Policy Brief

Waste management

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As of 2015, approximately 6.3 billion metric tons (Mt) of plastic waste had been generated, around 12% of which had been incinerated, 79% accumulated in landfills or the natural environment, and just 9% recycled.[1] The OECD estimates that under a business-as-usual scenario, global plastic waste will grow to over 1 billion Mt annually by 2060.[2] Reducing production and consumption of plastics should be prioritised, but comprehensive waste management must also be ensured for plastics at their end-of-life. A cohesive design, use, and post-use management strategy will be needed. Potential outcomes for plastic waste must be coordinated in a safe, environmentally sound, and circular system to keep plastics in their highest value state for as long as possible. This requires complementary forms of recycling, enabled by plastics designed for circularity, including its chemical composition, with improved collection and sorting for appropriate treatment. This policy brief draws on scientific evidence to set out the principles needed in an environmentally sound plastic waste management and recycling system.

Waste Management

- Reduce, Reuse, Recycle (3R) and Zero Waste Hierarchy principles prioritise reducing production/ consumption of materials, then re-using objects, followed by improving recycling efforts. All three are needed in concert.[2-6]
- There is no 'one size fits all' recycling system for waste plastics. The various potential end-of-life fates will have different environmental, economic, health, and climate impacts and energy demands.[7]
- Safe, sustainable, and essential plastic waste management must be based on a hierarchy of end-of-life choices, aiming to maximise circularity. The negative impacts of landfill, incineration, and waste-to-energy fates are incompatible with sustainability goals and must be avoided wherever possible.[5,8-11]
- Export of plastic waste as recyclate, primarily from high-income to low-income countries, is widespread, due to lower labour costs and health, safety and environment standards in receiving countries.[12] While the 2019 Basel Convention plastic waste amendments intended to prohibit such exports, many will continue.[13] This poses environmental/socio-economic risks through pollution, mismanagement, and transport.[14,15]
- Undisclosed or unclear composition of waste negatively affects waste management outcomes. Segregated plastic waste is often collected but not recycled due to cross material/polymer contamination and insufficient sorting.[2,4,16]
- Some bio-based plastics have a lower carbon footprint than fossil fuel-based plastics, but end-of-life treatment options can be unclear, unsuitable, unsustainable, unsafe, or even negatively affect existing recycling systems.[17-20]

Waste collection and sorting

- Regardless of treatment or disposal route, consistent collection of segregated waste is needed to minimise pollution and mismanagement. To tackle sources of pollution, priority should be given to communities, particularly in low and middle-income countries, that are underserved or unserved in waste collection.[21]
- Sorting for reuse is the most direct way to ensure circularity and is preferred over recycling. Packaging design, (eco)labelling regulations, and pricing/deposit schemes can be used to enable reuse systems.[22]
- Waste pickers play a key role in the collection and sorting process, recovering up to 60% of plastic waste recycled globally. They are a key player in low to middle-income countries as well as in some more developed nations.[23,24]
- High-quality sorting will always be required for safer and more sustainable recycling.[25] Contamination and mixing of plastic types, especially in household waste, are significant barriers to value retention that must be minimised.[26]
- Multi-materials and chemicals, including POPs and additives, reduce the recyclability and sortability of plastics.[27,28]
- Recycling of food-grade material is challenging due to the dangers of contamination and inconsistent sorting.[26,27]
- Emerging technologies, such as digital watermarking, AI sorting, or solvent washing could reduce contamination and improve sorting outcomes but require more evidence to show they work at scale.[29-32]

Post-use plastics treatment routes

Mechanical recycling

- Mechanical recycling (including processes such as grinding, washing, separating, drying, re-granulating, and compounding) is currently the only widely adopted, large-scale recycling method for plastics.[33]

- It is the environmentally favoured recycling route for most plastics when properly sorted, but environmental impact is dependent on polymer type, contamination, and degradation from repeated recycling.[7,30,34,35]
- Recycling products into longer life applications can be beneficial when this reduces dependence on virgin feedstock or diverts products from landfill and incineration but can also result in secondary pollution (e.g. through the release of microplastics, an emerging concern as a by-product of mechanical recycling).[36]
- Designing products for recycling is essential to improve mechanical recycling rates and avoid additives or applications that can negatively affect recycling outcomes and human and planetary health.[27]

