotterdam Convention may be adopted. Article 5 of the Convention states that any Party that has banned or severely restricted a chemical is required to notify this to the Secretariat. As soon as the Secretariat has received notifications from two parties from two different PIC regions regarding that chemical, the notifications shall be forwarded to the CRC for review and consideration for recommending the chemical for inclusion in Annex III to the Convention. Whether regulatory action in two regions equate with it being of concern such that it requires coordinated global reduction, or elimination, will require discussion.

The presence of a chemical in existing regulatory lists from two UN regions might be regarded as sufficient to trigger the review and the consideration for recommending by a committee. Listing of chemicals could serve as a control measure to restrict their use. Thus, it would significantly differ from the Rotterdam Convention that only applies a PIC procedure for listed chemicals. Alternatively, this approach could be used to list chemicals that need to be addressed as part of complying with the

109 The CAS registry is not free to access.

110 For more, see https://www.gadsl.org/

performance and transparency parameters developed under the sustainability criteria for plastics and associated chemicals.

This approach would have the advantage that it would make use of assessments and decisions already taken by authorities: 960 chemicals of potential concern used in plastics are subject to national/regional restrictions, from which only 7% are country/region specific (Wiesinger et al., 2021). The workload under the relevant instrument would be moderate, since a large portion of chemicals of potential concern used in plastics would directly qualify for listing.

Limitations under this approach include:

- An assessment of the chemicals that fulfil the criteria will have to be undertaken. The workload per chemical would be significantly smaller compared to approach 1, due to the use of assessments already carried out by authorities. However, there are no guarantees that the ad hoc nature of submissions can comprehensively address groups of chemicals of concern. A mapping of chemicals of potential concern used in plastics that are restricted in at least two regions organised under a groups of chemicals approach, could help to facilitate listing in an organised manner.
- Middle- and low-income countries have limited hazard and exposure data, and their capacities to effectively regulate and enforce hazard and risk assessment would benefit from assistance to allow for national upscaling under this approach.
- Chemicals of concern that are specific to individual countries/regions would not qualify for listing.

Approach 3: Global positive list based on chemicals deemed safe

A third approach could be to adopt a positive list of chemicals that can be used safely in the production of plastic materials and articles. At the global level, an example can be found in the London Protocol, which includes a whitelist in Annex 1 that lists those wastes or other matter that may be considered for dumping. This is in accordance with Article 4.1.1, which states that Contracting Parties shall prohibit the dumping of any wastes or other matter with the exception of those listed in Annex 1. Other examples can be found in the regional and national levels, for instance, China has adopted a positive list consisting of 1,294 additives used for food contact materials and articles, including some kinds of plastic (GB 9685-2016 Standard).[111] Moreover, as discussed above, OECD has developed criteria to identify polymers of concern that are used selectively by many jurisdictions to identify a positive list of PLCs.

The use of chemicals of concern could be restricted while allowing the use of safe chemicals approved by a scientific body and listed in a positive list. A positive list could be developed by excluding chemicals listed in existing authoritative lists developed by governments and other stakeholders or chemicals that fit into GHS hazard classes (altogether 590 chemicals of concern used in plastics) (Aurisano et al., 2021). Initially, a positive list could be developed for those product groups and applications (e.g., food contact materials or toys) in which exposure to chemicals of concern is particularly concerning. The use of other chemicals beyond the positive list would be permitted only if their use has been proven safe, with a pre-market toxicological risk assessment, and a notification of their use being sent to the Secretariat.

Limitations under this approach include:

- Considering the large number of chemicals used in plastics, the workload could be enormous. However, by pooling information from existing authoritative lists, the workload could reduce significantly. Nevertheless, a scientific and technical working group would need to be established to collect and update information as it becomes available (and request specific studies if needed), as well as to establish and maintain an authoritative information hub.

111 Positive lists for food contact plastics have been adopted in many countries and regions, including EU, Japan, US and MERCOSUR (Mercado Común del Sur).

- A positive list may lead to regrettable substitution, as it is commonly not based on groups of chemicals. A general challenge with this approach is the limited knowledge we have of the hazards and risks posed by chemicals, particularly for new chemicals. With this approach there is a risk of "whitelisting" chemicals that, as the knowledge of these chemicals expands, later turn out to have unwanted environmental health impacts. In addition, complexities can arise when chemicals included in whitelists require restriction for specific uses (e.g. restricting the use of certain chemicals in food materials plastics for fatty foods). A process for re-evaluating and updating the list would be required, including removing chemicals from the positive list.
- A positive list can stifle innovation if there are significant time lags in approving safer alternatives by the scientific and technical working group.
- It may be necessary to establish common naming standards for chemicals listed on the positive list.

Approach 4: Hybrid of any approaches 1-3

The options presented above are not mutually exclusive and can be combined in various ways. For instance, option 1 could be combined with a fast-track option for chemicals or groups of chemicals that do not need in depth scrutinising. Option 2 could be helpful in this regard.

In addition, a sector-specific approach can be an effective way forward in the development of guidelines that are more closely related and relevant to different uses and different needs within the various sectors. This may include whitelists and/or grey lists for plastics and associated chemicals to be favoured and/or avoided, respectively. This approach has been presented above to support the development of international sustainability criteria. To this end, this could include a broader approach and apply to all forms of plastic pollution. For chemicals of concern, it could consist of a whitelist that lists chemicals that have proven to be safe based on hazard and risk assessment (risk data and, where appropriate, risk management procedures are available), as well as a grey list of chemicals with hazard data indicating toxicity but has not yet undergone risk assessment. This approach would support chemical simplification, as it would clearly narrow the chemicals used in plastics.

4.3. Other possible mechanisms for closing the governance gaps

4.3.1. Developing a hierarchy of action for chemicals management

International governance regarding the use of chemicals and polymers could follow a priority order to help complement the waste management hierarchy from a chemical standpoint. A hierarchy of action for chemicals management can be promoted separately or viewed as a desired outcome of the applying the sustainability criteria for plastics and associated chemicals. It could include the following priority order of actions:

1. **Minimise:** Minimise the overall use of all chemicals.
2. **Restrict use**: Across the full life cycle of plastics, restrict use of chemicals and polymers of concern, and only allow their use for "essential uses" when currently no substitute is available.
3. **Safely manage and substitute:** Encourage use of safer and more sustainable and cost-appropriate chemicals through chemical substitution, engineering, and use of non-chemical alternatives.
4. **Reuse:** Promote the repeated use of items in their original form to eliminate the need to reprocess materials, which requires use of chemicals**.**
5. **Recycle and recover** with the following priority order: 1) keep form and size; 2) keep material (remould thermoplastics, avoid thermosets); 3) keep the composition (do not add or remove constituents when re-melting); 4) keep molecules (polymers, additives), 5) keep building blocks (monomers); 6) keep atoms (pyrolysis); and 7) keep energy ("thermal recycling") (Zuin and Kümmerer, 2022).

The application of the concept of essential uses for specific chemicals or groups of chemicals will require extensive scientific and technical expertise. The concept has been deployed by the Montreal Protocol, which through Decision IV/25, specifies the following criteria for essential uses for controlled substances: 1) it is necessary for the health, safety or is critical for the functioning of society; and 2) there are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health.

4.3.2. Harmonising methodologies for hazard and risk assessment

The Global Chemicals Outlook II report highlights that lack of agreed methodologies for chemical hazard and alternatives assessment hinders efforts to achieve chemicals safety (UNEP, 2019). To this end, a bottom-up approach could be taken, promoting the uptake of harmonised methodologies for hazard and risk assessment for chemicals used in plastic and, building on and complementing existing work, including the eChemPortal and OECD's Risk Assessment Toolkit. Moreover, efficiency gains could be achieved by promoting sharing and acceptance of hazard assessments undertaken at the national/regional level, including through better use of OECD's Mutual Acceptance of Data in the Assessment of Chemicals (MAD).[112]

An amended instrument or the new plastics agreement could help to develop and harmonise methodologies for hazard and risk profiles for polymers. To date, polymers have been a low priority for chemical assessment and management programs, thus most countries rely on polymer assessment schemes that were developed in the early 1990s (Groh et al., 2023). However, since then, scientific understanding related to the human health and environmental impacts of polymers has progressed considerably, for example, the notion of "high"-molecular weight polymers being generally inert and causing no biological effects has been challenged (Groh et al., 2023). Moreover, studies have demonstrated that weathering of plastics in the environment could result in significantly different toxicity profiles compared to the virgin materials (Groh et al., 2023).

4.3.3. Developing a global knowledge hub

Currently, existing data on identities, occurrence and toxicity data in chemicals and polymers of concern is limited and scattered across platforms, many of which are located behind paywalls, thus hindering access. There is a need to consider developing a global knowledge hub to increase access to data on identities, occurrence and toxicity data of chemicals and polymers of concern in commerce.

112 The OECD Council Act C(81)30 "requires that data generated in the testing of chemicals in an OECD Member country in accordance with OECD Test Guidelines and OECD Principles of Good Laboratory Practice shall be accepted in other Member countries for purposes of assessment and other uses relating to the protection of man and the environment."

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Tire wear is one the largest sources of secondary microplastics. They are commonly discarded in large tire dumps, increasing the risk of fire and the release of toxic chemicals. Photo © Maximlitus. Dreamstime.com

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Appendices

Appendix 1. Compilation of summary tables of governance elements included in the multilateral instruments reviewed

1. Summary table of governance elements included in the Stockholm Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Indicators included in the effectiveness evaluation	• Indicators included in the effectiveness evaluation	• Indicators included in the effectiveness evaluation
Control measures		• Prohibit the production and use of chemicals listed in Annex A, subject to provisions of that Annex • Restrict production and use of chemicals listed in Annex B in accordance with the provisions of that Annex	• Prohibit the production and use of chemicals listed in Annex A, subject to provisions of that Annex • Restrict the production and use of chemicals listed in Annex B in accordance with the provisions of that Annex	• Work towards elimination of UPOPs listed in Annex C • Safely manage POPs stockpiles, • Dispose of POPs wastes, including products/articles upon becoming waste, in such a way that the POP content is destroyed or irreversibly transformed, or otherwise disposed of in an environmentally sound manner • Endeavour to develop strategies to identify contaminated sites • Undertake remediation of sites contaminated with POPs (voluntarily)
Reporting, monitoring & inventories		• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export	• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export	• Provide statistical data on quantities of production, import and export of POPs listed in Annexes A and B, including, to the extent practicable, name states of import/export • Develop POPs inventories (voluntarily) • Develop source inventories and release estimates of UPOPs
Trade		• Take measures to ensure chemicals listed in Annex A or Annex B are imported only for a use or purpose permitted for the Party • Take measures to ensure chemicals listed in Annex A or Annex B are exported only to a Party which permitted to use that chemical or under specific conditions for non-Party states	• Take measures to ensure chemicals listed in Annex A or Annex B are imported only for a use or purpose permitted for the Party • Take measures to ensure chemicals listed in Annex A or Annex B are exported only to a Party which permitted to use that chemical or under specific conditions for non-Party states	• Ensure chemicals listed in Annex A or Annex B are imported or exported only for their environmentally sound disposal • International transport of POPs waste to take into account relevant international rules, standards and guidelines
NAPs		• Develop and update a NIP to implement the convention's obligations	• Develop and update a NIP to implement the convention's obligations	• Develop and update a NIP to implement the convention's obligations • Develop an action plan for UPOPs

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Transparency & information exchange		• Exchange information on the reduction/elimination of the production, use and release of POPs • Exchange information on alternatives to POPs	• Exchange information on the reduction/elimination of the production, use and release of POPs • Develop strategies to identify POPs in products/ articles • Label certain POPs, e.g., HBCD used in EPS/XPS in buildings	• Exchange information on the reduction/elimination of the production, use and release of POPs • Develop strategies to identify POPs in stockpiles and waste

2. Summary table of governance elements included in the Minamata Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Reduce the use of mercury containing catalysts in the production of PUR, ideally within 10 years of entry into force of the Convention • Reduce the use of mercury in VCM production by 50% by 2020 using 2010 as a base line		
Control measures	• Reduce reliance on mercury from primary mining for VCM production and the production of PUR using mercury containing catalyst	• Prohibits the use of mercury in VCM production 5 years after mercury-free catalysts have become available, as determined by the COP • Control emissions and releases of mercury		• Manage mercury waste in an environmentally sound manner • Action taken to [voluntarily] remediate contaminated sites needs to be conducted in an environmentally sound manner • Control emissions and releases of mercury
Reporting, monitoring & inventories		• Endeavour to cooperate to develop/improve inventories of use, consumption, and emissions/releases • Report on efforts to develop/ identify alternatives for mercury in VCM/PUR production • Submit information of use of mercury in facilities that produce VCM/PUR • Establish and maintain an inventory of emissions and releases		• Endeavour to identify individual stocks of mercury/mercury compounds exceeding 50 t, and sources of mercury supply generating stocks exceeding 10 t per year • Shall establish inventories or emissions and releases from relevant sources • Endeavour to develop strategies to identify/assess contaminated sites • Endeavour to cooperate to develop/improve modelling and monitoring of levels of mercury/ mercury compounds in vulnerable populations and in environmental media
Trade		• Exporting mercury requires written consent from the importer and only for the purpose of an allowed use or for environmentally sound interim storage		• Take appropriate measures so that mercury waste is, for Parties of the Basel Convention, transported across international boundaries only for environmentally sound disposal. In circumstances where the Basel Convention does not apply, a Party must take into account relevant international rules, standards, and guidelines

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
NAPs				
Transparency & information exchange		• Facilitate the exchange of information on the reduction/ elimination of the production, use, trade, and emissions/ releases of mercury/mercury compounds and information on alternative manufacturing processes • Reporting on mercury trade and other key provisions		

3. Summary table of governance elements included in the Montreal Protocol

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators		• Targets provided for phasing out production and consumption of ODSs listed in Annexes A, B, C, and E • Targets provided for phasing-down the production and consumption of HFCs listed in Annex F		
Control measures		• Controlled measures linked to achieving targets set for production of controlled substances listed in Annexes A, B, C, E and F		• Ensure that HFC-23 emissions generated from manufacture of certain controlled substances are destroyed to the extent practicable
Reporting, monitoring & inventories		• Provide statistical data on annual production of each of the controlled substances • Provide statistical data separately, for each controlled substance regarding amounts used for feedstocks • Provide statistical data separately, for each controlled substance regarding imports/exports		• Provide statistical data separately, for each controlled substances regarding amounts destroyed by technologies approved by parties
Trade		• Parties shall ban the import/export of all controlled substances from/to any State not party to the Protocol • If a Party is unable to cease production of a controlled substance for domestic consumption (other than for essential uses), it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction		• If, after the phase-out date of a controlled substance, a Party is unable to cease production of that substance for domestic consumption (other than for essential uses), it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction
NAPs				
Transparency & information exchange		• Encourages exchange of information on alternatives to replace ODS feedstocks; systems used for qualifying a specific ODS use as feedstock use; and systems used for monitoring feedstock containers placed on the market		

4. Summary table of governance elements included in the ILO Chemicals Convention (C170)

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures		• Prescribes the classification of chemicals by hazards • Employers shall make an assessment of the risks of using chemicals at work, including identify chemicals that can eliminate/minimise risk and limit exposure • Employers shall assess the exposure of workers to hazardous chemicals and ensure they are not exposed to chemicals exceeding limits	• Employers shall make an assessment of the risks of using chemicals at work, including identify chemicals that can eliminate/minimise risk and limit exposure • Employers shall assess the exposure of workers to hazardous chemicals and ensure they are not exposed to chemicals exceeding limits	• Employers shall ensure that unneeded hazardous chemicals are disposed of in a manner that eliminates/ minimises the risk to safety, health and the environment
Reporting, monitoring & inventories				
Trade		• Exporting member States shall communicate to any importing country whether uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it		
NAPs				
Transparency & information exchange		• Suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals • Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets have been provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained	• Suppliers of chemicals shall ensure that chemicals are marked to indicate their identities, hazardous chemicals are labelled, and workers receive safety data sheets of hazardous chemicals • Employers shall adhere to same marking/labelling requirements for chemicals used at work and ensure that safety data sheets have been provided. Where these are not available, the chemicals shall not be used by employers until such labelling and information has been obtained	

5. Summary table of governance elements included in the Rotterdam Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets and indicators				
Control measures				
Reporting, monitoring and inventories		• Measures to strengthen national infrastructures/institutions may include the establishment of national registers and databases, including safety information for chemicals		
Trade		• Exports of chemicals listed in Annex III subject to PIC procedure • When a chemical is not listed in Annex III but is banned or severely restricted by an exporting Party, it shall notify the importing Party before the first shipment and annually thereafter		
NAPs				
Transparency & information exchange		• Facilitate the exchange of scientific, technical, economic and legal information concerning the chemicals within the scope of the Convention • Facilitate the provision of publicly available information on domestic regulatory actions relevant to the objectives of the Convention and actions that substantially restrict one or more uses of the chemical		

6. Summary table of governance elements included in the Basel Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				• The strategic framework 2012-2021 provided targets and indicators. The only other targets adopted so far pertain to the overall rate, the timeliness and the completeness of national reports
Control measures	• Generation of wastes minimised	• Generation of wastes minimised	• Generation of wastes minimised	• Ensure the generation of hazardous wastes and other wastes is reduced to a minimum • Ensure availability of adequate disposal facilities • Ensure transboundary movement of hazardous wastes and other wastes is reduced to a minimum • Minimise the consequences of pollution resulting from the management of wastes
Reporting, monitoring & inventories	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Report annually on development of technologies for reduction &/ or elimination of generation of hazardous wastes & other wastes	• Mandatory annual reporting on amounts exported/imported • Voluntary annual reporting on amounts generated • Monitor effects of hazardous wastes management on human health and the environment • Review and evaluate the effective implementation of the Convention

Trade				• Three entries specific to plastic wastes regulated, with two requiring PIC procedure for transboundary movements • Transboundary movement of hazardous wastes prohibited from Annex VII Parties (Parties and other States which are members of the OECD, EC, Liechtenstein) that have ratified the Ban Amendment to non-Annex VII Parties • Illegal traffic to be considered criminal
NAPs				
Transparency & information exchange				• PIC procedure for transboundary movement of wastes subject to the Convention • Information to be provided on notification to include effects of transboundary movement of hazardous and other wastes on human health & environment

7. Summary table of governance elements included in MARPOL Annex V

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Discharge of plastics from ships into the sea is prohibited, including fishing gear • Provision of adequate garbage reception facilities at ports & terminals
Reporting, monitoring & inventories				• Require recording of each discharge to a reception facility and completed incinerations for larger ships (Garbage Record Book) and smaller ships (ship's official logbook) • In addition, any discharge provided for under the exemptions on the ban of plastic discharge shall also be recorded either in the Garbage Record Book or the ship's logbook, providing details of the items discharged or lost, the location, circumstances of, and the reasons for the discharge or loss. Where such discharge is fishing gear that poses a significant threat to the marine environment or navigation, it mut be reported to the flag State and the coastal State, if applicable
Trade				
NAPs				
Transparency & information exchange				• Right to inspect and make a copy of ship records regarding each discharge into a reception facility or a completed incineration, as well as exempted discharges[113] or accidental losses

113 Exception clauses: (1) The discharge of garbage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or (2) The accidental loss of garbage resulting from damage to a ship or its equipment, provided that all reasonable precautions have been taken before and after the occurrence of the damage, to prevent or minimise the accidental loss; or (3) The accidental loss of fishing gear from a ship provided that all reasonable precautions have been taken to prevent such loss; or (4) The discharge of fishing gear from a ship for the protection of the marine environment or for the safety of that ship or its crew (Reg 7.1).

8. Summary table of governance elements included in the London Convention

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Dumping of persistent plastics & other persistent synthetic materials • Includes some chemicals used in plastics life cycle • Permit required to dump sewage sludge and dredged material (can contain plastics) • Collaborate on mitigation of pollution caused by dumping upon request
Reporting, monitoring & inventories				• Keep records of all matter permitted to be dumped • Cooperate to develop reporting procedures for illegal dumping
Trade				
NAPs				
Transparency & information exchange				

9. Summary table of governance elements included in the London Protocol

	Sourcing/ Extraction Phase	Chemical Phase	Material Phase	Dematerialisation Phase
Targets & indicators				
Control measures				• Dumping of plastics and substances used in plastics is prohibited (not included in whitelist) • Provides for development of procedures on liability for environmental damage resulting from dumping or incineration of wastes or other matter at sea
Reporting, monitoring & inventories				• Establish procedures for assessing & promoting compliance • Continually evaluate effectiveness of the Protocol • Develop National Action Lists for screening of wastes that may be considered for dumping permits
Trade				• Trade of wastes or other matter for the purpose of dumping or incineration at sea shall be prohibited
NAPs				
Transparency & information exchange				• Promote availability information on scientific & technical activities & measures undertaken, and impacts observed from monitoring and assessment

Appendix 2. Mapping of legally binding multilateral instruments that could address plastics and associated chemicals

The summary of the mapping presented here contains text shortened by the authors with relevant articles cited.

Objectives

UNEA Res. 5/14 para 3(a) mandates the INC to specify the objectives of the plastics instrument. Table 15 provides an overview of existing Multilateral instruments with relevance to plastics and their objectives.

