Policy Brief: Climate change impacts of plastics

Nihan Karali, Ellen Palm, Juan Baztan, Patricia Villarubia Gomes, Nina Khanna, Karin Kvale, Ana Luzia Lacerda, Bethany Jorgenson

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The environmental impact of plastics is multi-fold, contributing to the triple planetary crisis of climate change, biodiversity loss, and pollution. Plastic pollution and climate change are intrinsically interconnected issues. The plastics value chain has a significant climate impact throughout the life cycle from extraction of fossil fuel to production to end-of-life disposal. However, up- and downstream greenhouse gas (GHG) emissions from plastics production and disposal are often not taken into consideration and may have been overlooked in the INC negotiation process. This Policy brief delves into the ways in which plastic contributes to the emission of GHGs throughout its life cycle.

Climate change impact of the plastics life cycle

Studies estimate that plastics account for around 3-8% of global GHG emissions, and it is projected to double by 2060 [1-4].

- Most of the GHG emissions from the plastic industry are in the form of carbon dioxide (CO_2) and are related to the energy used at various stages of the plastic life cycle, including extraction of fossil fuels, production of monomers, resins, and additives, plastic conversion, and end-of-life management. There are also process emissions that include CO_2 as well as other GHGs (e.g., fugitive methane emissions from upstream oil and gas operations) [1,5].

- 99% of plastic polymers and chemical additives are made from fossil fuel feedstocks [6]. Almost 15% of crude oil production goes to the petrochemicals sector with plastics as the largest end-use product [7]. Combustion of oil and gas is also required for power and high-temperature heat demand in the production of plastics.

- Estimates indicate that plastics and other petrochemicals industries will drive half of the growth in demand of fossil fuel production by 2050 [7]. The extraction, refining, and transportation of petrochemicals for plastic production involves various energy and emission-intensive processes.

- However, most studies of resin or monomer production ignore previous steps, thus providing a rather incomplete picture and underestimating the full climate impact [8].

- Studies estimate that emissions from end-of-life processes contribute to around 10% of total emissions from the plastic lifecycle, mainly from incineration. While production is the major concern for climate impact, continued mismanagement of end-of-life plastics presents a significant GHG emissions issue going forward [1,9].

- Incineration, in which about 20% of the plastic waste currently ends, is an energy and emission-intensive process [4]. Waste-to-energy is another form of incineration that uses plastic waste as an energy source [10]. However, burning fossil fuel-based plastic waste is not better for the climate than burning other fossil fuels [2,9]. It also generates toxic air pollution that is harmful to human health due to the chemicals released, and is particularly harmful to often-adjacent lower-income communities already impacted by climate change [11]. Some of these emissions could possibly be captured with carbon capture technologies, but these technologies remain largely unproven at scale, with concerns of cost and long-term mitigation impact [12,13].

- Mechanical recycling can lead to GHG emission reductions by avoiding incineration and reducing virgin plastic production. However, the quality of the material is often reduced, so the final product may not provide the same functionality [14]. Because of degradation, mechanically recycled products may still end up being incinerated after a few cycles, which must be avoided through other end-of-life treatment processes [15]. Delayed incineration negates short-term emission reductions and is not part of a sustainable recycling system [9,15]

- Chemical recycling processes are energy and emission-intensive [16,17], and depending on the recycling process (e.g. feedstock recycling, depolymerization and purification), the emissions intensity of recycling may be higher than that of virgin plastic production. Chemical recycling of plastics is also linked to generation of toxic materials [11].

- Landfill waste, in which about 40% of plastic waste current ends, is another source of GHG emissions with potential for additional GHG leakage with decomposition over time [4,18].

How can the treaty include climate change?

The combined effects of plastics pollution and climate change can have a disproportionate impact on already vulnerable populations through increased exposure to pollution, extreme weather events, and the health risks associated with the spread of vector diseases and heat exposure [19].

To simultaneously reduce plastic pollution and the climate change impacts of plastics **the plastic treaty could consider designing strategies, such as control measures across the lifecycle of plastic, that weigh the overall impacts of alternate upstream and downstream trajectories, including but not limited to plastic production caps, reduce, reuse, and recycling.**

Current plastic production is contributing to the devastating human health consequences associated with the triple planetary crisis of climate change, biodiversity loss, and pollution [4,20]. A robust and science-based approach is essential if the plastics treaty is to be effective, providing a narrative rooted in the scientific evidence explicitly addressing the consequences of fossil fuel extraction, conversion, and disposal, and offering transparent guidance on potential pathways for global cooperation and action towards a more sustainable and healthy future.

Contributors and references

This briefing was prepared by members of the Scientists' Coalition for an Effective Plastics Treaty:
Authors: Nihan Karali (co-chair) (Lawrence Berkeley National Laboratory, US), Ellen Palm (co-chair) (Lund University, Sweden), Juan Baztan (CEARC, Université de Versailles SQY, France), Patricia Villarrubia Gomez (Stockholm Resilience Centre, Stockholm University, Sweden), Nina Khanna (Lawrence Berkeley National Laboratory, US), Karin Kvale (GNS Science, New Zealand), Ana Luzia Lacerda (Sorbonne University, France), Bethany Jorgensen (Cornell University, US)

Reviewers: Fredric Bauer, Kishore Boodhoo, Xuejing Chen, Grau Etienne, Annika Jahnke, Jacob Kean-Hammerson, Kristoffer Kortsen, Doris Knoblauch, Eva Kumar, Peter Stoett, Hideshige Takada, Melissa Wang, Roland Weber.

Contact: scientists.coalition@ikhapp.org

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