Chemical recycling

- Chemical recycling is an umbrella term covering several technologies with different environmental consequences. Safe and sustainable **Plastic-to-plastic** chemical recycling can complement mechanical recycling and contribute positively to a sustainable plastics waste management system. It should not be a primary end-of-life goal but be a recovery option for materials which are not suitable for mechanical recycling.[11,37-39] **Plastic-to-fuel** chemical recycling equates to delayed incineration of fossil fuels, producing excessive greenhouse gases and pollution. It is not circular and less environmental harm occurs through residual waste energy recovery in cement kilns.[5,11,39] **Plastic-to-energy**, from pyrolysis or energy-from-waste systems, is equivalent to burning fossil fuels, is more polluting than electricity from coal, and must be avoided within a safe and sustainable system.[11,39]
- Chemical recycling requires high-purity waste streams and is sensitive to contamination. Mixed plastics chemical recycling is energy-intensive, polluting, and environmentally unfavourable.[5,33]
- Depolymerisation of polymers to monomers is mainly suitable for polymers with C-X bonds in the chain, such as polyesters, polycarbonates, or polyamides. It is not suitable for polyolefins that only contain C-C bonds.[35]
- Polyolefins are converted to plastic precursors or other chemicals through thermal decomposition under energy-intensive, extreme conditions, often at very low efficiency.[11] Green technological progress is needed before this can become a viable backup to other recycling methods.[39-41]
- Decomposition to plastic precursors and decomposition to fuel are technologically identical, opening the door to hidden plastic-to-fuel systems, which are incompatible with the Zero Waste Hierarchy.[7,11,39,42,43]
- Biological recycling, the degradation of plastic waste by enzymes or microbes, has the potential to contribute to a sustainable waste management system, but a lack of technological readiness and safety criteria is a hurdle.[42,44,45]

Landfilling

- Landfilling remains a common waste disposal method for plastics, particularly for unrecyclable and contaminated plastics and where no segregated collection systems are in place.[46]
- Landfills can be placed on a spectrum between sanitary landfills (lined, covered daily, methane and leachates are captured) and unsanitary landfills (unlined, uncovered, susceptible to fire). Unsanitary landfills and open-burning endanger people who live and work near where material is being openly burned, often in low and middle-income countries
- Unlined active and former landfills are a significant source of plastic and microplastic pollution.[47]
- The closure of open dumps can amplify the socio-economic precarity of workers whose livelihoods depend on the waste in open landfills.[48] Plans to upgrade or close open landfills should consider the knowledge and expertise of waste pickers in a participatory process towards safe and sustainable reuse and recycling within a just transition.[49]

Open-burning

- Up to 1 billion Mt of solid waste is openly burned worldwide each year.[50] Open-burning of plastic waste produces greenhouse gases and a range of potentially toxic emissions, including microplastics, which endanger people who live and work near where material is being openly burned, often in low and middle-income countries.[51]
- Waste might be burnt because communities lack other disposal methods, to prevent landfills reaching capacity, or to extract valuable materials such as metals. While this is clearly the least desirable disposal route, research shows that prohibition is insufficient without complementary measures and technology transfer on mutually agreed terms that offer communities and local authorities alternative, safe, and sustainable ways of disposing of plastic waste.[51]

How can the plastics treaty address waste management and recycling?

Waste management is intertwined with all proposed obligations of the plastics treaty. A clear push for sustainable design of plastic products as well as reuse and recycling infrastructure is needed to minimise unsafe, unsustainable, and non-essential production and resulting pollution while enabling a safer and more sustainable circular economy for plastics. An overreliance on a single technology must be avoided and a range of systems are needed to cope with the plastics problem, prioritising the reduction of plastic production and consumption of plastics while redesigning for circularity. This requires localised solutions and support for local capacity building. The safety and unintended consequences of post-use plastics and waste management systems should also be considered when negotiating the plastics treaty.

Contributors

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