Table 15: Selection of objectives from relevant global instruments and their relevance to plastics

Instrument	Overall objective	Relevance to plastics
MULTILATERAL INSTRUMENTS FOCUSED ON CHEMICALS		
Stockholm Convention	Mindful of the precautionary approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants (Art. 1).	Prohibits and/or restricts the use of listed POPs, some of which are used, among others, as additives in plastics (e.g., as flame retardants, plasticizers, or surfactants), as well as restricts releases of unintentional POPs deriving, inter alia, from open burning of waste and waste incinerators.
Montreal Protocol	Protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer (Preamble). "Adverse effects" means changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind (Vienna Convention, Art. 1, para 2).	Prohibits the use of controlled substances (ODSs and HFCs), including their use as blowing agents in the production of extruded-polystyrene and polyurethane foams. Provides an exemption for use of controlled substances as process agents and feedstocks. Restrictions apply to controlled substances existing alone or in a mixture but excludes their presence in manufactured products.
Minamata Convention	Protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds (Art. 1).	Restricts the use of mercury and mercury compounds in the production of polyurethane using mercury containing catalysts and in vinyl chloride monomer production.
ILO Chemicals Convention, 1990 (No. 170)	Each Member shall formulate, implement and periodically review a coherent policy on safety in the use of chemicals at work (Art. 4).	Places requirements on employers to improve transparency on exposure to chemicals in the workplace, which would include chemicals used in plastics and processing aids.
Rotterdam Convention	The objective of this Convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties (Art. 1).	Requires use of PIC procedure in international trade for chemicals listed in Annex III some of which are used, among others, as monomers, additives, or processing aids in the production of certain plastics. The PIC procedure only applies to chemicals and not to chemicals in articles (materials).

Instrument	Overall objective	Relevance to plastics
SAICM (Non-binding)	Achieve the sound management of chemicals throughout their life cycle so that, by 2020, chemicals are used and produced in ways that lead to the minimisation of significant adverse effects on human health and the environment (OPS, para 13).[114]	Several "Emerging Policy Issues" and "Other Issues of Concern" are of relevance to plastics.
MULTILATERAL INSTRUMENTS FOCUSED ON WASTE		
Basel Convention	Aware of the risk of damage to human health and the environment caused by hazardous wastes and other wastes and the transboundary movement thereof (Preamble). Determined to protect, by strict control, human health and the environment against the adverse effects which may result from the generation and management of hazardous wastes and other wastes (Preamble). "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 (Art. 2d).	It provides guidance on the technical requirements for the Environmental Sound Management of plastic waste[115]. Specifically regulates the transboundary movement of waste plastics, categorising waste plastics into three groups, two of which require prior informed consent before subjected to transboundary movement. It also prohibits the export of plastic waste identified as hazardous wastes from member states of the European Union, Organization for Economic Cooperation and Development (OECD), and Liechtenstein to all other countries.
MARPOL Annex V	Prohibit the discharge of garbage into the sea.	Plastics are included in the definition of garbage. A definition of plastics is provided that includes synthetic fishing nets.
London Convention	Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment and pledge themselves especially to take all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea (Art. I).	Bans the intentional dumping of all wastes generated on land that contain plastics and incineration of plastics at sea. Regulates the dumping of a small range of chemical feedstocks into the ocean.
London Protocol	Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonise their policies in this regard (Art. 2).	Bans the intentional dumping of all wastes generated on land unless allowed under the Protocol. Plastics and chemicals used in plastics are not included in the list of permissible wastes (whitelist) of Annex I.
RELEVANT FRAMEWORK AGREEMENTS		
UNCLOS	States have the obligation to protect and preserve the marine environment (Art. 192).	Establishes a duty for States to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source (Art. 194).

114 SAICM is effectively under renegotiation and will be replaced by the Beyond-2020 Framework for sound management of chemicals and waste to be adopted in 2023.

115 For information on the process for updating of the technical guidelines for the identification and environmentally sound management (ESM) of plastic wastes and for their disposal see: www.basel.int/Implementation/Plasticwaste/Technicalguidelines/Overview/tabid/7992/Default.aspx

Instrument	Overall objective	Relevance to plastics
CBD	The conservation of biological diversity, the sustainable use of various aspects of it, and the fair and equitable sharing of the benefits arising from commercial and other utilisation of genetic resources (Art. 1).	Requires rehabilitating and restoring degraded ecosystems and promoting the recovery of threatened species.
UNFCCC	Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (Art. 2).	Restricts some greenhouse-gas emissions, including applying to emissions related to production of plastics from fossil raw materials.
Kyoto Protocol	Each Party included in Annex I, in achieving its quantified emission limitation and reduction commitments under Article 3, in order to promote sustainable development, shall take the measures listed in the article (Art. 2.1).	Possible reduction targets for the emission of GHG from the plastics life cycle.
Paris Agreement	Strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty (Art. 2).	Possible reporting of contribution of plastics life cycle to GHG national and global targets.

The objectives provided in existing Multilateral instruments allow loose groupings to illustrate possible approaches to the design of an objective for the new global plastics instrument. These can be grouped into those that allude to outcomes, goals and the life cycle. Examples of each include:

- **Outcomes**
  - protect human health and environment
  - protect against significant adverse effects on human health and/or the environment resulting or likely to result from human activities
- **Goals**
  - prevent, reduce and, where practicable, eliminate pollution
  - minimise adverse effects of climate change, international trade, social, environmental and economic impacts
- **Full life cycle**
  - sound management of chemicals throughout life cycle
  - chemicals used and produced in ways that minimise significant adverse effects
  - hazardous wastes/other wastes managed in a manner which protect against the significant adverse effects which may result from such wastes.

Sourcing Phase – Extraction

Measures directly related to chemicals in plastics

Chemicals/materials/products and activities to be phased out:

- The **Minamata Convention** restricts the use of mercury or mercury compounds in the processes listed in Part II of Annex B (Art. 5, para 3). This includes reducing the reliance on mercury from primary mining for vinyl chloride monomer production and the production of polyurethane using mercury containing catalyst (Part II, Annex B).

Measures directly related to plastic products

There are no binding measures at the global level specific to extraction of hydrocarbons used to produce plastics (polymers) fossil raw materials for plastic production in the current global framework of chemicals and plastics (see section 3.1 for discussion on gaps).

Broader measures indirectly encompassing plastics and associated chemicals

Targets

- The objective of the **UNFCCC** is stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (Art. 2). This level was defined by the Paris Agreement that aims to strengthen the global response to the threat of climate change by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels (Art. 2, para. 1a)

Chemicals/materials/products and activities to be phased out:

- The **Minamata Convention** prohibits Parties from conducting primary mercury mining that was not being conducted within its territory at the date of entry into force of the Convention (Art. 3, para 3). Parties can conduct primary mercury mining that was being conducted within its territory at the date of entry into force of the Convention for it for a period of up to 15 years after that date (Art. 3, para 4)

Examples of approaches from other legal instruments

Chemicals/materials/products/activities to be regulated:

- The **EU Waste Framework Directive** requires Member States to take measures to prevent waste generation, including from extraction of minerals (Art. 9, para 1f).
- The **Antigua Convention** requires Contracting Parties to incorporate criteria within their economic development projects that provide sustainability in the use of resources and in the maintenance of the integrity of ecosystems (Art. 10, para 1).
- The **CBD** encourages Parties and other stakeholder engaged in the energy and mining, infrastructure, manufacturing and processing sectors to include approaches to conserve, enhance and sustainably use biodiversity and ecosystem functions and services in upstream decisions on investments in these sectors (Decision 14/3, para 11 b).

Chemical Phase – Production

Measures directly related to chemicals in plastics

Targets:

- The **Minamata Convention** includes measurable and time-bound targets to 1) reduce the use of mercury containing catalysts in the production of polyurethane aiming at the phase out of this use as fast as possible, within 10 years of the entry into force of the Convention, and 2) reduce the use of mercury in terms of per unit of vinyl chloride monomer production by 50% by 2020 using 2010 as a base line (Annex B, Part II).
- The **Montreal Protocol** includes targets for controlled substances, including for phasing out ozone-depleting substances (ODSs) listed in Annexes A, B, C, and E, and for phasing-down the production of hydrofluorocarbons (HFCs) listed in Annex F of the Protocol (Art. 2). The chemicals are used primarily for cooling and refrigeration, but many of them are used as blowing agents in the production of extruded-polystyrene and polyurethane foams. Some of these substances are also used as aerosol propellants, in fire extinguishing and fumigation applications, as well as feedstocks and process agents in the production of other chemicals including fluoropolymers.

Chemicals/materials/products and activities to be phased out:

- The **Stockholm Convention** requires Parties to prohibit and/or take the legal and administrative measures necessary to eliminate the production and use of the chemicals listed in Annex A (Art. 3, para 1a). Any Party may register for one or more types of specific exemptions for substances listed

in Annex A for a duration of five years (Art. 4, paras 3–4). A Party concerned may request the COP to extend a specific exemption an additional five years (Art. 4, para 7). When there are no longer any Parties registered for a particular type of specific exemption, no new registrations may be made with respect to it (Art. 4, para 9). Table 16 provides a summary of chemicals or chemical mixtures in Annex A that are relevant for plastics alongside other uses.

Table 16: Summary of chemicals in Annex A that are deemed relevant for plastics

Substance	Specific exemptions that apply to plastics when applicable	Decision
Short-chain chlorinated paraffins (SCCPs)	• Use in additives in the production of transmission belts in the natural and synthetic rubber industry • Spare parts of rubber conveyor belts in the mining and forestry industries • Secondary plasticizers in flexible PVC, except in toys and children's products	SC-8/11
Decabromodiphenyl ether (decaBDE))	• Use in parts for use in vehicles specified in paragraph 2 of Part IX of this Annex • Textile products that require anti-flammable characteristics, excluding clothing and toys • Additives in plastic housings and parts used for heating home appliances, irons, fans, immersion heaters that contain or are in direct contact with electrical parts or are required to comply with fire retardancy standards, at concentrations lower than 10% by weight of the part • Polyurethane foam for building insulation	SC-8/10
Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds	• Textiles for oil and water repellency for the protection of workers from dangerous liquids that comprise risks to their health and safety • Manufacture of polytetrafluoroethylene (PTFE) and polyvinylidene fluoride (PVDF) for the production of a) high-performance, corrosion-resistant gas filter membranes, water filter membranes and membranes for medical textiles, b) Industrial waste heat exchanger equipment, and c) Industrial sealants capable of preventing leakage of volatile organic compounds and PM2.5 particulates • Manufacture of polyfluoroethylene propylene (FEP) for the production of high-voltage electrical wire and cables for power transmission • Manufacture of fluoroelastomers for the production of O-rings, v-belts and plastic accessories for car interiors	SC-9/12
Perfluorohexane sulfonic acid (PFHxS), its salts, and PFHxS-related compounds	• No exemptions relevant for plastics	
Hexabromocyclododecane (HBCD)	• Expanded polystyrene and extruded polystyrene in buildings	SC-6/13
Polychlorinated naphthalenes (PCNs)	• No exemptions relevant for plastics	SC- 7/14
Pentachlorophenol (PCP) and its salts and esters	• No exemptions relevant for plastics	SC 7/13
Hexabromodiphenyl ether / heptabromodiphenyl ether	• Recycling of articles that contain or may contain hexabromodiphenyl ether and heptabromodiphenyl ether, and the use and final disposal of articles manufactured from recycled materials that contain or may contain hexabromodiphenyl ether and heptabromodiphenyl ether	SC-4/14

Substance	Specific exemptions that apply to plastics when applicable	Decision
Tetrabromodiphenyl ether / pentabromodiphenyl ether	• Recycling of articles that contain or may contain tetrabromodiphenyl ether and pentabromodiphenyl ether, and the use and final disposal of articles manufactured from recycled materials that contain or may contain tetrabromodiphenyl ether and pentabromodiphenyl ether	SC-4/18
Polychlorinated biphenyls (PCBs)	• No exemptions relevant for plastics. Note that PCBs might be used in open applications such as cable-sheaths, cured caulk and painted objects, which should be managed in accordance with Article 8.	Included in Annex A in conjunction with the adoption of the Convention

- The **Montreal Protocol** aim to phase out ODSs listed in Annexes A, B, C, and E (Art. 2)**.** The Protocol defines "production" as the amount of controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties and minus the amount entirely used as feedstock in the manufacture of other chemicals, whereas "consumption" means production plus imports minus exports of controlled substances. (Art. 1, para 6). The amount recycled and reused is not to be considered as "production" (Art. 1, para 5). Decision I/12B (para a) clarifies that "controlled substances produced" is the calculated level of controlled substances manufactured by a party excluding the calculated level of controlled substances entirely used as a feedstock in the manufacture of other chemicals. Parties shall assess the control measures (provided for in Art. 2 and Art. 2A to 2J) at least every four years based on available scientific, environmental, technical and economic information (Art. 6).
- The **Minamata Convention** prohibits the use of mercury in vinyl chloride monomer production five years after the COP has established that mercury-free catalysts based on existing processes have become technically and economically feasible (Part II, Annex B).

Chemicals/materials/products and activities to be regulated:

- The **Stockholm Convention** requires Parties to restrict their production and use of the chemicals listed in Annex B in accordance with the provisions of that Annex (Art. 3, para 1b). In addition to specific exemptions, any Party may register for one or more types of acceptable purposes listed in Annex B.
- The **Montreal Protocol** includes targets for controlled substances, including for phasing-down the production of hydrofluorocarbons (HFCs) listed in Annex F of the Protocol (Art. 2).

Emissions prohibited:

- The **Minamata Convention** requires Parties with relevant sources to take measures to control emissions (Art. 8, para 3) and releases (Art. 9, para 4). Measures to be taken to restrict the use of mercury or mercury compounds in the processes listed in Part II of Annex B in accordance with the provisions set out therein (Art. 5, para 3), including reduce emissions and releases from vinyl chloride monomer production and production of polyurethane using mercury containing (Annex B, Part II).
- The **ILO Chemicals Convention (170)** requires employers to assess the exposure of workers to hazardous chemicals and ensure that workers are not exposed to chemicals exceeding exposure limits or other exposure criteria established by appropriate bodies (Art. 12).

Trade:

- The **Rotterdam Convention** allows a State of import to decide to not consent or to consent with conditions to the future import of the chemicals listed in Annex III (Art. 10, para 2). Chemicals listed in Annex III shall not be exported to any importing Party that, in exceptional circumstances, has failed to transmit a response or has transmitted an interim response that does not contain an interim decision, unless a) It is a chemical that, at the time of import, is registered as a chemical in the importing Party; or b) it is a chemical for which evidence exists that it has previously been used in, or imported into, the importing Party and in relation to which no regulatory action to prohibit its use has been taken; or c) an explicit consent to the import has been sought and received by the exporter (Art. 11, para 2). When a chemical not listed in Annex III but banned or severely restricted by a Party is exported from its territory, that Party shall notify each individual importing Party before the first shipment and annually thereafter (Art. 12, paras 1-2). The following decisions have been taken to amend Annex III to the Rotterdam Convention to list hazardous chemicals that are of relevance to plastics (alongside other uses):
    - Perfluorooctane sulfonic acid (PFOS) its salts and perfluorooctane sulfonyl fluoride (PFOSF) (Decision RC-6/7)
    - Tetrabromodiphenyl ether / pentabromodiphenyl ether (Decision RC-6/5)
    - Hexabromodiphenyl ether / heptabromodiphenyl ether (Decision RC-6/6)
    - Short-chain chlorinated paraffins (SCCPs) (Decision RC-8/4)
    - Hexabromocyclododecane (HBCD) (Decision RC-9/3)
    - Decabromodiphenyl ether (DecaBDE) (Decision RC-10/6)
    - Perfluorooctanoic acid (PFOA), it salts and PFOA-related compounds (Decision RC-10/7)
    - Tributyltin compounds (tributyltin chloride, tributyltin methacrylate and bis(tributyltin)oxide are of relevance to plastics) (RC-8/5)
    - Polychlorinated biphenyls (PCBs) were included in Annex III in conjunction with adoption of the Convention. Moreover, the convention has listed several chemicals used in plastics as pesticides (Ethylene dichloride, Ethylene oxide, 1,2-dibromoethane, mercury compounds) and one as a severely hazardous pesticide formulation (Thiaram) (Wiesinger et al., 2021).

Reporting:

- The **Minamata Convention** requires Parties to report on efforts to develop and/or identify alternatives to help phase out mercury use in vinyl chloride monomer production and production of polyurethane using mercury containing catalysts, and requires Parties with one or more facilities that use those chemicals to submit to the Secretariat, information on the number and types of such facilities and the estimated annual amount of mercury or mercury compounds used in those facilities (Art. 5, para 5c).

Transparency and information sharing

- The **Montreal Protocol** encourages parties to exchange information on known alternatives being applied to replace ODS in feedstock uses (Decision XXIIV/6, para 1). Moreover, parties with feedstock uses are encouraged to exchange information on systems they have in place for qualifying a specific ODS use as feedstock use and for identification and/or monitoring of containers placed on the market and intended for feedstock uses, for example reporting or labelling requirements (Decision XXIIV/6, para 2).

Measures directly related to plastic products

There are no binding measures at the global level specific to plastic products in the chemical phase.

Broader measures indirectly encompassing plastics and associated chemicals

Chemicals/materials/products and activities to be regulated:

- The **ILO Chemicals Convention (C170)** provides for the establishment of a chemicals classification system to be based on systems and specific criteria for determining the type and degree of health and physical hazards, including how to such information can be used to assess if a chemical is hazardous (Art. 6.1). These classification systems and their application shall be progressively extended (Art. 6.2).
- The **ILO Chemicals Convention (170)** requires employers to make an assessment of the risks arising from the use of chemicals at work, including the choice of chemicals that can eliminate or minimise risk, and limit exposure to hazardous chemicals to protect safety and health of workers (Art. 13).

Emissions prohibited:

- The **ILO Chemicals Convention (170)** requires employers to assess the exposure of workers to hazardous chemicals and ensure that workers are not exposed to chemicals exceeding exposure limits or other exposure criteria established by appropriate bodies (Art. 12).

Trade:

- The **Minamata Convention** allows Parties to export mercury only to other Parties that have provided the exporting Party with its written consent, and only for the purpose of a use allowed to the importing Party under this Convention or environmentally sound interim storage (Art. 3, para 6a). Moreover, the convention allows Parties to export mercury only to non-Parties that have provided their written consent, including certification demonstrating that the non-Party has measures in place to ensure the protection of human health and the environment and to ensure its compliance with the provisions of Articles 10 and 11; and mercury will be used only for a use allowed to a Party under this Convention or for environmentally sound interim storage (Art 3, para 6b).
- The **Montreal Protocol** requires Parties to ban the import/export of any controlled substances in Annexes A, B, C, E and F from/to any State not party to the Protocol (Art. 4). Where, after the phase-out date applicable to it for a controlled substance, a Party is unable, despite having taken all practicable steps to comply with its obligation under the Protocol, to cease production of that substance for domestic consumption, other than for uses agreed by the Parties to be essential, it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction (Art. 4A). Moreover, Parties shall implement a system for licensing the import and export of new, used, recycled and reclaimed controlled substances in Annexes A, B, C, E and F.
- The **ILO Chemicals Convention (C170)** requires an exporting member State to communicate to any importing country whether all or some uses of hazardous chemicals are prohibited for reasons of safety and health at work, and the reasons for it (Art. 19).

Reporting:

- The **Stockholm Convention** requires Parties to provide statistical data on its total quantities of production, import and export of each of the chemicals listed in Annexes A and B (or a reasonable estimate of such data); and a list of the States from which it has imported each such substance and the States to which it has exported each such substance (Art. 15, para 2).

Monitoring and evaluation plans:

- The **Stockholm Convention** requires Parties to encourage and/or undertake appropriate research, development, monitoring and cooperation pertaining to POPs and, where relevant, to their alternatives and to candidate POPs (Art. 11, para 1).
- The **Montreal Protocol** requires Parties to assess every four years the control measures provided for in Article 2 and Articles 2A to 2J based on available scientific, environmental, technical and economic information (Art. 6).

National inventories:

- The **Montreal Protocol** requires Parties to provide statistical data on its annual production of each of the controlled substances listed in Annexes A, B, C, E and F and, separately, for each substance: amounts used for feedstocks; amounts destroyed by technologies approved by parties; and regarding Imports from and exports to Parties and non-Parties respectively (Art. 7, paras 2–-3).
- The **Minamata Convention** requires Parties to establish, as soon as practicable and no later than five years after the date of entry into force of the Convention for it, and maintain thereafter, an inventory of emissions from relevant sources (Art. 8, para 7) and an inventory of releases from relevant sources (Art 9, para 6). Relevant sources of releases are identified by the individual Party, whereas relevant sources of emissions are identified according to point source categories listed in Annex D to the Convention, including waste incineration facilities.
- The **Rotterdam Convention** requires Parties to take measures to establish and strengthen its national infrastructures and institutions for the effective implementation of the Convention, including the establishment of national registers and databases including safety information for chemicals (Art. 15, para 1a).

Research:

- The **Stockholm Convention** requires Parties, within their capabilities, at the national and international levels, encourage and/or undertake appropriate research, development, monitoring and cooperation pertaining to POPs and, where relevant, to their alternatives and to candidate POPs (Art. 11, para 1).

National action plans:

- The **Stockholm Convention** requires Parties to develop and endeavour to implement a plan for the implementation of its obligations under the Convention, transmit its implementation plan to the COP within two years of the date on which this Convention enters into force for it; and review and update its implementation plan on a periodic basis (Art. 7, para 1).

Transparency and information sharing:

- The **Stockholm Convention** requires Parties to facilitate or undertake the exchange of information relevant to the reduction or elimination of the production, use and release of POPs; and alternatives to POPs, including information relating to their risks as well as to their economic and social costs. (Art. 9, para 1).
- The **Minamata Convention** requires parties to facilitate the exchange of information on the reduction or elimination of the production, use, trade, emissions and releases of mercury and mercury compounds and information on technically and economically viable alternatives to manufacturing processes in which mercury or mercury compounds are used (Art. 17, para 1b and 1c.11). Parties shall also, within their capabilities, promote and facilitate the provision to the public of available information on the health and environmental effects of mercury and mercury compounds, as well as the alternatives to mercury added products and manufacturing process using mercury (Art. 18, para 1). Moreover, Parties shall endeavour to cooperate to develop and improve Information on commerce and trade in mercury and mercury compounds and mercury-added products; and information and research on the technical and economic availability of mercury-free products and processes and on BAT/BEP to reduce and monitor emissions and releases of mercury and mercury compounds (Art. 19, para 1f-g).
- The **Rotterdam Convention** requires Parties to provide information to the Secretariat on the chemicals it has banned or severely restricted, which is compiled and disseminated to all Parties to the Convention (Art. 12, para 1). Moreover, the Convention requires Parties to facilitate the exchange of scientific, technical, economic and legal information concerning the chemicals within the scope of the Convention, including toxicological, ecotoxicological and safety information; the provision of publicly available information on domestic regulatory actions relevant to the

objectives of this Convention; and the provision of information to other Parties, directly or through the Secretariat, on domestic regulatory actions that substantially restrict one or more uses of the chemical, as appropriate (Art. 14, para 1).

- The **ILO Chemicals Convention (C170)** requires suppliers of chemicals (manufacturers, importers and distributors) to have their chemicals assessed in accordance with the national classification system for degree of hazard or shall identify the chemicals they supply and conduct their own search to assess their hazard potential (Art. 9.1.a, 3). Suppliers shall also mark chemicals to allow for their identification (Art. 7.1) and, additionally, hazardous chemicals shall carry additional labelling that is easily understandable by workers (Art. 7.2). Chemical data sheets shall also be provided to employers for hazardous chemicals (Art. 9.1.d).
- The **ILO Chemicals Convention (170)** requires all chemicals to be marked to enable their identification, with hazardous chemicals additionally labelled so that workers can easily understand the essential information regarding classification, hazards they present and safety precautions (Art. 7). Chemical safety data sheets shall be provided for hazardous chemicals (Art. 8). Where these are not available, the chemicals shall not be used until such labelling and information has been obtained (Art. 10).

Examples of approaches from other legal instruments

Chemicals/materials/products and activities to be regulated:

- **The Protocol on PRTRs** aims to enhance public access to information through the establishment of coherent, integrated, nationwide PRTRs, which could facilitate public participation in environmental decision-making as well as contribute to the prevention and reduction of pollution of the environment (Art. 1). Parties must require reporting, record keeping and quality assessment by operators and owners of industrial facilities, and share available information on diffuse sources, including releases of pollutants from products through the PRTR portal (Art. 7-10). Pursuant to activities listed under Annex I, reporting on releases and transfers of pollutants is required from operators and owners of production facilities of basic plastic materials, Pursuant to pollutants listed in Annex II, reporting on releases and transfers of pollutants is required for at least 15 chemicals used in the production of plastics.[116]
- K-REACH in **South Korea** requires registration of polymers unless they meet criteria for polymer of low concern (ChemSafetyPRO, 2022).
- The **EU** REACH legislation requires manufacturers and importer of a polymer to submit a registration to the Agency for the monomer substance(s) or any other substance(s), that have not already been registered by an actor up the supply chain, if both the following conditions are met: the polymer consists of 2% weight by weight (w/w) or more of such monomer substance(s) or other substance(s) in the form of monomeric units and chemically bound substance(s); and the total quantity of such monomer substance(s) or other substance(s) makes up one tonne or more per year (Art. 6, para 3).
- **China** has adopted a positive list consisting of 1,294 additives used for food contact materials and articles, including some kinds of plastic (GB 9685-2016 Standard).
- The **Protocol to the Jeddah Convention** for the protection of the marine environment from land-based activities promotes the control or elimination of pollution at its source. In achieving this, Parties shall give attention to, without limitation, the development or modification of raw materials (Annex II).

116 1,2-dichloroethane, Benzene, Brominated diphenylethers (PBDE), Chloro-alkanes, C10-C13, Cyanides (as total CN), Di-(2-ethyl hexyl) phthalate (DEHP), Ethyl benzene, Ethylene oxide, Hydrogen cyanide (HCN), Naphthalene, Nonylphenol ethoxylates (NP/NPEs) and related substances; Organotin compounds (as total Sn), Polychlorinated biphenyls (PCBs), Vinyl chloride, Xylenes, and other substances (for example, national PRTR systems may include further substances of relevance to the topic, such as hexabromobiphenyl in the European PRTR or styrene in the Czech Integrated Pollutant Register.

Material Phase – Manufacture

Measures directly related to chemicals in plastics

Chemicals/materials/products and activities to be regulated:

- The **Montreal Protocol** defines a "controlled substance" (including ODSs listed in Annex A, B, C, and E) as a substance existing alone or in a mixture but excludes their presence in a manufactured product other than a container used for the transportation or storage of that substance (Art. 1, para 4). Decision I/12A (para 5c) provides examples of such products, including polyurethane prepolymer or any foam containing, or manufactured with, a controlled substance.

Measures directly related to plastic products

There are no binding measures at the global level that directly regulate plastics in the manufacture phase of the life cycle.

Broader measures indirectly encompassing plastics and associated chemicals

Goals and targets:

- The **Basel Convention** acknowledges that the most effective way of protecting human health and the environment from the dangers posed by such wastes is the reduction of their generation to a minimum in terms of quantity and/or hazard potential (Preamble).

Chemicals/materials/products and activities to be regulated:

- The **London Protocol** does not explicitly allow for the dumping of plastic waste, therefore inferring plastics are included in the general ban of dumping of wastes and other matter into the ocean. Should any wastes be considered for dumping, a permit shall comply with Annex 2 provisions (Art. 4.1.2). Annex 2 includes a waste prevention audit as a first step to assessing alternatives before permitting the dumping. This includes an evaluation of 1) the details of the production process and the sources of wastes within that process, and 2) the feasibility of waste reduction/prevention techniques of:
  - product reformulation,
  - clean production technologies,
  - process modification, and
  - input substitution.
- The **ILO Chemicals Convention (170)** requires employers to make an assessment of the risks arising from the use of chemicals at work, including the choice of chemicals that can eliminate or minimise risk, and limit exposure to hazardous chemicals to protect safety and health of workers (Art. 13).

Emissions prohibited

- The **ILO Chemicals Convention (170)** requires employers to assess the exposure of workers to hazardous chemicals and ensure that workers are not exposed to chemicals exceeding exposure limits or other exposure criteria established by appropriate bodies (Art. 12).

Transparency and information sharing:

- The **Stockholm Convention** encourages Parties to use safety data sheets in providing information on POPs and their alternatives (Article 10, para 4)
- The **Minamata Convention** requires Parties to endeavour to cooperate to develop and improve Information on commerce and trade in mercury and mercury compounds and mercury-added products; and information and research on the technical and economic availability of mercury-free products and processes and on BAT/BEP to reduce and monitor emissions and releases of mercury and mercury compounds (Art. 19, para 1f-g).

- The **ILO Chemicals Convention (C170)** requires suppliers of chemicals (manufacturers, importers and distributors) to have their chemicals assessed in accordance with the national classification system for degree of hazard or shall identify the chemicals they supply and conduct their own search to assess their hazard potential (Art. 9.1.a, 3). Suppliers shall also mark chemicals to allow for their identification (Art. 7.1) and, additionally, hazardous chemicals shall carry additional labelling that is easily understandable by workers (Art. 7.2). Chemical data sheets shall also be provided to employers for hazardous chemicals (Art. 9.1.d).
- The **ILO Chemicals Convention (170)** requires all chemicals to be marked to enable their identification, with hazardous chemicals additionally labelled so that workers can easily understand the essential information regarding classification, hazards they present and safety precautions (Art. 7). Chemical safety data sheets shall be provided for hazardous chemicals (Art. 8). Where these are not available, the chemicals shall not be used until such labelling and information has been obtained (Art. 10).

Examples of approaches from other legal instruments

- The **Protocol to the Jeddah Convention** for the protection of the marine environment from land-based activities promotes the control of importing, manufacturing or processing certain hazardous substances and development of rules for their regulation (Annex II, para 1), as well as the development or modification of manufacturing process (para 3) and following environmentally sound operation methodologies (Annex II, para 4).
- The **Protocol to the Barcelona Convention** for the prevention of marine pollution from land-based activities requires Parties to progressively formulate and adopt, in cooperation with the competent international organisations, common guidelines and, as appropriate, standards or criteria dealing in particular with the control and progressive replacement of products, installations and industrial and other processes causing significant pollution of the marine environment (Art. 7, para 1d).
- The **OSPAR regional marine litter action plan** encourages the recyclability of plastic products, singling out the reduction of additives (para 39). Initiatives and exchange of best practices aiming at zero pellet loss along the whole plastics manufacturing chain from production to transport are also promoted (para 52).
- The **Aarhus Convention** promotes access to environmental information (Art. 4) and collection and dissemination of environmental information (Art. 5). It requires Parties to encourage operators whose activities have a significant impact on the environment to inform the public regularly of the environmental impact of their activities and products, where appropriate within the framework of voluntary eco-labelling or eco-auditing schemes or by other means (Art. 5, para 6). Moreover, the Convention requires Parties to make appropriate practical and/or other provisions for the public to participate during the preparation of plans relating to the environment within a transparent and fair framework, having provided the necessary information to the public (Art. 7).
- A draft Commission regulation has been presented with aim to amend **EU REACH legislation** to restrict the placing on the market of microplastics, which is expected to prevent the release of 500,000 tonnes of microplastics over 20 years (European Commission, 2022a).

Material Phase – Consumption

Measures directly related to chemicals in plastics

There are no binding measures at the global level that directly regulate chemicals in plastic products in the consumption phase.

Measures directly related to plastic products

There are no binding measures at the global level that directly regulate plastic products in the consumption phase.

Broader measures indirectly encompassing plastics and associated chemicals

Goals and targets:

- The **Basel Convention** requires each Party to ensure the generation of hazardous wastes and other wastes is *reduced to a minimum* (Art. 4), recognising that this should be achieved in terms of quantity and/or hazard potential (Preamble).
- The **London Protocol** requires a waste prevention audit to be conducted prior to issuing a permit to dump wastes and other matter into the ocean. As per Annex 2, if the audit reveals that opportunities exist for waste prevention at source, the permit applicant shall formulate and implement a waste prevention strategy which includes specific waste reduction targets, with further audits to ensure these targets are being met. For dredged material and sewage sludge, Annex 2 also sets a goal for waste management to identify and control sources of contamination, which would include microplastics from point and non-point sources.

Chemicals/materials/products and activities to be regulated:

- The **London Protocol** provides for permits to be issued for those products that may be considered for dumping at sea, as listed in Annex 1. Although plastics and the chemicals used in the manufacture of plastics are prohibited from dumping, the permit conditions outlined in Annex 2 promotes upstream activities to reduce the need to dump wastes generated on land into the ocean and to reduce contamination of such wastes. These include evaluating the feasibility of the following waste reduction/prevention techniques of 1) product reformulation, 2) clean production technologies, 3) process modification, 4) input substitution, and 5) on-site closed-loop recycling. In addition, the sources of contamination in sewage sludge and dredged material, which include microplastics, shall be prevented from point and non-point sources (Annex 2).
- The **Kyoto Protocol** requires Parties to implement measures that encourage appropriate reforms in relevant sectors aimed at limiting or reducing emissions of GHGs not controlled by the Montreal Protocol, including by the transport sector (Art. 2.a.vi, vii).

International trade of material/product:

- The **Stockholm Convention** requires Parties to take measures to ensure that a chemical listed in Annex A or B is imported only for a use or purpose which is permitted for that Party under Annex A or B (Art. 3, para 2a(ii)).

Establish and maintain national inventories:

- The **Stockholm Convention** requires Parties to develop appropriate strategies for identifying products and articles in use and wastes consisting of, containing or contaminated with a chemical listed in Annex A, B or C (Art. 6, para 1a(ii)).
- Parties to the **Minamata Convention** shall establish, as soon as practicable and no later than five years after the date of entry into force of the Convention for it, and maintain thereafter, an inventory of emissions from relevant sources (Art. 8, para 7). Parties shall also establish, as soon as practicable and no later than five years after the date of entry into force of the Convention for it, and maintain thereafter, an inventory of releases from relevant sources (Art. 9, para 6). The Convention also requests Parties to endeavour to cooperate to develop and improve inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds (Art. 19, para 1a) and endeavour to identify individual stocks of mercury or mercury compounds exceeding 50 tonnes, as well as sources of mercury supply generating stocks exceeding 10 tonnes per year, that are located within its territory (Art. 3, para 5a).

Examples of approaches from other legal instruments

- The **EU Single-Use Plastics Directive** requests Member States to take necessary measures that lead to a measurable quantitative reduction in the consumption of the single-use plastic products listed in Part A of the Annex [cups for beverages, including their covers and lids and food containers] by 2026 compared to 2022 (Art. 4, para 1)
- The **EU Packaging and Packaging Waste Directive** requests Member States to include either or both of the targets: a) by 2020, to ensure that the annual consumption level does not exceed 90 lightweight plastic carrier bags per person and 40 lightweight plastic carrier bags per person by 2026, or equivalent targets set in weight and b) by 2019, to ensure that lightweight plastic carrier bags are not provided free of charge at the point of sale of goods or products, unless equally effective instruments are implemented (very lightweight plastic carrier bags may be excluded from those measures)
- The **Protocol on Environmental Protection to the Antarctic Treaty on Waste Disposal and Waste Management** requires Parties to reduce the amount of wastes produced or disposed of in the Antarctic Treaty area as far as practicable so as to minimise impact on the Antarctic environment and to minimise interference with the natural values of Antarctica, with scientific research and with other uses of Antarctica which are consistent with the Antarctic Treaty (Annex III, Art. 1, para 2), with source reduction an essential consideration in the planning and conduct of activities in the Antarctic Treaty area (Annex III, Art. 1, para 3).
- The **regional marine litter action plan for the Mediterranean** requires Parties by the year 2017 to explore and implement to the extent possible prevention measures related to:
  - Sustainable Procurement Policies contributing to the promotion of the consumption of recycled plastic-made products,
  - Establishment of voluntary agreements with retailers and supermarkets to set an objective of reduction of plastic bags consumption as well as selling dry food or cleaning products in bulk and refill special and reusable containers,
  - Fiscal and economic instruments to promote the reduction of plastic bag consumption (Art. 9, para 3).

Dematerialisation Phase – Waste Management (collection/sorting)

Measures directly related to chemicals in plastics

Chemicals/materials/products and activities to be phased out:

- The **Basel Convention** prohibits the exports of hazardous plastic wastes intended for final disposal or recovery operations (from countries listed in Annex VII to the Convention (Parties and other States which are members of the OECD, EC, Liechtenstein) to all other countries not listed in that Annex. This was achieved through adoption of the Basel Ban Amendment (Decision III/1), which came into force in 2019 and is only binding on those countries that have ratified the Amendment.
- The **London Protocol** prohibits all wastes and other matter from being incinerated at sea (Art. 5).

Emissions prohibited:

- The **London Convention** prohibits the dumping of wastes or other matter listed in Annex I (Art. IV), which includes organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, although these are allowed where they are contained in dumped waste or other materials as trace contaminants. These are then subject to Annex II and Annex III provisions (Annex I, para 9). Waste containing significant amounts of organosilicon compounds and fluorides (Annex I) require special care when issuing permits (Art. VI.1) as per exceptional circumstances listed in Article V(2).

- The **London Protocol** prohibits the dumping of any wastes or other matter into the ocean with the exception of those listed in Annex I (Art. 4.1.1). This Annex therefore provides a "white-list" of wastes that may be considered for dumping and, because chemicals used in plastics are not listed, they are included in the prohibition of dumping at sea.

International trade of material/product:

- The **London Protocol** prohibits the export of wastes or other matter to other countries for dumping or incineration at sea (Art. 6).

Measures directly related to plastic products

Indicators:

- The **CBD Ocean Health Index** incorporates data on coastal chemical pollution and global marine plastic pollution (Decision 13/28, Annex).

Chemicals/materials/products and activities to be phased out:

- The **London Protocol** prohibits all wastes and other matter from being incinerated at sea (Art. 5).

Chemicals/materials/products and activities to be regulated:

- The **CBD** encourages the adoption of EPR where there is damage or sufficient likelihood of damage to marine and coastal biodiversity and habitats caused by marine debris (Decision 13/10, para 7). Moreover, Parties are urged to increase efforts to avoid minimise and mitigate the impacts of plastic pollution on marine and coastal biodiversity and habitats (Decision 14/10, para 1a).

Emissions prohibited:

- The **Stockholm Convention** requires Parties to pursue the goal of their continuing minimisation and, where feasible, ultimate elimination of unintentional POPs (UPOPs) listed in Annex C (Art. 5). Part I of Annex C lists POPs subject to Article 5, including hexachlorobenzene (HCB), hexachlorobutadiene, pentachlorobenzene (PeCB), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF) and polychlorinated naphthalenes (PCNs). Parties are required to implement best available techniques (BAT) and best environmental practice (BEP) for the sources listed in Annex C, Parts II and III (Art. 5d). BAT means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of chemicals listed in Part I of Annex C and their impact on the environment as a whole, whereas, BEP means the application of the most appropriate combination of environmental control measures and strategies (Art. 5f). Sources relevant for plastics as inferred in Part II of Annex C includes UPOPs formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions, including waste incinerators, as well as Part III of Annex C that adds that UPOPs may be formed and released from open burning of waste, including burning of landfill sites. The Convention requires Parties to phase in BAT for new sources for unintentional POPs in the categories listed in Part II of Annex C–including waste incinerators–as soon as practicable but no later than four years after the entry into force of the Convention for that Party (Art. 5d).
- The **London Convention** prohibits the dumping of wastes or other matter listed in Annex I (Art. IV). This includes persistent plastics and other persistent synthetic materials, for example, netting and ropes, which may float or may remain in suspension in the sea in such a manner as to interfere materially with fishing, navigation or other legitimate uses of the sea (Annex I, para 4).
- The **London Protocol** prohibits the dumping of any wastes or other matter into the ocean, with the exception of those listed in Annex I (Art. 4.1.1). This Annex therefore provides a "white-list" of wastes that may be considered for dumping and, because plastics are not listed, they are included in the prohibition of dumping at sea.

- **MARPOL Annex V** defines garbage as "*all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes*…" (Reg, 1.9). Plastic is further defined and include *"all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products."* As per Annex V, the discharge of all plastics anywhere into the sea is prohibited (Reg 3.2), with exemptions provided (Reg, 7). Should garbage be mixed or contaminated by plastics, it is also prohibited from discharge (Reg. 4.4).

International trade of material/product:

- The **Basel Convention** lists plastic wastes in 3 Annexes. Annex VIII and Annex IX provide specific details on the types of plastic wastes covered by their entries, with Annex II providing a "catch-all" entry for all other plastic waste, including mixtures of waste.
  - **Annex II** (Wastes requiring special consideration and is subject to the PIC procedure)
    Entry Y48:[117]
    - All plastic waste, including mixtures of such waste, except for the following:
      - Hazardous plastic waste covered by Annex VIII, entry A3210
      - Following plastic waste that is destined for recycling[118] in an environmentally sound manner and almost free from contamination and other types of wastes:[119]
        - Plastic waste almost exclusively[120] consisting of one non-halogenated polymer;
        - Plastic waste almost exclusively consisting of one cured resin or condensation product of certain resins;
        - Plastic waste almost exclusively consisting of one of the fluorinated polymers listed therein.
      - Mixture of plastic waste, consisting of polyethylene (PE), polypropylene (PP) and/or polyethylene terephthalate (PET), provided they are destined for separate recycling of each material and in an environmentally sound manner and almost free from contamination and other types of wastes.
  - **Annex VIII** (Waste considered hazardous and is subject to the PIC procedure)
    Entry A3210:
    - Plastic waste, including mixtures of such waste, containing or contaminated with Annex I constituents, to an extent that it exhibits hazardous characteristics listed in Annex III.
  - **Annex IX** (Waste presumed not to be hazardous and is not subject to the PIC procedure)
    Entry B3011:
    - Plastic waste listed below, provided it is destined for recycling[121] in an environmentally sound manner and almost free from contamination and other types of wastes:[122]
      - Plastic waste almost exclusively[123] consisting of one non-halogenated polymer, including but not limited to the following polymers:
        - Polyethylene (PE)

117 Parties can impose stricter requirements in relation to this entry.

118 Recycling/reclamation of organic substances that are not used as solvents (R3 in Annex IV, sect. B) or, if needed, temporary storage limited to one instance, provided that it is followed by operation R3 and evidenced by contractual or relevant official documentation.

119 In relation to "almost free from contamination and other types of wastes", international and national specifications may offer a point of reference.

120 In relation to "almost exclusively", international and national specifications may offer a point of reference.

121 Recycling/reclamation of organic substances that are not used as solvents (R3 in Annex IV, sect. B) or, if needed, temporary storage limited to one instance, provided that it is followed by operation R3 and evidenced by contractual or relevant official documentation.

122 In relation to "almost free from contamination and other types of wastes", international and national specifications may offer a point of reference.

123 In relation to "almost exclusively", international and national specifications may offer a point of reference.

        - › Polypropylene (PP)
        - › Polystyrene (PS)
        - › Acrylonitrile butadiene styrene (ABS)
        - › Polyethylene terephthalate (PET)
        - › Polycarbonates (PC)
        - › Polyethers
      - Plastic waste almost exclusively consisting of one cured resin or condensation product, including but not limited to the following resins:
        - › Urea formaldehyde resins
        - › Phenol formaldehyde resins
        - › Melamine formaldehyde resins
        - › Epoxy resins
        - › Alkyd resins
      - Plastic waste almost exclusively consisting of one of the following fluorinated polymers:[124]
        - › Perfluoroethylene/propylene (FEP)
        - › Perfluoroalkoxy alkanes:
          - Tetrafluoroethylene/perfluoroalkyl vinyl ether (PFA)
          - Tetrafluoroethylene/perfluoromethyl vinyl ether (MFA)
        - › Polyvinylfluoride (PVF)
        - › Polyvinylidenefluoride (PVDF)
    - o Mixtures of plastic waste, consisting of PE, PP and/or PET, provided they are destined for separate recycling[125] of each material and in an environmentally sound manner, and almost free from contamination and other types of wastes.[126]
- The **Basel Convention** prohibits the exports of hazardous plastics wastes intended for final disposal or recovery operations from countries listed in Annex VII to the Convention (Parties and other States which are members of the OECD, EC, Liechtenstein) to all other countries not listed in Annex VII. This was achieved through adoption of the Basel Ban Amendment (Decision III/1) and is only binding on those countries that have ratified the Amendment.
- The **Basel Convention** has been amended to include provisions for e-waste (much of which contain plastics). The amendments come into effect 1st January 2025 and include:
  - **Annex II** (Waste requiring special consideration and is subject to the PIC procedures)
    Entry Y49:
    - o All e-wastes, components thereof and wastes resulting from e-waste processing (e.g. fractions from shredding), unless covered by Annex VIII, entry A1181
  - **Annex VIII** (Waste presumed to be hazardous and subject to the PIC procedures)
    Entry A1181:
    - o Hazardous e-wastes, components thereof and wastes resulting from e-waste processing (e.g. fractions from shredding)
  - **Annex IX** (Waste presumed not to be hazardous and is not subject to the PIC procedures)
    - o Entries B1110 and B4030 removed.

124 Post-consumer wastes are excluded.

125 Recycling/reclamation of organic substances that are not used as solvents (R3 in Annex IV, sect. B), with prior sorting and, if needed, temporary storage limited to one instance, provided that it is followed by operation R3 and evidenced by contractual or relevant official documentation.

126 In relation to “almost free from contamination and other types of wastes”, international and national specifications may offer a point of reference.

- The **London Protocol** prohibits the export of wastes or other matter to other countries for dumping or incineration at sea (Art. 6).

Reporting requirements:

- **MARPOL Annex V** requires the recording in a Garbage Record Book of each discharge into the sea or reception facility, as well as completed incinerations (Reg 10.3.1). In addition, any discharge provided for under the exemptions on the ban of plastic discharge shall also be recorded either in the Garbage Record Book or the ship's logbook, providing details of the items discharged or lost, the location, circumstances of, and the reasons for the discharge or loss (Reg 10.3.4). Where such discharge is fishing gear that poses a significant threat to the marine environment or navigation, it mut be reported to the flag State and the coastal State, if applicable (Reg 10.6).

Transparency and information sharing:

- The **Basel Convention** requires that information provided to states concerned in a transboundary movement of hazardous wastes and other wastes state clearly the effects of the proposed movement on human health and the environment (Art. 4, para 2f). The notification document whereby a transboundary movement of wastes is proposed contains information on the designation, quantity and nature of the wastes, its hazardous characteristic, and any special handling requirement (Annex V). Hazardous wastes and other wastes to be subjected to transboundary movement shall be labelled in conformity with generally accepted and recognised international rules and standards for labelling (Art. 4, para 7b). This is in addition to the movement document required from the point at which a transboundary movement commences to the point of disposal. (Art. 4, para 7c).
- **MARPOL Annex V** gives the government of the port of offshore terminal a ship is visiting to inspect and make a copy of the applicable Garbage Record Book or logbook regarding exempted discharges of garbage or lost fishing gear into the sea. (Reg 10.5).
- The **London Convention** requires Parties to co-operate in the development of procedures for the reporting of vessels and aircraft observed dumping in contravention of the Convention (Art. VII.3), which would include dumping of plastics.

Broader measures indirectly encompassing plastics and associated chemicals

Goals and targets

- The **Basel Convention** requires each Party to take appropriate measures to ensure that the generation of hazardous wastes and other wastes is reduced to a minimum taking into account social, technological and economic aspects, and that adequate disposal facilities are available to the extent possible within it for the environmentally sound management of such wastes (Art. 4, para 2).
- The **London Convention** requires Contracting Parties to especially pledge to prevent pollution of the sea by dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea (Art. I). They shall also pledge to promote measures to protect the marine environment from pollution caused by other noxious or hazardous matter transported by vessels for purposes other than dumping (Art. XII).
- The **London Protocol** requires Contracting Parties to protect and preserve the marine environment from all sources of pollution and prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter (Art. 2), prioritising environmentally preferable alternatives over dumping (Art. 4, para 1.2).
- The **CBD** requires Parties to protect ecosystems and natural habitats, as well as maintain viable populations of species in natural surroundings (Art. 8d). In so doing, by 2030, at least 30% of terrestrial, inland water, and of coastal and marine areas need to be effectively conserved and managed (GBF Target 3).

Indicators:

- **Stockholm Convention** lists effectiveness evaluation indicators of relevance:
  - Number of parties with measures in place to manage wastes in an environmentally sound manner
  - Percentage change in the quantity of Annex C POPs produced unintentionally and released into the environment by each party

Chemicals/materials/products and activities to be phased out:

- The **Basel Convention's Ban Amendment**[127] requires each Party listed in Annex VII (Parties and other States which are members of the OECD, EC, Liechtenstein) that has ratified the amendment to prohibit transboundary movements of wastes captured under Article 1.1(a) which are destined for final disposal or recovery operations to States not listed in Annex VII. Should Parties otherwise prohibit the import of hazardous wastes or other wastes for disposal or develop a national definition of hazardous wastes that goes beyond the scope of Article 1.1(a), notification shall be given to other Parties (Art. 4, para 1) (Art. 13, para 1a).
- The **Stockholm Convention** requires Parties to take measures so that products and articles upon becoming wastes–consisting of, containing or contaminated with a chemical listed in Annex A, B or C–are handled, collected, transported and stored in an environmentally sound manner (Art. 6, para 1d (i)).
- The **Minamata Convention** requires Parties to take measures so that mercury waste is managed in an environmentally sound manner taking into account the guidelines developed under the Basel Convention (Art. 11, para 3a).

Chemicals/materials/products and activities to be regulated:

- **UNCLOS** requires states to adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere, applicable to the air space under their sovereignty and to vessels flying their flag or vessels or aircraft of their registry, and take other measures as may be necessary to prevent, reduce and control such pollution (Art. 212).
- The **Stockholm Convention** requires Parties to take measures so that products and articles upon becoming wastes–consisting of, containing or contaminated with a chemical listed in Annex A, B or C–are handled, collected, transported and stored in an environmentally sound manner (Art. 6, para 1d (i)).
- Parties to the **Basel Convention** shall require that any exported waste is managed in an environmentally sound manner (Art. 4, para 8) but shall also periodically review the options for reducing the amount of these wastes that are exported (Art. 4, para 13). Parties shall adopt national law to prevent and punish illegal traffic (Art. 9).
- Parties shall inform other Parties, through the Secretariat, of wastes considered or defined as hazardous under national legislation and which are not listed in Annexes I and II, as well as any requirements the Party has for transboundary movement of these wastes (Art. 3 para 1). Parties shall also inform other Parties of their decision to prohibit the import of hazardous wastes or other wastes for disposal (Article 4.1). Changes to national definitions of hazardous wastes or limits/bans on the import or export of hazardous wastes and other wastes shall also be notified as soon as possible (Art. 13).
- For wastes not prohibited by the **London Convention** from dumping and incineration at sea or those listed under Annex II to the Convention, a prior permit is required (Art. IV, para 1b-c, Annex I, para 10b). This includes dredged material and sewage sludge (Annex I).
- The **CBD u**rges Parties to develop and implement measures, policies and instruments to prevent the discard, disposal, loss or abandonment of any persistent, manufactured or processed solid material in the marine and coastal environment (Decision 13/10, para 8).

127 The Ban Amendment came into force in 2022 for those Parties that ratified it.

Emissions prohibited:

- **UNCLOS** requires States to adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, taking into account internationally agreed rules, standards and recommended practices and procedures. (Art. 207, para 1), as well as any other measures necessary in this regard (Art. 207, paras 1, 2). Global and regional rules, standards and recommended practices and procedures shall be established that minimise, to the fullest extent possible, the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment (Art. 207, paras 4, 5). States have the obligation to protect and preserve the marine environment (Art. 192) and to take all measures necessary to prevent, reduce and control such pollution from any source (Art. 194), as well as measures to minimise substances of concern. A precautionary approach is promoted whereby the definition of pollution refers to substances that "result" or are "likely to result" in deleterious effects (Art. 1). Where releases are of toxic, harmful or noxious substances, measures shall include those designed to minimise such pollution to the fullest possible extent (Art. 194 para 3a).
- The **Stockholm Convention** requires Parties to give priority to the consideration of approaches to prevent the formation and release UPOPs (Art. 5, para c). Useful measures could include improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimise the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste. Under this approach, public health concerns should be carefully considered (Annex C, Part V, para f)
- The **Basel Convention** requires any transboundary movement of hazardous wastes or other wastes that results in deliberate disposal (e.g., dumping) of hazardous wastes or other wastes to be considered illegal traffic (Art. 9, para 1.e). Countries shall also ensure those involved in the management of hazardous or other wastes within their jurisdiction take the necessary steps to prevent pollution and minimise the effects on human health and the environment should such pollution occur (Art. 4, para 2c).
- **MARPOL Annex V** requires each Party to ensure adequate facilities are available at ports and terminals for the reception of garbage without causing undue delay to ships, and according to the needs of the ships using them (Reg 8.1). Regional arrangements may be used by SIDS in this regard (Reg. 8.2).

International trade of material/product:

- The **Stockholm Convention** requires Parties to ensure that such wastes, including products and articles upon becoming wastes, are not transported across international boundaries without taking into account relevant international rules, standards and guidelines (Art. 6, para 1d (iv)).
- The **Minamata Convention** requires Parties to ensure that mercury waste is (for Parties to the Basel Convention) not transported across international boundaries except for the purpose of environmentally sound disposal in conformity with this Article and with that Convention (Art. 11, para 3c). In circumstances where the Basel Convention does not apply to transport across international boundaries, a Party shall allow such transport only after taking into account relevant international rules, standards, and guidelines (para 3c). For Parties to the Minamata Convention that are not also Party to the Basel Convention, appropriate measures shall be taken so that mercury waste is managed in an environmentally sound manner, taking into account the guidelines developed under the Basel Convention and in accordance with requirements of the Minamata Convention (para 3a). Mercury waste shall only recovered, recycled, reclaimed or directly re-used for a use allowed to a Party under this Convention or for environmentally sound disposal pursuant to paragraph 3a (para 3b).

- The **Montreal Protocol** states that where, after the phase-out date applicable to it for a controlled substance, a Party is unable, despite having taken all practicable steps to comply with its obligation under the Protocol, to cease production of that substance for domestic consumption, other than for uses agreed by the Parties to be essential, it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction (Art. 4A, para 1).
- The **Basel Convention** requires Parties to prohibit or not permit the export of hazardous wastes and other wastes to the Parties which have prohibited the import of such wastes (Art. 4, para 2b) or if the State of import does not consent to the specific import if not prohibited by that State (Art. 4, para 2c). Export of such wastes to non-Parties shall not be permitted (Art. 4, para 5), and where these wastes will transit through non-Party States, such States will be so notified (Art. 7). Parties shall also cooperate in achieving the objects of the Convention's provisions on illegal traffic (Art. 9, para 5).

Reporting requirements:

- The **Montreal Protocol** requires Parties to provide to the Secretariat statistical data on its annual production (as defined in paragraph 5 of Article 1) of each of the controlled substances listed in Annexes A, B, C, E and F and, separately, for each substance the amounts destroyed by technologies approved by the Parties (Art. 7, para 3).
- Parties to the **Basel Convention** shall report each year on the previous year regarding:
  - The amount of hazardous wastes and other wastes exported and imported, their category, characteristics, destination, any transit country and disposal method
  - Disposals which did not proceed as intended;
  - Efforts to achieve a reduction of the amount of hazardous wastes or other wastes subject to transboundary movement;
  - Information on available qualified statistics which have been compiled by them on the effects on human health and the environment of the generation, transportation and disposal of hazardous wastes or other wastes;
  - Information on accidents occurring during the transboundary movement and disposal of hazardous wastes and other wastes and on the measures undertaken to deal with them;
  - Information on disposal options operated within the area of their national jurisdiction;
  - Information on measures undertaken for development of technologies for the reduction and/or elimination of production of hazardous wastes and other wastes (Art. 13, para 3).
- The **London Convention** requests Parties to cooperate in developing procedures for the reporting of vessels and aircraft observed dumping in contravention of the Convention (Art. VII, para 3). Records shall be kept of all matter permitted to be dumped (Art. VI, para 1c).
- The **London Protocol** requires each Contracting Party to report on a voluntary basis a summary of the type and nature of the materials dumped in marine internal waters (Art. 7, para 3), as well as a summary of administrative, legislative and enforcement measures taken to implement the Protocol and their effectiveness.

Monitoring and evaluation programmes:

- The **Basel Convention** requires parties to periodically review the possibilities for the reduction of the amount and/or the pollution potential of hazardous wastes and other wastes which are exported to other States, in particular to developing countries. (Art. 4, para 13). They shall also cooperate in monitoring the effects of the management of hazardous wastes on human health and the environment (Art. 10, para 2b) and keep under continuous review and evaluation the effective implementation of this Convention (Art. 15, para 5). An evaluation of the effectiveness of the Convention shall be conducted at least every six years, including consideration of additional bans or partial bans on the transboundary movement of hazardous wastes and other wastes in light of the latest scientific, environmental, technical and economic information. (Art. 15, para 7).

- Parties to the **London Convention** shall monitor the condition of the seas for the purposes of this Convention. (Art. VI, para d).
- Similarly, parties to the **London Protocol** shall monitor the condition of the seas for the purposes of this Protocol (Art. 9, para 1.3) and collaborate in assessments of the state of the marine environment (Art. 19, para 3.1), while keeping under continuing review the implementation of this Protocol and evaluation of its effectiveness (Art. 18, para 1).

Establish and maintain national inventories:

- The **Stockholm Convention** encourages Parties to develop strategies for identifying stockpiles consisting of or containing chemicals listed in Annex A, B or C (Art. 6, para 1a (i)).
- The **Montreal Protocol** requires Parties to provide statistical data on its annual production of each of the controlled substances listed in Annexes A, B, C and E and, separately, for each substance amounts destroyed by technologies approved by the Parties (Art. 7.3).
- Parties to the **London Convention** shall keep records of the nature and quantities of all matter permitted to be dumped and the location, time and method of dumping (Art. VI, para 1c).
- Similarly, Parties to the **London Protocol** shall keep records of the nature and quantities of all wastes or other matter for which dumping permits have been issued and where practicable the quantities actually dumped and the location, time and method of dumping (Art. 9, para 1.2).
- In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bioaccumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons). An Action List can also be used as a trigger mechanism for further waste prevention considerations (Annex 2(9)).
- A national Action List shall also be developed for screening candidate wastes according to upper and lower levels and for which three possible categories of waste could be applied:
  - wastes which contain specified substances, or which cause biological responses, exceeding the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes;
  - wastes which contain specified substances, or which cause biological responses, below the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and
  - wastes which contain specified substances, or which cause biological responses, below the upper level but above the lower level require more detailed assessment before their suitability for dumping can be determined (Annex 2, para 10).

Develop national action plans:

- The **Stockholm Convention** requires Parties to develop an action plan or a regional or subregional action plan within two years of the date of entry into force of the Convention and implement it as part of its implementation plan specified in Article 7, designed to identify, characterise and address the release of UPOPs (Art. 5, para a).

Transparency and information sharing:

- The **Basel Convention** promotes the proper exchange of information on and control of the transboundary movement of hazardous wastes and other wastes (Preamble). The information provided to the importing State shall clearly state the effects of the proposed movement on human health and the environment (Art. 4, para 2f). Parties shall also cooperate in the dissemination of information to improve the environmentally sound management of such wastes and to achieve the prevention of illegal traffic (Art. 4, para 2h). The notification document whereby a transboundary movement of wastes is proposed contains information on the designation, quantity and nature of the wastes, its hazardous characteristic, and any special handling requirement (Annex V). Hazardous wastes and other wastes to be subjected to transboundary movement shall be labelled

in conformity with generally accepted and recognised international rules and standards for labelling (Art. 4, para 7b) and accompanied by a movement document from the point at which a transboundary movement commences to the point of disposal. (Art. 4, para 7c). If requested, Parties shall make available information that promotes the environmentally sound management of hazardous wastes and other wastes, including harmonisation of technical standards and practices for the adequate management of hazardous wastes and other wastes (Art. 9, para 2a). Should an accident occur during the transport of such wastes which is likely to present risks to human health and the environment in other States, those States are immediately informed (Art. 13, para 1), and where a Party considers the movement of such wastes to be a risk to their environment and has notified the exporting Party, a copy of the notification shall be sent to the Secretariat should that Party request it (Art. 13, para 4). Any information regarding illegal traffic shall be provided by the Secretariat to concerned Parties (Art. 16, para 1i).

- The **London Protocol** requires Parties to establish procedures and mechanisms for assessing and promoting compliance with this Protocol and with a view to allowing for the full and open exchange of information, in a constructive manner (Art. 11, para 1). Parties shall also promote the availability of relevant information to other Contracting Parties who request it on 1) .1 scientific and technical activities and measures undertaken in accordance with this Protocol, and 2) the impacts observed from monitoring and assessment (Art. 14, para 2).

Examples of approaches from other legal instruments

- The **Annex III to the Protocol on Environmental Protection to the Antarctic Treaty on Waste Disposal and Waste Management** requires removal by the waste generator of wastes containing harmful levels of heavy metals or acutely toxic or harmful persistent compounds (para d), as well as poly-vinyl chloride (PVC), polyurethane foam, polystyrene foam, rubber and other products which contain additives that could produce harmful emissions if incinerated (Annex III, Art. 2, para 1e). This also applies to all other plastic wastes, except low density polyethylene containers, provided are incinerated in accordance with the Protocol (Annex III, Art. 2, para 1f). No polychlorinated biphenyls (PCBs), polystyrene beads, chips or similar forms of packaging (other than those required for scientific, medical or hygiene purposes) shall be introduced onto land or ice shelves or into water in the Antarctic Treaty area (Annex III, Art. 7).
- The **2017 Guidelines for the Implementation of MARPOL ANNEX V** (Resolution MEPC.295(71)) promote the exchange of information between governments relevant to compliance, including information and reports on the nature and extent of garbage from shipping found along beaches and in coastal waters under their respective jurisdictions. To assess the effectiveness of Annex V, these studies should provide details on amounts, distribution, sources and impacts of garbage from shipping (Para 4.2.3).
- The **Aarhus Convention** grants the public rights and imposes on Parties and public authorities' obligations regarding effective access to environmental information, including on chemicals, products and wastes (Art. 2, paras 3-5) The Convention requires Parties to ensure that sufficient product information is made available to the public in a manner which enables consumers to make informed environmental choices (Art. 5, para. 6 and 8). Each Party shall encourage operators whose activities have a significant impact on the environment to inform the public regularly of the environmental impact of their activities and products, including though eco-labelling or eco-auditing schemes (Art 6).
- **The Protocol on PRTRs** aims to enhance public access to information through the establishment of coherent, integrated, nationwide PRTRs (Art. 1). Parties must require reporting, record keeping and quality assessment by operators and owners of industrial facilities and share available information on diffuse sources through the PRTR portal (Art. 7-10). Pursuant to activities listed under Annex I, reporting on releases and transfers of pollutants is required from final disposal and recovery operations, such as wastewater treatment plants, waste incineration and landfills.

Dematerialisation Phase – Waste management (recovery and final disposal)

Measures directly related to chemicals in plastics

Chemicals/materials/products and activities to be regulated:

- The **Stockholm Convention** allows recycling of articles that contain or may contain PBDEs[128] and the use and final disposal of articles manufactured from recycled materials that contain or may contain PBDEs if certain conditions are met, including the recycling and final disposal is carried out in an environmentally sound manner and does not lead to recovery of PBDEs the purpose of their reuse (Decision SC-4/14, Part IV, para 1; Decision SC-4/18, Part IV, para 1).
- The **ILO Chemicals Convention (170)** requires employers to make an assessment of the risks arising from the use of chemicals at work, including the choice of chemicals that can eliminate or minimise risk, and limit exposure to hazardous chemicals to protect safety and health of workers (Art. 13).

Measures directly related to plastic products

There are no binding measures directly related to plastic products in the recovery and final disposal phase.

Broader measures indirectly encompassing plastics and associated chemicals

Goals and targets

- The **London Protocol** promotes a hierarchy of waste management options and implied increase in environmental impact, in which applications to dump wastes or other matter shall demonstrate that this hierarchy has been considered, namely: 1) re-use, 2) off-site recycling, 3) destruction of hazardous constituents, 4) treatment to reduce or remove the hazardous constituents, and 5) disposal on land, into air and in water (in Annex 2, para 5). In addition, a permit to dump wastes or other matter shall be refused if appropriate opportunities exist for re-use, recycling or treating the waste without undue risks to human health or the environment or disproportionate costs (Annex 2, para 6).

Indicators

- The **Stockholm Convention** provides effectiveness evaluation indicators:
  - For each chemical listed in Annexes A and B, changes in quantities imported or exported for environmentally sound waste disposal
  - Number of parties with measures in place to manage wastes in an environmentally sound manner
  - Quantity of wastes identified and destroyed over time (includes wastes of products and articles consisting of or contaminated with POPs)
  - Number of parties that have developed and used appropriate strategies to identify contaminated sites
  - Number of parties that have identified contaminated sites
  - Number of parties that have voluntarily undertaken remediation activities

Chemicals/materials/products and activities to be phased out

- The **Stockholm Convention** requires to manage stockpiles in a safe, efficient and environmentally sound manner and take measures so that products and articles upon becoming wastes–consisting of, containing or contaminated with a chemical listed in Annex A, B or C–are disposed so that the POP content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of POPs or otherwise disposed of in an environmentally sound manner when destruction or

128 Hexabromodiphenyl ether, heptabromodiphenyl ether, tetrabromodiphenyl ether and pentabromodiphenyl ether.

irreversible transformation does not represent the environmentally preferable option or the POP content is low (Art. 6, para 1c-d).

- The **Minamata Convention** requires Parties to take measures so that mercury waste is managed in an environmentally sound manner, taking into account the guidelines developed under the Basel Convention (Art. 11, para 3a).

Chemicals/materials/products and activities to be regulated

- The **Stockholm Convention** requires Parties to manage stockpiles in a safe, efficient and environmentally sound manner and take measures so that products and articles upon becoming wastes–consisting of, containing or contaminated with a chemical listed in Annex A, B or C–are disposed so that the POP content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of POPs or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option or the POP content is low (Art. 6, para 1c-d).
- The **Basel Convention** requires Parties to ensure transboundary movement of hazardous wastes and other wastes is only allowed if the State of export does not have the technical capacity and the necessary facilities, capacity or suitable disposal sites in order to dispose of the wastes in question in an environmentally sound and efficient manner; or the wastes in question are required as a raw material for recycling or recovery industries in the State of import (Art. 4. Para 9a–b).

Emissions prohibited

- The **Stockholm Convention** requires that proposals to construct new facilities or significantly modify existing facilities using processes that release UPOPs, should prioritise alternative processes, techniques or practices that have similar usefulness, but which avoid the formation and release of UPOPs, including through the control of incineration temperature or residence time (Annex C, Part V, section B, para b).
- The **Montreal Protocol** requires Parties manufacturing Annex C, Group I, or Annex F substances to ensure its emissions of HFC-23 substances generated are destroyed to the extent practicable using technology approved by the Parties (Art. 2J, para 6).

International trade of material/product

- The **Stockholm Convention** requires Parties to take measures to ensure that a chemical listed in Annex A or B is imported only for the purpose of environmentally sound disposal as set forth in paragraph 1 (d) of Article 6 (Art. 3, para 2a (i)).
- The **Basel Convention** requires Parties to prevent the import of hazardous wastes and other wastes if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner (Art. 4, para 2g). The export of such wastes shall only be allowed if the State of export does not have the technical capacity and the necessary facilities, capacity or suitable disposal sites in order to dispose of the wastes in an environmentally sound and efficient manner; or the wastes are required as a raw material for recycling or recovery industries in the State of import (Art. 4, para 9). The import or export of such wastes with non-Parties is not to be permitted (Art. 4, para 5) unless an Article 11 agreement/arrangement is in place. Should the export of such wastes not occur as per the agreed terms and no suitable alternate arrangements can be made, the exporter shall re-import the hazardous wastes or other wastes (Art. 8).

Establish and maintain national inventories

- The **Stockholm Convention** states that the action plan for UPOPs shall include an evaluation of current and projected releases, including the development and maintenance of source inventories and release estimates (Art. 5, para 1 (i)).

Examples of approaches from other legal instruments

- The **regional marine litter action plan for the Mediterranean** requires Parties by the year 2025 at latest, to base urban solid waste management on reduction at source, applying the following waste hierarchy as a priority order in waste prevention and management legislation and policy: prevention, preparing for re-use, recycling, other recovery, e.g., environmentally sound disposal (Art. 9, para 1).

Dematerialisation Phase – Remediation

Broader measures indirectly encompassing chemicals in plastics and plastics

- The **CBD** requires Parties to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies (Art. 8f). In doing so, Parties need to ensure that by 2030 at least 30% of areas within degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration (GBF Target 2). Decision 14/10 (para 4) emphasises the need for the clean-up and removal of marine debris, where appropriate and practical, and the urgency of such efforts where marine debris poses a threat to sensitive marine and coastal biodiversity and habitats. The convention uses SDG indicator 14.1.1 on Floating Plastic debris Density (Decision 13/28, Annex).
- The **Basel Convention** requires Parties to ensure that persons involved in the management of hazardous wastes or other wastes prevent pollution by such wastes, but should pollution occur, they shall minimise the consequences thereof for human health and the environment (Art. 4.2(c)).
- Should countries request support, Parties to the **London Convention** shall promote collaboration for the mitigation of pollution caused by dumping (Art. IX).
- The **London Protocol** provides for the development of procedures regarding liability resulting from dumping or incineration of wastes or other matter at sea, in accordance with the principles of international law regarding State responsibility for damage to the environment of other States or to any other area of the environment (Art. 15).
- **The Stockholm Convention** requests Parties to manage stockpiles in a safe, efficient and environmentally sound manner (Art. 6, para 1c) and endeavour to develop strategies for identifying sites contaminated by chemicals listed in Annex A, B or C–if remediation of contaminated sites is undertaken it is to be performed in an environmentally sound manner (Art. 6, para 1e). The convention's effectiveness evaluation includes the following relevant indicators for measuring progress:
  - Changes in levels of each of the listed POPs in air / in humans / in other environmental media
  - Number of parties that have developed and used appropriate strategies to identify stockpiles
  - Number of parties with measures in place to manage stockpiles in a safe, efficient and environmentally sound manner
  - Changes in the quantity of stockpiles being managed in an environmentally sound manner
- The **Minamata Convention** requires Parties endeavour to develop strategies for identifying and assessing sites contaminated by mercury and mercury compounds. Parties that take actions to reduce the risks posed by such sites shall do so in an environmentally sound manner incorporating an assessment of the risks to human health and the environment (Art. 12, paras 1–2). Moreover, the convention requires Parties to endeavour to cooperate to develop and improve modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and in environmental media, including biotic media such as fish, marine mammals, sea turtles and bird (Art. 19, para 1b).

Examples of approaches from other legal instruments

- The **Regional Marine Litter Action Plan for the Mediterranean** requires Parties, where it is environmentally sound and cost effective, to remove existing accumulated litter, subject to Environmental Impact Assessment procedure, in particular from specially protected areas and Specially Protected Areas of Mediterranean Importance (SPAMI) and litter impacting endangered species listed in Annexes II and III of the SPA and Biodiversity Protocol. To this aim the Parties undertake to explore and implement to the extent possible the following measures by 2019:[129]
  a) Identify in collaboration with relevant stakeholders accumulations/hotspots of marine litter and implement national programmes on their regular removal and sound disposal,
  b) Implement National Marine Litter Cleanup Campaigns on a regular basis,
  c) Participate in International Coastal Cleanup Campaigns and Programmes,
  d) Apply as appropriate "Adopt-a-Beach" or similar practices and enhance public participation role with regard to marine litter management,
  e) Apply "Fishing for Litter" in an environmentally sound manner, based on agreed guidelines and best practice, in consultation with the competent international and regional organisations and in partnership with fishermen and ensure adequate collection, sorting, recycling and/or environmentally sound disposal of the fished litter, and
  f) Charge reasonable costs for the use of port reception facilities or, when applicable apply "No-Special-Fee system", in consultation with competent international and regional organisations, when using port reception facilities for implementing the measures provided for in Article 10 (Art. 10).
- **The Aarhus Convention** requires Parties to ensure that members of the public have access to administrative or judicial review procedures to challenge decisions, acts and omissions by public authorities and private persons which contravene provisions of its national law relating to the environment (Art. 9), for example in the case of environmental damage.

Appendix 3. Summarised mapping of non-binding measures for plastics and associated chemicals

Sourcing Phase – Extraction

Goals and targets

- The **2030 Agenda** includes Target 13.2: Integrate climate change measures into national policies, strategies and planning.

Indicators

- The **2030 Agenda** includes Indicator 13.2.2: Total greenhouse gas emissions per year.

Transparency

- *Chemicals/Plastics:* PRTRs promoted under SAICM aim at preventing and reducing pollutant releases into the environment, by establishing coherent and integrated Pollutant Release and Transfer Registers that require data collection, management and dissemination related to pollution (GPA, para 8c).

129 Article 9 of the Regional Marine Litter Action Plan for the Black Sea includes almost identical measures.

Chemical Phase – Production

Targets:

- The **2030 Agenda** includes the following relevant targets:
- 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.
- 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment.

Indicators

- The **2030 Agenda** includes the following indicators:
- 12.1.1: Number of countries developing, adopting or implementing policy instruments aimed at supporting the shift to sustainable consumption and production.
- 12.4.1: Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement

Transparency and information sharing

- *Chemicals:* The SAICM Objective with regard to risk reduction is to ensure, by 2020, that chemicals or chemical uses that pose an unreasonable and otherwise unmanageable risk to human health and the environment based on a science-based risk assessment and taking into account the costs and benefits as well as the availability of safer substitutes and their efficacy, are no longer produced or used for such uses (OPS, para 14d).
- *Chemicals/Plastics:* PRTRs promoted under SAICM aim at preventing and reducing pollutant releases into the environment, by establishing coherent and integrated Pollutant Release and Transfer Registers that require data collection, management and dissemination related to pollution (GPA, para 8c).

Material Phase – Manufacture

Goals and targets:

- The **2030 Agenda** includes following relevant targets:
  - 12.1: Implement the 10-YFP on SCP Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries.
  - 12.2: By 2030, achieve the sustainable management and efficient use of natural resources.
  - 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment.
  - 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
- **UNEA** calls for addressing the damage to our ecosystems caused by the unsustainable use and disposal of plastic products, including by significantly reducing the manufacturing and use of single-use plastic products by 2030 (UNEA Res. 4/HLS, para 5l)

Indicators

- The **2030 Agenda** includes the following relevant indicators:
  - 12.1.1: Number of countries developing, adopting or implementing policy instruments aimed at supporting the shift to sustainable consumption and production.
  - 12.6.1: Number of companies publishing sustainability reports.

Chemicals/materials/products and activities to be phased out:

- **SAICM** has recognised the following emerging policy issues/other issues of concern that are of relevance to chemicals in plastics with emphasis given to phasing out substances of concern:
  - *Hazardous substances within the life cycle of electrical and electronic products (HSLEEP),* recognising there is *a* pressing need for the continued development of clean technology and the environmentally friendly design and recycling of electronic and electrical products, with the goal of phasing out, where feasible, those hazardous substances contained in electronic and electrical product (ICCM II/4 section D, para c).
  - *Perfluorinated chemicals (PFCs) and the transition to safer alternatives, inviting* Governments and other stakeholders to consider the development, facilitation and promotion in an open, transparent and inclusive manner of national and international stewardship programmes and regulatory approaches to reduce emissions and the content of relevant PFCs of concern in products and to work toward global elimination, where appropriate and technically feasible (ICCM II/5, para 1).

Materials/products/activities to be regulated:

- *Chemicals:* **UNEA** encourages member states to set standards for food-grade plastics to minimise the risk of toxins getting into food (UNEA Res. 4/7, para 1l) and UNEA highlights the importance of minimising and preventing, when feasible, the use of hazardous substances in material cycles and managing chemicals in products throughout their life cycle, from design to waste, in order to adapt production and consumption models to achieve SCP, including but not limited to the circular economy and other sustainable economic models (UNEA Res. 4/8, para 3).
- *Plastics:* **UNEA** encourages Member States to promote the identification and development of environmentally friendly alternatives to single-use plastic products, taking into account the full life cycle implications of those alternatives (UNEA Res. 4/9, para 2); more resource-efficient design, production, use and sound management of plastics across their life cycle, (UNEA Res. 4/9, para 5); and sustainable consumption and production of products likely to generate marine litter, including plastic litter and microplastics (UNEA Res. 4/6, para 6b). Moreover, UNEA resolutions provide more guidance on design is prominently featured in UNEA resolutions, although Resolution 5/14 is the only on that refers specifically to plastics, with the acknowledgement that a more circular economy in which products and materials are designed to be reused, remanufactured recycled or recovered and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimised, and greenhouse gas emissions are prevented or reduced, can contribute significantly to sustainable consumption and production (UNEA Res. 4/1, preamble) and invitation to Member States to prevent and reduce waste at the source of origin by minimising packaging materials, discouraging planned obsolescence of products, improving their safety, reusability, recyclability and resource efficiency through improved product design, using easy-to-recycle materials and using secondary raw materials, where feasible, rather than primary raw materials (UNEA Res. 4/7, para 1b); and to enhance the design of products, taking into account life cycle assessments, to favour product lifetime extension, repair, re-use and easier recycling in the context of a circular economy, to contribute to resource efficiency (UNEA Res. 5/11, para 2). Lastly, UNEA underlines the importance of waste prevention and minimisation at source through minimising packaging materials, discouraging planned product obsolescence and improving the reusability and recyclability of products and the efficiency of resources through improved design and the use of secondary raw materials (UNEA Res. 4/8, para 4).

Emissions prohibited:

- *Plastics:* **UNEA** encourages product manufacturers and others to consider the life cycle environmental impacts of products containing microbeads and compostable polymers, including possible downstream impacts that may compromise the recycling of plastic waste; to eliminate or reduce the use of primary microplastic particles in products, including, wherever possible, products such as personal care products, industrial abrasives and printing products; to ensure that any replacement products are environmentally sound; and to cooperate in the environmentally sound management of such plastic waste (UNEA Res. 2/11, para 18). Moreover, UNEA invites member States to reduce the discharge of microplastics into the marine environment, including, through the phasing out of products that contain microplastics (UNEA Res. 4/6, para 4a), foster innovation in product design to reduce secondary microplastics release from land- and sea-based sources and improve waste management where needed (UNEA Res. 4/6, para 4b), prevent losses of primary microplastics, in particular pre-production pellets (flakes and powders), to prevent spillage into the environment across the whole manufacturing and supply chain (Res 4/6, para 4c), and to reduce microplastics in wastewater treatment plants, and encourage producers to use alternatives to microbeads (UNEA Res. 4/7, para 1n).

Develop national action plans:

- *Plastics/chemicals:* **UNEA** encourages Member States to develop and implement action plans for preventing marine litter and the discharge of microplastics; encouraging resource efficiency and increasing collection and recycling rates of plastic waste and re-design and re-use of products and materials; and avoiding the unnecessary use of plastic and plastic containing chemicals of particular concern (UNEA Res. 3/7, para 4c).

Transparency and information sharing:

- *Chemicals*: **SAICM** objective with regard to knowledge and information are "to ensure that information on chemicals throughout their life cycle, including, where appropriate, chemicals in products, is available, accessible, user friendly, adequate and appropriate to the needs of all stakeholders. Appropriate types of information include their effects on human health and the environment, their intrinsic properties, their potential uses, their protective measures and regulation" (OPS, para 15c). It further asks that "in making information available in accordance with paragraph 15 (b), confidential commercial and industrial information and knowledge are protected in accordance with national laws or regulations or, in the absence of such laws or regulations, are protected in accordance with international provisions. In the context of this paragraph, information on chemicals relating to the health and safety of humans and the environment should not be regarded as confidential" (OPS, para 15c).
- *Chemicals:* **SAICM** asks "to facilitate public access to appropriate information and knowledge on chemicals throughout their life cycle, including the risks that they pose to human health and the environment" (Dubai Declaration, paras 21). Moreover, SAICM asks to "ensure that, when information is made available, confidential commercial and industrial information and knowledge are protected in accordance with national laws or regulations or, in the absence of such laws and regulations, are protected in accordance with international provisions" and continues that "In making information available, information on chemicals relating to the health and safety of humans and the environment should not be regarded as confidential" (Dubai Declaration, para 22). Moreover, SAICM has recognised the following emerging policy issues that are of relevance for chemicals in plastics with emphasis given to promoting transparency and information sharing:
  - *Chemicals in Products (CIP)* with the commitment to consider further the need to improve the availability of and access to information on chemicals in products in the supply chain and throughout their life cycle (ICCM II/4, section C, para 1). Governments and other stakeholders and encouraged to participate actively in the development of the proposal for the CiP programme, including associated pilot demonstration projects (ICCM III/2, section C, para 7).
  - *Nanotechnologies and manufactured nanomaterials* with the aim to facilitate the exchange

of information on nanotechnologies and manufactured nanomaterials to improve global transparency and allow better decision-making processes, noting that examples of such information might include information on risk assessments, risk reduction measures and environmental, health and safety research (ICCM III/2, section E, para 2).
    - *Endocrine-disrupting chemicals* with the overall objective of increasing awareness and understanding among policymakers and other stakeholders (ICCM III/2, section F, para 5).
- *Chemicals/Plastics:* PRTRs promoted under SAICM aim at preventing and reducing pollutant releases into the environment, by establishing coherent and integrated Pollutant Release and Transfer Registers that require data collection, management and dissemination related to pollution (GPA, para 8c).

Material Phase – Consumption

Goals and targets:

- The **2030 Agenda** includes the following relevant targets:
    - 12.7: Promote public procurement practices that are sustainable, in accordance with national policies and priorities.
    - 12.1: Implement the 10-YFP on SCP Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries.
    - 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment
    - 12.8: By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
- *Plastics:* **UNEA** calls for addressing the damage to our ecosystems caused by the unsustainable use and disposal of plastic products, including by significantly reducing the manufacturing and use of single-use plastic products by 2030 (UNEA Res. 4/HLS Declaration, para 5l).

Indicators:

- The **2030 Agenda** includes the following relevant indicators:
    - 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)
    - 12.2.1: Material footprint, material footprint per capita, and material footprint per GDP
    - 12.2.2: Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP.
    - 12.4.2: (a) Hazardous waste generated per capita

Emissions prohibited:

- *Plastics:* **UNEA** encourages all member States and invites other actors, taking into account national conditions to step up measures to prevent marine litter and the discharge of microplastics from sea-based sources, such as fisheries, aquaculture, off-shore installations and shipping, including through the promotion of accessibility and use of port reception facilities (UNEA Res. 3/7, para 4f).

Develop national action plans

- *Plastics/chemicals:* **UNEA** encourages all member States to develop and implement action plans for preventing marine litter and the discharge of microplastics; encouraging resource efficiency, and increasing collection and recycling rates of plastic waste and re-design and re-use of products and materials; and avoiding the unnecessary use of plastic and plastic containing chemicals of

particular concern (UNEA Res. 3/7, para 4c) and to develop and implement national or regional actions to address the environmental impact of single-use plastic products (UNEA Res. 4/9, para 1).

Transparency and information sharing

- *Chemicals:* **UNEA** calls upon Governments to improve the information provided about chemicals in consumer goods and throughout the supply chain (UNEA Res. 4/8, para 12d).
- *Products/Chemicals:* The **Aarhus Convention** encourage Parties, signatories and other interested States to ensure effective public access to product-specific data and information, such as those on material and energy efficiency, toxicity, material composition, durability, environmental impact, repairability and recycling, to enable consumers as well as other actors in value chains (for example, market surveillance and waste management) to improve their environmental performance; cooperation with the private sector being essential in ensuring provision of this information. Examples include product databases, digital product passports, eco-labelling, energy efficiency and eco-auditing schemes and environmental product declarations.
- The process leading to the adoption of the **Beyond-2020** framework for sound management of chemicals and waste has developed a draft wording for a target connected specifically to improve information on chemicals in articles: *"By 2030, stakeholders in the value chain ensure that reliable information on chemicals in [materials and] articles is available throughout their life cycle, [including at the waste stage], to enable informed decisions and safe management of chemicals in a clean circular economy."*

Dematerialisation Phase – Waste Management (collection/sorting)

Goals and targets:

- The **2030 Agenda** includes the following relevant targets
  - 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
  - 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment.
  - 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.
- *Plastics:* **UNEA** stresses the importance of long-term elimination of discharge of litter and microplastics to the oceans and of avoiding detriment to marine ecosystems and the human activities dependent on them from marine litter and microplastics (UNEA Res. 3/7, para 1).

Indicators:

- The **2030 Agenda** includes the following relevant indicators:
  - 6.3.2: Proportion of bodies of water with good ambient water quality
  - 12.4.2 (a): Hazardous waste generated per capita
  - 12.4.2 (b): proportion of hazardous waste treated, by type of treatment
  - 12.5.1: National recycling rate, tons of material recycled

Materials/products/activities to be phased out:

- *Plastics:* **UNEA** emphasises that further urgent action is needed to address the challenges posed by marine plastic debris and microplastics, by addressing such materials at source, by reducing pollution through improved waste management practices and by cleaning up existing debris and litter (UNEA 1/6, para 8) and encourages Member States to:

- Take comprehensive action to address the marine plastic debris and microplastic issue through legislation, enforcement of international agreements, provision of adequate reception facilities for ship-generated wastes, improvement of waste management practices and support for beach clean-up activities, as well as information, education and public awareness programmes (UNEA 1/6, para 17).
- Take comprehensive action with regard to single-use plastic products in addressing related waste through legislation; implementation of international agreements; provision of adequate waste management infrastructure; improvement of waste management practices and support for waste minimisation; environmentally sound clean-up activities; information sharing; and supporting innovation (UNEA Res. 4/9, para 6).
- To promote improved waste management that will contribute to reducing the discharge of plastic waste into the environment (UNEA Res. 4/9, para 3).

Materials/products/activities to be regulated:

- *Chemicals:* **UNEA** invites Member States to promote integrated approaches to solid waste management through sustainable consumption and production, including but not limited to a circular economy and other sustainable economic models, as well as other innovative means, including the removal of hazardous substances from waste before recycling, special attention to preparing waste for reuse and recycling, a reduction in landfill use, and the application of the "waste hierarchy" set of priorities for all waste (UNEA Res. 4/7, para 1a)

Emissions prohibited:

- *Plastics:* **UNEA** invites Member States to support the recycling of plastics, including the improvement of waste collection, transportation and recycling infrastructure (UNEA Res. 4/7, para 1p).

Develop national action plans:

- *Plastics:* **UNEA** encourages Member States to:
  - Develop and implement action plans for preventing marine litter and the discharge of microplastics; encouraging resource efficiency and increasing collection and recycling rates of plastic waste and re-design and re-use of products and materials; and avoiding the unnecessary use of plastic and plastic containing chemicals of particular concern (UNEA Res. 3/7, para 4c).
  - Include marine litter and microplastics in local, national and regional waste management plans and in wastewater treatment (UNEA Res. 3/7, para d).
  - Include the land/sea and freshwater/sea interface in action plans for preventing marine litter, including microplastics (UNEA Res. 3/7, para 4e).
- *Plastics/Chemicals:* The Maastricht Recommendations on Promoting Effective Public Participation in Decision-making in Environmental Matters, including on plastics, prepared under the Aarhus Convention provide Member States with a step-by-step approach for engaging all interested stakeholders, so as to improve decision-making, planning and the implementation of policies, plans and programmes in environmental matters.

Transparency and information sharing

- Chemicals/Plastics: PRTRs promoted under SAICM aim at preventing and reducing pollutant releases into the environment, by establishing coherent and integrated Pollutant Release and Transfer Registers that require data collection, management and dissemination related to pollution (GPA, para 8c).

Dematerialisation Phase – Waste management (recovery and final disposal)

Goals and targets

- The **2030 Agenda** includes the following relevant targets:

- 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
- 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Indicators

- The **2030 Agenda** includes the following relevant indicators:
  - 14.1.1 (b) plastic debris density
  - 6.3.1: Proportion of domestic and industrial wastewater flows safely treated.
  - 12.4.2 (b): proportion of hazardous waste treated, by type of treatment.
  - 11.6.1: Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities.

Emissions prohibited

- *Plastics:* **UNEA** invites Member States to strengthen legislation to prohibit the open burning of plastics to avoid air pollution and its associated negative impacts on health (UNEA Res. 4/7, para 1o) and to reduce microplastics, including in wastewater treatment plants (UNEA Res. 4/7, para 1n).

Dematerialisation Phase – Remediation

- **UNEA** encourages Member States to support environmentally sound clean-up activities (Res 4/9, para 6).
- The 2017 Guidelines for the Implementation of **MARPOL Annex V** promotes the recovery of garbage at sea, encouraging seafarers to recover persistent garbage from the sea during routine operations as opportunities arise and to retain the material for discharge to port reception facilities (Resolution MEPC.295(71), para 2.4.9).

Appendix 4. Chemicals of relevance for plastics listed by the Stockholm Convention, Minamata Convention and Montreal Protocol

Substances regulated by the Stockholm Convention, Minamata Convention and Montreal Protocol of relevance for plastics are extracted from supplementary data provided in studies conducted by Aurisano et al. (2021) and Wiesinger et al. (2021). The studies identified several POPs used in plastics that are listed as pesticides in the Stockholm Convention (i.e. Lindane, Chlordane, Endrin, DDT, Mirex, Heptachlor, alpha-HCH, beta-HCH and endosulfan) as well as three industrial chemicals (i.e. HCBD, PeCB and HCB) that are not commonly associated with plastics within the Stockholm Convention.[130] In relation to chemicals listed under the Stockholm Convention, the data does not include information on two groups of chemicals known to be associated with plastics: 1) Perfluorohexane sulfonic acid (PFHxS), its salts, and PFHxS-related, and 2) Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated dibenzofurans (PCDFs).

130 The following POPs are commonly associated to plastics within the Stockholm Convention: 1) Annex A (Elimination): Short-chain chlorinated paraffins (SCCPs), Decabromodiphenyl ether (deca-BDE), Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds, Perfluorohexane sulfonic acid (PFHxS), its salts, and PFHxS-related compounds, Hexabromocyclododecane (HBCD), Polychlorinated naphthalenes (PCNs), Pentachlorophenol (PCP) and its salts and esters, Hexabromodiphenyl ether / heptabromodiphenyl ether, Tetrabromodiphenyl ether / pentabromodiphenyl ether and Polychlorinated biphenyls (PCBs); 2) Annex B (Restriction): Perfluorooctane sulfonic acid (PFOS, its salts, and PFOSF); and Annex C (UPOPs): Hexachlorobenzene (HCB), hexachlorobutadiene, pentachlorobenzene (PeCB), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF) and polychlorinated naphthalenes (PCNs).

Table 17: Chemicals of relevance listed by the Stockholm Convention, Minamata Convention and Montreal Protocol

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	1.	Polychlorinated biphenyls (PCBs)	1336-36-3	Plasticizer	PET			x
	2.	PCB 1254 (PCBs)	11097-69-1	Flame Retardant	Other - Rubber			x
	3.	1,1'-Biphenyl, 2,3,4',5-tetrachloro- (PCBs)	74472-34-7		HDPE, LDPE			x
	4.	1,1'-Biphenyl, 2,2',4,4',5,6'-hexachloro- (PCBs)	60145-22-4		Other - Thermoplastic			x
	5.	1,1'-Biphenyl, 3,5-dichloro- (PCBs)	34883-41-5		LDPE			x
	6.	1,1'-Biphenyl, 2,4,6-trichloro- (PCBs)	35693-92-6		LDPE			x
	7.	1,1'-Biphenyl, 3,4-dichloro- v	2974-92-7		HDPE, LDPE			x
	8.	1,1'-Biphenyl, 2,2',3,3',4,5,6,6'-octachloro- (PCBs)	52663-73-7		HDPE, LDPE			x
	9.	1,1'-Biphenyl, 2,2',3,4,4'-pentachloro- (PCBs)	65510-45-4		HDPE, LDPE			x
	10.	1,1'-Biphenyl, 2,2',3,4',6-pentachloro (PCBs)	68194-05-8		HDPE, LDPE			x
	11.	1,1'-Biphenyl, 2,2',4,4',6,6'-hexachloro- (PCBs)	33979-03-2		HDPE, LDPE, Other - Thermoplastic			x
	12.	1,1'-Biphenyl, 2,4',6-trichloro- (PCBs)	38444-77-8		HDPE, LDPE			x
	13.	1,1'-Biphenyl, 2,5-dichloro- (PCBs)	34883-39-1		HDPE, LDPE			x
	14.	1,1'-Biphenyl, 2,6-dichloro- (PCBs)	33146-45-1		HDPE, LDPE			x
	15.	1,1'-Biphenyl, 2,4-dichloro- (PCBs)	33284-50-3		HDPE, LDPE, Other - Bioplastic			x
	16.	1,1'-Biphenyl, 2,3,3',4'-tetrachloro- (PCBs)	41464-43-1		HDPE, LDPE			x
	17.	1,1'-Biphenyl, 2,2',3,3'-tetrachloro- (PCBs)	38444-93-8		HDPE, LDPE			x
	18.	1,1'-Biphenyl, 2,4,5-trichloro- (PCBs)	15862-07-4		HDPE, LDPE			x
	19.	1,1'-Biphenyl, 2,2',3,4,4',5-hexachloro- (PCBs)	35694-06-5		HDPE, LDPE			x
	20.	1,1'-Biphenyl, 2,2',4-trichloro- (PCBs)	37680-66-3		HDPE, LDPE			x
	21.	1,1'-Biphenyl, 2,3-dichloro- (PCBs)	16605-91-7		HDPE, LDPE			x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	22.	1,1'-Biphenyl, 2,2',3,3',6,6'-hexachloro- (PCBs)	38411-22-2		HDPE, LDPE			x
	23.	1,1'-Biphenyl, 2,2',3,4',5'-pentachloro- (PCBs)	41464-51-1		HDPE, LDPE			x
	24.	1,1'-Biphenyl, 2,2',3,3',4,4',6-heptachloro- (PCBs)	52663-71-5		HDPE, LDPE			x
	25.	1,1'-Biphenyl, 2,2',3,3',4,5,6'-heptachloro- (PCBs)	38411-25-5		HDPE, LDPE			x
	26.	1,1'-Biphenyl, 2,3',4'-trichloro- (PCBs)	38444-86-9		HDPE, LDPE			x
	27.	1,1'-Biphenyl, 2,2'-dichloro- (PCBs)	13029-08-8		HDPE, LDPE			x
	28.	1,1'-Biphenyl, 2-chloro- (PCBs)	2051-60-7		HDPE, LDPE			x
	29.	1,1'-Biphenyl, 2,2',3,5,5',6-hexachloro- (PCBs)	52663-63-5		HDPE, LDPE			x
	30.	1,1'-Biphenyl, 2,4'-dichloro- (PCBs)	34883-43-7		HDPE, LDPE			x
	31.	1,1'-Biphenyl, 2,2',4,4'-tetrachloro- (PCBs)	2437-79-8		HDPE, LDPE, PET			x
	32.	1,1'-Biphenyl, 2,3',4',5-tetrachloro- (PCBs)	32598-11-1		HDPE, LDPE			x
	33.	1,1'-Biphenyl, 2,2',3,3',4,4',5,5',6-nonachloro- (PCBs)	40186-72-9		HDPE, LDPE			x
	34.	1,1'-Biphenyl, 4,4'-dichloro- (PCBs)	2050-68-2		HDPE, LDPE, Other - Bioplastic			x
	35.	1,1'-Biphenyl, 2,3,3',4',6-pentachloro- (PCBs)	38380-03-9		HDPE, LDPE			x
	36.	1,1'-Biphenyl, 2,2',3,4',5',6-hexachloro- (PCBs)	38380-04-0		HDPE, LDPE			x
	37.	1,1'-Biphenyl, 2,4',5-trichloro- (PCBs)	16606-02-3		HDPE, LDPE			x
	38.	1,1'-Biphenyl, 2,2',3,5'-tetrachloro- (PCBs)	41464-39-5		HDPE, LDPE			x
	39.	1,1'-Biphenyl, 2,2',5-trichloro- (PCBs)	37680-65-2		HDPE, LDPE			x
	40.	1,1'-Biphenyl, 2,2',3,3',4,4',5,5'-octachloro-	35694-08-7		HDPE, LDPE			x
	41.	1,1'-Biphenyl, 4-chloro- (PCBs)	2051-62-9		HDPE, LDPE, Other - Bioplastic			x
	42.	1,1'-Biphenyl, 3,4,4',5-tetrachloro- (PCBs)	70362-50-4		HDPE, LDPE			x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	43.	1,1'-Biphenyl, 2,3',4,4',5'-pentachloro- (PCBs)	65510-44-3		HDPE, LDPE			x
	44.	1,1'-Biphenyl, 2,2',3,3',4,4'-hexachloro- (PCBs)	38380-07-3		HDPE, LDPE			x
	45.	1,1'-Biphenyl, 2,2',3,4',5,5',6-heptachloro- (PCBs)	52663-68-0		HDPE, LDPE			x
	46.	1,1'-Biphenyl, 2,3,4,4',5-pentachloro- (PCBs)	74472-37-0		HDPE, LDPE			x
	47.	1,1'-Biphenyl, 2,3,3',4,4',5'-hexachloro- (PCBs)	69782-90-7		HDPE, LDPE			x
	48.	1,1'-Biphenyl, 2,2',3,3',4,4',5-heptachloro- (PCBs)	35065-30-6		HDPE, LDPE			x
	49.	1,1'-Biphenyl, 2,3,3',4,4',5-hexachloro- (PCBs)	38380-08-4		HDPE, LDPE, Other - Thermoplastic			x
	50.	1,1'-Biphenyl, 3,3',4,4'-tetrachloro-(PCBs)	32598-13-3		HDPE, LDPE			x
	51.	1,1'-Biphenyl, 2,3,3',4,4'-pentachloro- (PCBs)	32598-14-4		HDPE, LDPE, Other - Thermoplastic			x
	52.	1,1'-Biphenyl, 2,4,4'-trichloro- (PCBs)	7012-37-5		HDPE, LDPE, Other - Bioplastic			x
	53.	1,1'-Biphenyl, 2,2',4,5,5'-pentachloro- (PCBs)	37680-73-2		HDPE, LDPE, Other - Bioplastic, Other - Thermoplastic			x
	54.	1,1'-Biphenyl, 2,2',5,5'-tetrachloro- (PCBs)	35693-99-3		HDPE, LDPE, Other - Bioplastic, Other - Thermoplastic			x
	55.	1,1'-Biphenyl, 2,2',3,4,4',5'-hexachloro- (PCBs)	35065-28-2		HDPE, LDPE, Other - Thermoplastic			x
	56.	1,1'-Biphenyl, 2,2',3,4,4',5,5'-heptachloro- (PCBs)	35065-29-3		HDPE, LDPE, Other - Thermoplastic			x
	57.	1,1'-Biphenyl, 2,3',4,4',5-pentachloro- (PCBs)	31508-00-6		HDPE, LDPE, Other - Thermoplastic			x
	58.	1,1'-Biphenyl, 2,2',4,4',5,5'-hexachloro- (PCBs)	35065-27-1		HDPE, LDPE, Other - Thermoplastic			x
	59.	Hexabromodiphenyl ether (Commercial octabromodiphenyl ether, c-OctaBDE)	36483-60-0	Flame retardant	ABS, HIPS, PBT	Electrical and electronic equipment		x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	60.	Heptabromodiphenyl ether (Commercial octabromodiphenyl ether, c-OctaBDE)	68928-80-3	Flame retardant	ABS, HIPS, PBT	Electrical and electronic equipment		x
	61.	Tetrabromodiphenyl ether (Commercial pentabromodiphenyl ether, c-PentaBDE)	32534-81-9	Flame Retardant, Other Processing Aids	ABS, EPS, HDPE, HIPS, LDPE	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys	x	x
	62.	2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	Flame retardant			x	
	63.	Pentabromodiphenyl ether (Commercial pentabromodiphenyl ether, c-PentaBDE)	40088-47-9	Flame Retardant	PET, PUR	Automotive		x
	64.	Decabromdiphenyl ether (c-DecaBDE)	1163-19-5	Biocide, Colorant, Filler, Flame Retardant, Heat Stabilizer, Intermediates, Lubricant, Odor Agent, Other Processing Aids	ABS, EPS, HDPE, HIPS, LDPE, Other - Rubber, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys	x	x
	65.	alpha-HBCD (Hexabromocyclododecane, HBCD)	134237-50-6	Flame retardant	EPS, HIPS, PP, PS	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Textiles		x
	66.	beta-HBCD (Hexabromocyclododecane, HBCD)	134237-51-7	Flame Retardant	EPS, HIPS, PP, PS	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Textiles		x
	67.	gamma-HBCD (Hexabromocyclododecane, HBCD)	134237-52-8	Flame retardant	ABS, EPS, HDPE, HIPS, LDPE, Other - Rubber, Other - Thermoplastic, PA, PP, PS, PUR	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys		x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	68.	1,2,5,6,9,10- Hexabromocyclododecane (Hexabromocyclododecane, HBCD)	3194-55-6	Flame retardant	ABS, EPS, HDPE, HIPS, LDPE, Other - Rubber, Other - Thermoplastic, PA, PP, PS, PUR	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys	x	x
	69.	Commercial HCBD (Hexabromocyclododecane, HBCD)	25637-99-4	Colorant, Flame Retardant, Intermediates, Other Processing Aids	EPS, HIPS, Other - Rubber, Other - Thermoplastic, PA, PET, PP, PS, PUR	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys		x
	70.	Pentachlorophenol (PCP) and its salts and esters	87-86-5	Biocide, Colorant	Other - Thermoplastic, PET	Food-contact plastics, Packaging	x	x
	71.	Phenol, 2,3,4,5,6-pentachloro-, sodium salt (1:1) (Pentachlorophenol (PCP) and its salts and esters)	131-52-2	Biocide, Other Processing Aids	Other - Rubber	Automotive, Building & Construction, Electrical and Electronic Equipment, Food-contact plastics, Packaging, Textiles		x
	72.	Phenol, 2,3,4,5,6-pentachloro-, potassium salt (1:1) (Pentachlorophenol (PCP) and its salts and esters)	7778-73-6	Biocide, Other Processing Aids		Food-contact plastics, Packaging		x
	73.	1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro- Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	1763-23-1			Automotive, Textiles		x
	74.	1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, potassium salt (1:1) Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	2795-39-3			Automotive, Textiles		
	75.	1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, ammonium salt (1:1) Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	29081-56-9			Automotive, Textiles		

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	76.	1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, lithium salt (1:1) Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	29457-72-5			Automotive, Textiles		
	77.	1-Octanesulfonyl fluoride, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro- Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	307-35-7			Automotive, Textiles		
	78.	Ethanaminium, N,N,N-triethyl-, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-1-octanesulfonate (1:1) Perfluorooctane sulfonic acid (PFOS) its salts and Perfluorooctane sulfonyl fluoride (PFOSF):	56773-42-3			Automotive, Textiles		
	79.	Perfluorooctanoic acid (PFOA), its salts and PFOA related compounds	335-67-1[131]	Colorant, Intermediates, Monomer, Other Processing Aids	Other - Thermoplastic	Agriculture, Automotive, Building & Construction, Electrical and Electronic Equipment, Food-contact plastics, Packaging, Textiles	x	x
	80.	Short-chain chlorinated paraffins (SCCPs)	85535-84-8	Colorant, Filler, Flame Retardant, Lubricant, Other Processing Aids, Plasticizer	Other - Rubber, PUR, PVC	Automotive, Building & Construction, Electrical and Electronic Equipment, Household items, furniture and other, Packaging, Textiles, Toys		x
	81.	Paraffin waxes, chloro (Short-chain chlorinated paraffins, SCCPs)	63449-39-8	Blowing Agent, Colorant, Crosslinking Agent, Filler, Flame Retardant, Lubricant, Other Processing Aids, Plasticizer, Solvent	HDPE, LDPE, PET, PP, PS, PUR, PVC	Agriculture, Automotive, Building & Construction, Electrical and Electronic Equipment, Food-contact plastics, Household items, furniture and other, Hygiene and Medical items, Packaging, Textiles		x

131 This is a large group of substances with still limited understanding of substances used in plastics.

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	82.	Chloroalkanes (Short-chain chlorinated paraffins, SCCPs)	61788-76-9	Flame Retardant, Lubricant, Other Processing Aids, Plasticizer	PET, PS	Automotive, Building & Construction, Textiles		x
	83.	Naphthalene, pentachloro- (Pentachlorinated naphthalenes, PCN)	1321-64-8	Flame Retardant				x
	84.	Naphthalene, 1,2,3,4,5,6,7,8-octachloro (Pentachlorinated naphthalenes, PCN)	2234-13-1	Flame Retardant				x
	85.	Hexacholrobutadiene (HCBD)	87-68-3					x
	86.	Pentachlorobenzene (PeCB)	608-93-5	Flame Retardant	LDPE, Other - Bioplastic, Other - Thermoplastic	Automotive		x
	87.	Hexachlorobenzene (HCB)	118-74-1	Plasticizer, Solvent	Other - Rubber, PVC			x
	88.	4,4'-DDT	50-29-3		HDPE, LDPE, Other - Bioplastic, Other - Thermoplastic			x
	89.	Chlordane	57-74-9			Other - Bioplastic		x
	90.	Lindane	58-89-9		LDPE, Other - Bioplastic, Other - Thermoplastic			x
	91.	Mirex	2385-85-5	Colorant, Flame Retardant	Other - Rubber, PA	Automotive, Electrical and Electronic Equipment		x
	92.	Heptachlor	76-44-8		LDPE, Other - Bioplastic, Other - Thermoplastic			x
	93.	Aldrin	309-00-2		LDPE, Other - Thermoplastic			x
	94.	Dieldrin	60-57-1		LDPE, Other - Bioplastic, Other - Thermoplastic			x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Stockholm Convention	95.	Endrin	72-20-8		LDPE, Other - Thermoplastic			x
	96.	Alpha hexachlorocyclohexane (Alpha-HCH)	319-84-6		LDPE, Other - Thermoplastic			x
	97.	Beta hexachlorocyclohexane (Beta-HCH)	319-85-7		LDPE, Other - Thermoplastic			x
	98.	Endosulfan	959-98-8		LDPE, Other - Thermoplastic			x
	99.	Endosulfan sulphate	1031-07-8		LDPE			x
	100.	Beta-endosulfan	33213-65-9		Other - Thermoplastic			x
Convention	**No.**	**Substance**	**CAS**	**Function**	**Polymer**	**Use**	**Aurisano et al. 2021**	**Wiesinger et al. 2021**
Minamata convention	1.	Mercury	7439-97-6	Catalyst, Colorant, Crosslinking Agent, Filler, Other Processing Aids	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	2.	Mercury, hydroxyphenyl-, mixt. with (nitrato-O) phenylmercury (9Cl)	8003-05-2	Solvent			x	
	3.	Mercury, hydroxyphenyl-	100-57-2	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	4.	Mercury chloride (Hg2Cl2)	10112-91-1	Biocide, Catalyst, Other Processing Aids	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Minamata convention	5.	Mercury, phenyl(propanoato-╬‖O)- 9	103-27-5	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	6.	Mercury, chloro(2-methoxyethyl)-	123-88-6	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	7.	Phenylmercury 2-ethylhexanoate	13302-00-6	Catalyst			x	
	8.	Mercury cyanide oxide (Hg2(CN)2O)	1335-31-5	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	9.	Mercury sulfide (HgS)	1344-48-5	Catalyst, Colorant	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	10.	Mercury, (octanoato)phenyl-	13864-38-5	Catalyst			x	
	11.	Mercury, (neodecanoato-.kappa.O)phenyl-	26545-49-3	Catalyst, Filler	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Automotive, Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	12.	Mercury, (nitrato-╬‖O)phenyl-	55-68-5	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Minamata convention	13.	Mercury, dimethyl-	593-74-8	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	14.	Mercury, (acetato-O)phenyl-	62-38-4	Catalyst, Colorant	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	15.	Mercury, diethyl-	627-44-1	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	16,	Mercury, bis(fulminato-C)-	628-86-4; 20820-45-5; 42240-20-0	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	17.	Mercuric chloride	7487-94-7	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	18.	Mercury chloride (HgCl)	7546-30-7	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x

Convention	No.	Substance	CAS	Function	Polymer	Use	Aurisano et al. 2021	Wiesinger et al. 2021
Montreal Protocol	1.	Mercuric sulfate	7783-35-9	Catalyst	ABS, EPS, HDPE, HIPS, LDPE, Other - Bioplastic, Other - Thermoplastic, PA, PC, PET, PP, PS, PUR, PVC	Building & Construction, Electrical and Electronic Equipment, Packaging	x	x
	2.	Ethane, 1,1,1-trichloro-	71-55-6	Lubricant, Odor Agent, Other Processing Aids, Plasticizer, Solvent	Other - Bioplastic	Automotive, Building & Construction, Food-contact plastics, Packaging, Textiles	x	x
	3.	Methane, tetrachloro-	56-23-5	Colorant, Other Processing Aids, Solvent	Other - Bioplastic	Automotive, Building & Construction, Food-contact plastics, Packaging	x	x
	4.	Ethane, 2,2-dichloro-1,1,1-trifluoro-	306-83-2					x
	5.	Ethane, 1,1,2-trichloro-	79-00-5	Intermediates	Other - Thermoplastic	Automotive, Food-contact plastics, Packaging		x
	6.	Ethane, 1,1-difluoro-	75-37-6	Biocide, Blowing Agent, Colorant, Filler, Light Stabilizer, Lubricant, Odor Agent, Other Processing Aids	PS, PUR	Automotive, Building & Construction, Electrical and Electronic Equipment, Food-contact plastics, Household items, furniture and other, Packaging, Textiles, Toys		x
	7.	Ethane, 1,1,2-trichloro-1,2,2-trifluoro-	76-13-1	Blowing Agent, Intermediates, Solvent		Electrical and Electronic Equipment		x
	8.	Methane, chlorodifluoro-	75-45-6	Blowing Agent, Filler, Intermediates	PS, PUR	Agriculture, Automotive, Building & Construction, Electrical and Electronic Equipment, Food-contact plastics, Household items, furniture and other, Packaging, Textiles		x
	9.	Methane, dichlorodifluoro-	75-71-8					x
	10.	1,1-Dichloro-1-fluoroethane	1717-00-6				x	

Appendix 5. Compilation of existing selection criteria

Below is a compilation of existing criteria and other requirement for screening or prioritising chemicals under existing multilateral instruments. The level of stringency varies considerably, with the Stockholm Convention placing strictest control measures. Voluntary multilateral instruments, such as SAICM, address emerging policy issues and other issues of concern with soft approaches, such as requesting to facilitate the exchange of information on specific issues.

Stockholm Convention

Box 3 includes the screening criteria from Annex D to the Stockholm Convention, which are used to evaluate chemicals proposed by Parties for listing in Annexes A, B, and/or C to the Convention.

Box 3: Annex D screening criteria under the Stockholm Convention

1. A Party submitting a proposal to list a chemical in Annexes A, B and/or C shall identify the chemical in the manner described in subparagraph (a) and provide the information on the chemical, and its transformation products where relevant, relating to the screening criteria set out in subparagraphs (b) to (e):
   a) **Chemical identity:**
      i. Names, including trade name or names, commercial name or names and synonyms, Chemical Abstracts Service (CAS) Registry number, International Union of Pure and Applied Chemistry (IUPAC) name; and
      ii. Structure, including specification of isomers, where applicable, and the structure of the chemical class;
   b) **Persistence:**
      i. Evidence that the half-life of the chemical in water is greater than two months, or that its half-life in soil is greater than six months, or
      ii. that its half-life in sediment is greater than six months; or
      iii. Evidence that the chemical is otherwise sufficiently persistent to justify its consideration within the scope of this Convention;
   c) **Bio-accumulation:**
      i. Evidence that the bio-concentration factor or bio-accumulation factor in aquatic species for the chemical is greater than 5,000 or, in the absence of such data, that the log Kow is greater than 5;
      ii. Evidence that a chemical presents other reasons for concern, such as high bio-accumulation in other species, high toxicity or ecotoxicity; or
      iii. Monitoring data in biota indicating that the bio-accumulation potential of the chemical is sufficient to justify its consideration within the scope of this Convention;
   d) **Potential for long-range environmental transport:**
      i. Measured levels of the chemical in locations distant from the sources of its release that are of potential concern;
      ii. Monitoring data showing that long-range environmental transport of the chemical, with the potential for transfer to a receiving environment, may have occurred via air, water or migratory species; or
      iii. Environmental fate properties and/or model results that demonstrate that the chemical has a potential for long-range environmental transport through air, water or migratory species, with the potential for transfer to a receiving environment in locations distant from the sources of its release. For a chemical that migrates significantly through the air, its half-life in air should be greater than two days; and
   e) **Adverse effects:**
      i. Evidence of adverse effects to human health or to the environment that justifies consideration of the chemical within the scope of this Convention; or
      ii. Toxicity or ecotoxicity data that indicate the potential for damage to human health or to the environment.
2. The proposing Party shall provide a statement of the reasons for concern including, where possible, a comparison of toxicity or ecotoxicity data with detected or predicted levels of a chemical resulting or anticipated from its long-range environmental transport, and a short statement indicating the need for global control.
3. The proposing Party shall, to the extent possible and taking into account its capabilities, provide additional information to support the review of the proposal referred to in paragraph 6 of Article 8. In developing such a proposal, a Party may draw on technical expertise from any source.

Basel Convention

Annex III List of Hazardous Characteristics

Corresponds to the hazard classification system included in the United Nations Recommendations on the Transport of Dangerous Goods (ST/SG/AC.10/1Rev.5, United Nations, New York, 1988)

a) Explosive – An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

b) Flammable liquids – The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5oC, closed-cup test, or not more than 65.6oC, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)

c) Flammable solids – Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.

d) Substances or wastes liable to spontaneous combustion – Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire

e) Substances or wastes which, in contact with water emit flammable gases – Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities

f) Oxidizing – Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.

g) Organic Peroxides – Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition

h) Poisonous (Acute) – Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact

i) Infectious substances – Substances or wastes containing viable micro organisms or their toxins which are known or suspected to cause disease in animals or humans

j) Corrosives – Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.

k) Liberation of toxic gases in contact with air or water – Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

l) Toxic (Delayed or chronic) – Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.

m) Ecotoxic – Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems

n) Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

MARPOL Annex V – Appendix I

Criteria for the classification of solid bulk cargoes as harmful to the marine environment.

For the purpose of this Annex, cargo residues are considered to be harmful to the marine environment (HME) if they are residues of solid bulk cargoes which are classified according to the criteria of the

United Nations Globally Harmonized System of Classification and Labelling of Chemicals (GHS) meeting the following parameters:[132]

1. Acute Aquatic Toxicity Category 1; and/or
2. Chronic Aquatic Toxicity Category 1 or 2; and/or
3. Carcinogenicity Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or
4. Mutagenicity Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or
5. Reproductive Toxicity Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or
6. Specific Target Organ Toxicity Repeated Exposure Category 1 combined with not being rapidly degradable and having high bioaccumulation; and/or
7. Solid bulk cargoes containing or consisting of synthetic polymers, rubber, plastics, or plastic feedstock pellets (this includes materials that are shredded, milled, chopped or macerated or similar materials).

2017 Guidelines for the Implementation of MARPOL Annex V (MEPC 71/17/Add.1)

A cleaning agent or additive is considered not harmful to the marine environment if it:

1. is not a "harmful substance" in accordance with the criteria in MARPOL Annex III; and
2. does not contain any components which are known to be carcinogenic, mutagenic or reprotoxic (CMR) (para 1.7.5).

EU REACH[133] Regulation (Annex XIV)

Box 4 outlines hazard criteria specified in Article 57 of EU's REACH legislation for the identification of substances of very high concern (SVHC) for listing in the REACH Candidate List (List of substances subject to authorisation).

Box 4: Hazard criteria used for listing substances under Annex XIV of EU's REACH legislation

The following substances may be included in Annex XIV in accordance with the procedure laid down in Article 58:

a) Substances meeting the criteria for classification in the hazard class **carcinogenicity** category 1A or 1B in accordance with section 3.6 of Annex I to Regulation (EC) No 1272/2008;

b) Substances meeting the criteria for classification in the hazard class **germ cell mutagenicity** category 1A or 1B in accordance with section 3.5 of Annex I to Regulation (EC) No 1272/2008;

c) Substances meeting the criteria for classification in the hazard class **reproductive toxicity** category 1A or 1B, adverse effects on sexual function and fertility or on development in accordance with section 3.7 of Annex I to Regulation(EC) No 1272/2008;

d) Substances which are **persistent, bioaccumulative and toxic** in accordance with the criteria set out in Annex XIII of this Regulation;

e) Substances which are **very persistent and very bioaccumulative** in accordance with the criteria set out in Annex XIII of this Regulation;

f) Substances – such as those having **endocrine disrupting properties** or those having **persistent, bioaccumulative and toxic properties or very persistent and very bioaccumulative properties**, which do not fulfil the criteria of points (d) or (e) – for which there is scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern to those of other substances listed in points (a) to (e) and which are identified on a case-by-case basis in accordance with the procedure set out in Article 59.

132 Resolution MEPC.277(70).

133 Registration, Evaluation, Authorisation and Restriction of Chemicals.

Appendix 6. OECD Chemicals Perspective for Sustainable Plastics Design

The following is copied verbatim from the OECD report entitled A Chemicals Perspective on Designing with Sustainable Plastics: Goals, Considerations and Trade-offs (OECD, 2021a).

Designers need to set sustainable design goals as they consider sustainable plastics selection from a chemicals perspective. It is recommended that these build upon the following set of principles derived from the American Chemical Society (ACS) Green Chemistry Institute's (GC) design principles of sustainable chemistry and engineering:

- Maximise resource efficiency.
- Eliminate and minimise hazards and pollution.
- Design systems holistically and using life-cycle thinking.

Based on the principles, the following sustainable design goals can be set and also added to depending on the level of ambition of the company. These design goals are further elaborated in the report.

- Select materials with an inherently low risk/hazard.
- Select materials that have a commercial "afterlife".
- Select materials that generate no waste.
- Select materials that use secondary feedstock or biobased feedstock.

At a final, more granular level, the following general considerations for sustainable design from a chemicals perspective were identified as key elements for designers to take into account for each life-cycle phase when selecting material composition. While presented as the main considerations of individual phases, ultimately these considerations are brought together as a whole-product assessment and optimisation taking the whole life-cycle into account.

Considerations during the sourcing phase

A. Select a base polymer (secondary or primary renewable source; secondary or primary non-renewable source) that:
   - the least emissions during extraction and production.
   - uses non-hazardous or the least hazardous chemicals during extraction and production.
   - minimises worker exposure during extraction and production.

B. Primary renewable feedstock (i.e., bio(based)plastics) is potentially a sustainable source, when:
   - the benefits of using this feedstock, demonstrated through life-cycle assessment, outweigh the costs of externalities, such as water consumption, and competition with food production or social or ecological land use.
   - the availability and continuity of availability of the supply of the feedstock enables its use.

C. Secondary feedstock is potentially a sustainable source, when:
   - the propagation of hazardous chemicals is avoided.
   - the resulting material contains a high percentage of the recycled material when designed.
   - the current and future availability of the supply of the secondary feedstock enables its use.

D. Primary non-renewable feedstock can be used as last resort, if it minimises hazardous chemicals or hazardous mixtures of chemicals.

E. Strive for transparency in chemical compositions throughout the value chain.

Considerations during the manufacturing phase

A. Select a manufacturing technique that:
   - generates the least emissions.
   - uses the least processing aids.
   - uses non-hazardous or the least hazardous chemicals.
   - minimises worker exposure.

B. Consider sustainable manufacturing on a systems level.

C. Ensure transparency in chemical composition throughout the value chain.

Considerations during the use phase

A. Consider whether the determined chemical and mechanical requirements are strict, or there is flexibility to allow for more sustainable choices.

B. Select a base polymer/source material that:
   - generates the least emissions.
   - prevents or minimises exposure to hazardous chemicals during use and maintenance.
   - enables the intended lifespan of the product.

C. Map exposure scenarios during use and reduce exposure to hazard as much as possible.

Considerations during the end-of-use phase

A. Minimise the amount of waste at end-of-use through polymer selection.

B. Simplify designs to include as few different polymers as possible.

C. Maximise the production of high-quality recycled materials as output of the recycling process.

D. Minimise the amount of and exposure to chemical hazard at end-of-use through chemical selection.

E. Match the polymer selection to the waste management operations in the intended market.

F. Consider ways to mitigate the risk of littering.

G. Ensure transparency of chemical composition.

These considerations will also lead to trade-offs that will need to be carefully balanced in the decision-making process by the design team, but they are expected to promote transparency and reflection on the implications of making these choices. Ultimately, the report should help to equip designers and engineers with knowledge of relevant chemical considerations when selecting sustainable plastic and support better outcomes as a result.

Appendix 7. Examples of key terms

Examples of key terms and definitions are provided here from a selection of sources. This is not exhaustive and serves only as examples for consideration. These examples are not intended to be a definitive glossary and serve only to complement the work underway by the Basel Convention and the INC to develop a glossary for interpretation of the plastics instrument.

Definitions used under the Basel Convention

Article 2:

1. "**Wastes**" are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.
4. "**Disposal**" means any operation specified in Annex IV to this Convention.
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.

Glossary of terms:[134]

Recovery

Commonly used to refer to operations specified in Annex IV B to the Basel Convention.

Explanatory notes:

a) Pre-existing definitions:

   (i) Technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment, in particular regarding the distinction between waste and non-waste under the Basel Convention:[135] "Relevant operations specified in Annex IV, part B, to the Basel Convention."

   (ii) Technical guidelines on the environmentally sound co-processing of hazardous wastes in cement kilns:[136] "Any operation where waste is serving a useful purpose by replacing other materials that would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy".

   (iii) Technical guidelines on the environmentally sound recycling/ reclamation of metals and metal compounds (R4):[137] "Recovery: Taking metallic or metal-containing items and metallic pieces before they reach the waste stream or taking them out of the waste stream."

b) Generic term for Annex IV B operations:

   "Recovery" is commonly used to refer to operations specified in Annex IV B to the Basel Convention, although only two operations listed in Annex IV B refer explicitly to "recovery". In addition, national legislation in some countries may use the term "recycling" to refer to the operations listed in Annex IV B. Furthermore, according to decision BC-12/1, there is currently a review process of Annex IV, for the consideration of the thirteenth meeting of the Conference of the Parties to the Basel Convention.

134 http://www.basel.int/Implementation/LegalMatters/LegalClarity/Glossaryofterms/SmallIntersessionalWorkingGroup/tabid/3622/Default.aspx

135 The technical guidelines, adopted by decision BC-12/5, are set out in the annex to document UNEP/CHW.12/5/Add.1/Rev.1, available at: http://www.basel.int/TheConvention/ ConferenceoftheParties/Meetings/COP12/tabid/4248/mctl/ViewDetails/EventModID/8051/ EventID/542/xmid/13027/Default.aspx

136 The technical guidelines, adopted by decision BC-10/8 are set out in the annex to document UNEP/CHW.10/6/Add.3/Rev.1 available at: http://www.basel.int/Implementation/ Publications/TechnicalGuidelines/tabid/2362/Default.aspx#

137 The technical guidelines, adopted by decision VII/14, are available at: www.basel.int/ Implementation/Publications/TechnicalGuidelines/tabid/2362/Default.aspx

c) Interim operations:

Recovery may be done in more than one stage, so it includes interim operations (see Annex IV B operations R12 and R13).

d) Environmentally sound management:

Recovery and final disposal operations should be performed in an environmentally sound manner.

e) Useful benefit from recovery operations:

Recovery operations make use of resources as they will obtain some useful benefit from the waste, either by bringing it back into productive use or recovering energy from it. A recovery operation can be understood as an operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.

f) Distinguished from reuse and direct reuse:

The term "recovery" does not include the actual reuse or direct reuse. The caption to Annex IV B refers to operations that may lead to direct reuse. However, no operation listed may lead to direct reuse as that term itself requires that reuse will occur without repair or refurbishment. The recovery operations listed include operations that may lead to reuse (such as R9 – used oil re-refining). Once oil is re-refined, it is no longer waste and its reuse is therefore not a recovery operation as such operations only apply to waste.

g) Relationship to "repair" and "refurbishment":

No suitable operation is listed in Annex IV to the Convention that describes "repair" or "refurbishment". In some countries, national legislation has recognised that where repair is necessary to prepare a waste for reuse, it is regarded as a recovery operation.

Recycling

Relevant operations specified in Annex IV B to the Basel Convention.

Explanatory notes:

a) Pre-existing definitions:

1. (i) Technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment, in particular regarding the distinction between waste and non-waste under the Basel Convention:[138] "Relevant operations specified in Annex IV, part B, to the Basel Convention."
2. (ii) Revised guidance document on the environmentally sound management of used and end-of-life computing equipment:[139] "Relevant operations specified in Annex IV B to the Basel Convention."

   (iii) Revised technical guidelines for the environmentally sound management of used and waste pneumatic tyres:[140] "Any process by which waste tyres are reprocessed into products, materials or substances for any purpose. It does not include energy recovery or reprocessing into materials for use as fuels or in backfilling operations."

   (iv) Technical guidelines on the environmentally sound recycling/ reclamation of metals and metal compounds (R4):[141] "(a) The preparation of recovered items and pieces so that they may be used directly (e.g., in direct remelt) or sent for reclamation; (b) The series of activities,

138 The technical guidelines, adopted by decision BC-12/5, are set out in the annex to document UNEP/CHW.12/5/Add.1/Rev.1, available at: http://www.basel.int/TheConvention/ ConferenceoftheParties/Meetings/COP12/tabid/4248/mctl/ViewDetails/ EventModID/8051/ EventID/542/xmid/13027/Default.aspx

139 Sections 1, 2, 4 and 5 of the guidance document were adopted by decision BC-11/15. The glossary of terms is set out in the appendix I to the guidance document, which is set out in the annex to document UNEP/CHW.11/6/Add.1/Rev.1, available at: http://www.basel.int/ TheConvention/ConferenceoftheParties/Meetings/COP11/tabid/3256/Default.aspx

140 The technical guidelines, adopted by decision BC-10/6, are available at: http://www.basel.int/Implementation/Publications/ TechnicalGuidelines/tabid/2362/Default.aspx

141 The technical guidelines, adopted by decision VII/14, are available at: www.basel.int/Implementation/Publications/ TechnicalGuidelines/tabid/2362/Default.aspx

including collection, separation, and processing, by which products or other materials are recovered from the solid waste stream for use in the form of raw materials in the manufacture of new products, other than fuel for producing heat or power by combustion."

b) Distinguished from other recovery operations:

Recycling operations usually involves the reprocessing of waste into products, materials or substances, though not necessarily for the original purpose. Resources are saved by recovering material benefits from the waste. Recycling is to be distinguished from operations that recover energy from the waste. In some countries, where material is used once merely for its physical properties e.g. for backfilling, this does not amount to recycling. An example is used lubricating oil re-refined which could result in high grade oil which is valuable for its chemical properties and hence that would be a recycling operation. Used oil could also simply be used as a fuel so that the recovery operation would be energy recovery and not recycling.

Annex IV – Disposal operations

A. Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses

Section A encompasses all such disposal operations which occur in practice.

D1 Deposit into or onto land, (e.g., landfill, etc.)
D2 Land treatment, (e.g., biodegradation of liquid or sludgy discards in soils, etc.)
D3 Deep injection, (e.g., injection of pumpable discards into wells, salt domes of naturally occurring repositories, etc.)
D4 Surface impoundment, (e.g., placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5 Specially engineered landfill, (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6 Release into a water body except seas/oceans
D7 Release into seas/oceans including sea-bed insertion
D8 Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations in Section A
D9 Physico chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations in Section A, (e.g., evaporation, drying, calcination, neutralisation, precipitation, etc.)
D10 Incineration on land
D11 Incineration at sea
D12 Permanent storage (e.g., emplacement of containers in a mine, etc.)
D13 Blending or mixing prior to submission to any of the operations in Section A
D14 Repackaging prior to submission to any of the operations in Section A
D15 Storage pending any of the operations in Section A

B. Operations which may lead to resource recovery, recycling reclamation, direct re-use or alternative uses

Section B encompasses all such operations with respect to materials legally defined as or considered to be hazardous wastes and which otherwise would have been destined for operations included in Section A.

R1 Use as a fuel (other than in direct incineration) or other means to generate energy
R2 Solvent reclamation/regeneration
R3 Recycling/reclamation of organic substances which are not used as solvents
R4 Recycling/reclamation of metals and metal compounds
R5 Recycling/reclamation of other inorganic materials
R6 Regeneration of acids or bases
R7 Recovery of components used for pollution abatement

R8 Recovery of components from catalysts
R9 Used oil re-refining or other reuses of previously used oil
R10 Land treatment resulting in benefit to agriculture or ecological improvement
R11 Uses of residual materials obtained from any of the operations numbered R1-R10
R12 Exchange of wastes for submission to any of the operations numbered R1-R11
R13 Accumulation of material intended for any operation in Section B

Definitions used in the OECD Global Plastics Outlook[142]

Biobased plastics
Plastics manufactured from biomass.

Degradation
The partial or complete breakdown of a polymer as a result of e.g., UV radiation, oxygen attack, biological attack. This implies alteration of the properties, such as discolouration, surface cracking, and fragmentation.

Environmentally-relevant plastics technologies
Plastics technologies that are relevant to the environment including technologies for prevention, recycling, conversion or disposal of waste; for leakage removal; and for biobased feedstock.

(Waste) incineration
Incineration in a state-of-the-art industrial facility.

(Sanitary) landfilling
The final disposal of waste in or on land in a controlled way and according to state-of-the-art sanitary, environmental protection and other safety requirements.

(Plastic) leakage
Plastic leakage refers to plastics that enter terrestrial and aquatic environments.

Litter
Waste that results from littering by individuals in the environment and from fly-tipping. Littered waste is distinct from mismanaged waste, because littering behaviour not necessarily correlated to the provision of basic waste collection and disposal infrastructure. Littered waste can either be collected for further disposal or remain uncollected and leak into the environment.

Macroplastics
Recognisable plastic items, such as littered plastic bottles and packaging. In this report, the use of the term encompasses plastics above 5 mm in diameter (i.e. what is often defined as meso and macro plastics elsewhere in the literature).

Microplastics
Solid plastic particles up to 5mm in diameter composed of mixtures of polymers and additives. They may also contain residual impurities

Mismanaged waste
Waste that is not captured by any state-of-the-art waste collection or treatment facilities. It includes waste that is burned in open pits, dumped into seas or open waters, or disposed of in unsanitary landfills and dumpsites.

142 https://www.oecd-ilibrary.org/sites/e427e93c-en/index.html?itemId=/content/component/e427e93c-en

Plastic
Plastic in the singular form is used as an adjective describing a noun. For example, plastic waste.

Plastic pollution
Broadly, all emissions and risks resulting from plastics production, use, waste management and leakage.

Plastics
All plastic polymers studied in the report.

Primary microplastics
Plastics that are smaller than 5 mm in diameter by design, such as cosmetic scrubbing agents and plastic pellets.

Primary or virgin plastics
Plastics manufactured from fossil-based (e.g., crude oil) or biobased (e.g., corn, sugarcane, wheat) feedstock that has never been used or processed before.

Recycling
Any recovery operation by which plastic waste materials are reprocessed into products, materials or substances whether for the original or other purposes, excluding energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Recycling rate
Depending on the context, either the share of waste that is collected for recycling or the share of waste that is available as recycled scrap after reprocessing and after taking into account the disposal of recycling residues.

Secondary (recycled) plastics
Plastic polymers made from recycled material.

Secondary microplastics
Microplastics that are formed from the fragmentation of larger plastics, such as microplastics from tyre abrasion, synthetic microfibres shed from textile products and microplastics stemming from the degradation and fragmentation of macroplastics that have already been lost to the environment.

ILO Chemicals Convention 1990 (No. 170) – Article 2

a) the term **chemicals** means chemical elements and compounds, and mixtures thereof, whether natural or synthetic;
b) the term **hazardous chemical** includes any chemical which has been classified as hazardous in accordance with Article 6 or for which relevant information exists to indicate that the chemical is hazardous;
c) the term **use of chemicals at work** means any work activity which may expose a worker to a chemical, including:
   (i) the production of chemicals;
   (ii) the handling of chemicals;
   (iii) the storage of chemicals;
   (iv) the transport of chemicals;
   (v) the disposal and treatment of waste chemicals;
   (vi) the release of chemicals resulting from work activities;
   (vii) the maintenance, repair and cleaning of equipment and containers for chemicals;

e) the term **article** means an object which is formed to a specific shape or design during its manufacture or which is in its natural shape, and whose use in that form is dependent in whole or in part on its shape or design;

Kyiv Protocol on Pollutant Release and Transfer Registers – Annex III

Part A – Disposal operations ('D')

- Deposit into or onto land (e.g., landfill)
- Land treatment (e.g., biodegradation of liquid or sludgy discards in soils)
- Deep injection (e.g., injection of pumpable discards into wells, salt domes or naturally occurring repositories)
- Surface impoundment (e.g., placement of liquid or sludge discards into pits, ponds or lagoons)
- Specially engineered landfill (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment)
- Release into a water body except seas/oceans
- Release into seas/oceans including sea-bed insertion
- Biological treatment not specified elsewhere in this annex which results in final compounds or mixtures which are discarded by means of any of the operations specified in this part
- Physico-chemical treatment not specified elsewhere in this annex which results in final compounds or mixtures which are discarded by means of any of the operations specified in this part (e.g., evaporation, drying, calcination, neutralisation, precipitation)
- Incineration on land
- Incineration at sea
- Permanent storage (e.g., emplacement of containers in a mine)
- Blending or mixing prior to submission to any of the operations specified in this part
- Repackaging prior to submission to any of the operations specified in this part
- Storage pending any of the operations specified in this part

Part B – Recovery operations ('R')

- Use as a fuel (other than in direct incineration) or other means to generate energy
- Solvent reclamation/regeneration
- Recycling/reclamation of organic substances which are not used as solvents
- Recycling/reclamation of metals and metal compounds
- Recycling/reclamation of other inorganic materials
- Regeneration of acids or bases
- Recovery of components used for pollution abatement
- Recovery of components from catalysts
- Used oil re-refining or other reuses of previously used oil
- Land treatment resulting in benefit to agriculture or ecological improvement
- Uses of residual materials obtained from any of the recovery operations specified above in this part
- Exchange of wastes for submission to any of the recovery operations specified above in this part
- Accumulation of material intended for any operation specified in this part

EU Directive on Packaging and Packaging Waste[143]

"**Packaging**" shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. "Non-returnable" items used for the same purposes shall also be considered to constitute packaging.

"**Packaging**" consists only of:

a) sales packaging or primary packaging, i.e. packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase;

b) grouped packaging or secondary packaging, i.e. packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics;

c) transport packaging or tertiary packaging, i.e. packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packaging in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers.

The definition of "**packaging**" shall be further based on the criteria set out below. The items listed in Annex I are illustrative examples of the application of these criteria.

(i) Items shall be considered to be packaging if they fulfil the abovementioned definition without prejudice to other functions which the packaging might also perform, unless the item is an integral part of a product and it is necessary to contain, support or preserve that product throughout its lifetime and all elements are intended to be used, consumed or disposed of together.

(ii) Items designed and intended to be filled at the point of sale and "disposable" items sold, filled or designed and intended to be filled at the point of sale shall be considered to be packaging provided they fulfil a packaging function.

(iii) Packaging components and ancillary elements integrated into packaging shall be considered to be part of the packaging into which they are integrated. Ancillary elements hung directly on, or attached to, a product and which perform a packaging function shall be considered to be packaging unless they are an integral part of this product and all elements are intended to be consumed or disposed of together.

1a. "**plastic**" shall mean a polymer within the meaning of Article 3(5) of Regulation (EC) No 1907/2006 of the European Parliament and of the Council ([1]), to which additives or other substances may have been added, and which is capable of functioning as a main structural component of carrier bags;

1b. "**plastic carrier bags**" shall mean carrier bags, with or without handle, made of plastic, which are supplied to consumers at the point of sale of goods or products;

1c. "**lightweight plastic carrier bags**" shall mean plastic carrier bags with a wall thickness below 50 microns;

1d. "**very lightweight plastic carrier bags**" shall mean plastic carrier bags with a wall thickness below 15 microns which are required for hygiene purposes or provided as primary packaging for loose food when this helps to prevent food wastage;

1e. "**oxo-degradable plastic carrier bags**" shall mean plastic carrier bags made of plastic materials that include additives which catalyse the fragmentation of the plastic material into micro-fragments;

143 European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.

"**Packaging waste**" shall mean any packaging or packaging material covered by the definition of waste laid down in Article 3 of Directive 2008/98/EC, excluding production residues;

2a. "**reusable packaging**" shall mean packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived;

2b. "**composite packaging**" shall mean packaging made of two or more layers of different materials which cannot be separated by hand and form a single integral unit, consisting of an inner receptacle and an outer enclosure, that it is filled, stored, transported and emptied as such;

2c. the definitions of "**waste**", "**waste management**", "**collection**", "**separate collection**", "pr**evention**", "**reuse**", "**treatment**", "**recovery**", "**recycling**", "**disposal**", and "**extended producer responsibility scheme**" laid down in Article 3 of Directive 2008/98/EC shall apply;

EU Directive on single use plastics[144]

"**plastic**" means a material consisting of a polymer as defined in point 5 of Article 3 of Regulation (EC) No 1907/2006, to which additives or other substances may have been added, and which can function as a main structural component of final products, with the exception of natural polymers that have not been chemically modified;

"**single-use plastic product**" means a product that is made wholly or partly from plastic and that is not conceived, designed or placed on the market to accomplish, within its life span, multiple trips or rotations by being returned to a producer for refill or re-used for the same purpose for which it was conceived;

"**oxo-degradable plastic**" means plastic materials that include additives which, through oxidation, lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition;

"**fishing gear**" means any item or piece of equipment that is used in fishing or aquaculture to target, capture or rear marine biological resources or that is floating on the sea surface, and is deployed with the objective of attracting and capturing or of rearing such marine biological resources;

"**waste fishing gear**" means any fishing gear covered by the definition of waste in point 1 of Article 3 of Directive 2008/98/EC, including all separate components, substances or materials that were part of or attached to such fishing gear when it was discarded, including when it was abandoned or lost;

"**placing on the market**" means the first making available of a product on the market of a Member State;

"**making available on the market**" means any supply of a product for distribution, consumption or use on the market of a Member State in the course of a commercial activity, whether in return for payment or free of charge;

"**waste**" means waste as defined in point 1 of Article 3 of Directive 2008/98/EC;

"**extended producer responsibility scheme**" means extended producer responsibility scheme as defined in point 21 of Article 3 of Directive 2008/98/EC;

"**producer**" means:

144 Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.

a) any natural or legal person established in a Member State that professionally manufactures, fills, sells or imports, irrespective of the selling technique used, including by means of distance contracts as defined in point (7) of Article 2 of Directive 2011/83/EU of the European Parliament and of the Council ([21]), and places on the market of that Member State single-use plastic products, filled single-use plastic products or fishing gear containing plastic, other than persons carrying out fishing activities as defined in point (28) of Article 4 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council (22); or

b) any natural or legal person established in one Member State or in a third country that professionally sells in another Member State directly to private households or to users other than private households, by means of distance contracts as defined in point (7) of Article 2 of Directive 2011/83/EU, single-use plastic products, filled single-use plastic products or fishing gear containing plastic, other than persons carrying out fishing activities as defined in point (28) of Article 4 of Regulation (EU) No 1380/2013;

"**biodegradable plastic**" means a plastic capable of undergoing physical, biological decomposition, such that it ultimately decomposes into carbon dioxide (CO_2), biomass and water, and is, in accordance with European standards for packaging, recoverable through composting and anaerobic digestion

Definitions from California's Senate Bill 54. "Solid waste: reporting, packaging, and plastic food service ware."[145]

Article 1, **42041**
(j) "**Eliminate**" or "**elimination,**" with respect to source reduction, means the removal of a plastic component from a covered material without replacing that component with a nonplastic component.

(m) "**Lightweighting**" means reducing the weight or amount of material used in a specific packaging or food service ware without functionally changing the packaging or food service ware. "Lightweighting" does not include changes that result in a recyclable or compostable covered material becoming nonrecyclable or non-compostable or less likely to be recycled or composted.

(r) "**Optimize**" or "**optimization**" means limiting the amount of covered material used in packaging by meeting product or packaging needs with minimal material. This includes, but is not limited to, eliminating unnecessary components, right-sizing, concentrating, and using bulk or large format packaging.

(s) "**Packaging**" means any separable and distinct material component used for the containment, protection, handling, delivery, or presentation of goods by the producer for the user or consumer, ranging from raw materials to processed goods. "Packaging" includes, but is not limited to, all of the following:

1) Sales packaging or primary packaging intended to provide the user or consumer the individual serving or unit of the product and most closely containing the product, food, or beverage.
2) Grouped packaging or secondary packaging intended to bundle, sell in bulk, brand, or display the product.
3) Transport packaging or tertiary packaging intended to protect the product during transport.
4) Packaging components and ancillary elements integrated into packaging, including ancillary elements directly hung onto or attached to a product and that perform a packaging function, except both of the following:

   (A) An element of the packaging or food service ware with a de minimis weight or volume, which is not an independent plastic component, as determined by the department.

   (B) A component or element that is an integral part of the product, if all components or elements of the product are intended to be consumed or disposed of together.

145 Available at: https://trackbill.com/bill/california-senate-bill-54-solid-waste-reporting-packaging-and-plastic-food-service-ware/1954043/

(t) "**Plastic**" means a synthetic or semisynthetic material chemically synthesized by the polymerization of organic substances that can be shaped into various rigid and flexible forms, and includes coatings and adhesives. "Plastic" includes, without limitation, polyethylene terephthalate (PET), high density polyethylene (HDPE), polyvinyl chloride (PVC), low density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), polylactic acid (PLA), and aliphatic biopolyesters, such as polyhydroxyalkanoate (PHA) and polyhydroxybutyrate (PHB). "Plastic" does not include natural rubber or naturally occurring polymers such as proteins or starches.

(u) "**Plastic component**" means any single piece of covered material made partially or entirely of plastic. A plastic component may constitute the entirety of the covered material or a separate or separable piece of the covered material.

(v) "**Processing**" means to sort, segregate, break or flake, and clean material to prepare it to meet the specification for sale to a responsible end market.

(z) "**Rate of inbound contamination**" means the amount of nonrecyclable or noncompostable materials arriving at a materials recovery facility or other recycling or composting facility.

(aa) 1) "**Recycle**" **or** "**recycling**" means the process of collecting, sorting, cleansing, treating, and reconstituting materials that would otherwise ultimately be disposed of onto land or into water or the atmosphere, and returning them to, or maintaining them within, the economic mainstream in the form of recovered material for new, reused, or reconstituted products, including compost, that meet the quality standards necessary to be used in the marketplace.

2) "**Recycle**" or "**recycling**" does not include any of the following:

(A) Combustion.
(B) Incineration.
(C) Energy generation.
(D) Fuel production, except for anaerobic digestion of source separated organic materials.
(E) Other forms of disposal.

3) To be considered recycled, covered material shall be sent to a responsible end market.

4) (A) The department may adopt regulations to define guidelines and verification requirements for covered material shipped out of state and exported to other countries for recycling, including processing requirements, and contamination standards, or to otherwise implement this paragraph.

(B) For any mixture of plastic waste exported to another country, the PRO or producer shall certify to the department that the processes and recycling technologies used meet both of the following requirements, as determined by the department:

(i) The plastic waste is a mixture of plastic types consisting only of one or more of polyethylene, polypropylene, or polyethylene terephthalate, and the export is destined for separate recycling of each material.

(ii) The plastic waste export is not prohibited by an applicable law or treaty of the destination jurisdiction, and the import of the plastic waste into the destination jurisdiction will be conducted in accordance with all applicable laws and treaties of that destination jurisdiction.

(C) For any mixture of plastic waste exported to other states or countries, the PRO or producer shall certify to the department that the recycling technology used meets the requirements of this subdivision.

(D) In meeting the requirements of subparagraphs (B) and (C), the PRO or producer shall provide documentation necessary to verify this certification and shall make the certification under penalty of perjury.

5) The department's regulations shall encourage recycling that minimises generation of hazardous waste, generation of greenhouse gases, environmental impacts, environmental justice impacts,

and public health impacts. The regulations shall include criteria to exclude plastic recycling technologies that produce significant amounts of hazardous waste.

(ab) "**Recycling rate**" means the percentage, overall and by category, of covered material sold, offered for sale, distributed, or imported in the state that is ultimately recycled. The recycling rate shall be calculated as the amount of covered material that is recycled in a given year divided by the total amount of covered material disposed of, as defined in subdivision (b) of Section 40192, and the amount of covered material recycled, unless and until the department adopts a new methodology for calculating the recycling rate by regulation.

(ad) "**Responsible end market**" means a materials market in which the recycling and recovery of materials or the disposal of contaminants is conducted in a way that benefits the environment and minimises risks to public health and worker health and safety. The department may adopt regulations to identify responsible end markets and to establish criteria regarding benefits to the environment and minimises risks to public health and worker health and safety.

(af) "**Reusable**" or "**refillable**" or "**reuse**" or "**refill,**" in regard to packaging or food service ware, means either of the following:

1) For packaging or food service ware that is reused or refilled by a producer, it satisfies all of the following:

   (A) Explicitly designed and marketed to be utilised multiple times for the same product, or for another purposeful packaging use in a supply chain.

   (B) Designed for durability to function properly in its original condition for multiple uses.

   (C) Supported by adequate infrastructure to ensure the packaging or food service ware can be conveniently and safely reused or refilled for multiple cycles.

   (D) Repeatedly recovered, inspected, and repaired, if necessary, and reissued into the supply chain for reuse or refill for multiple cycles.

2) For packaging or food service ware that is reused or refilled by a consumer, it satisfies all of the following:

   (A) Explicitly designed and marketed to be utilised multiple times for the same product.

   (B) Designed for durability to function properly in its original condition for multiple uses.

   (C) Supported by adequate and convenient availability of and retail infrastructure for bulk or large format packaging that may be refilled to ensure the packaging or food service ware can be conveniently and safely reused or refilled by the consumer multiple times.

(ag) "**Right-size**" or "**right-sizing**" means reducing the amount of material used to package an item by reducing unnecessary space or eliminating unnecessary components of the packaging.

(ai) "**Single use**" means conventionally disposed of after a single use or not sufficiently durable or washable to be, or not intended to be, reusable or refillable.

(aj) "**Source reduction**" means the reduction in the amount of covered material created by a producer relative to a baseline established pursuant to subdivision (b) of Section 42057. Methods of source reduction include, but are not limited to, shifting covered material to reusable or refillable packaging or a reusable product or eliminating unnecessary packaging. "Source reduction" does not include either of the following:

1) Replacing a recyclable or compostable covered material with a nonrecyclable or noncompostable covered material or a covered material that is less likely to be recycled or composted.
2) Switching from virgin covered material to postconsumer recycled content.

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