The term recycling must not be watered down by pyrolysis and gasification

On behalf of the European Commission, two studies were recently published that are intended to provide a basis for a legal framework for chemical ‘recycling’. According to European environmental NGOs, these studies set the wrong priorities and could encourage problematic policy decisions on pyrolysis and gasification of plastic packaging waste.

The JRC study defining and calculating recycling focuses mainly on the development of ‘innovative’ technologies, especially on multi-output technologies[1] (i.e. pyrolysis and gasification), which **wrongly displaces the attention from already at scale and efficient mechanical recycling process**. From an environmental point of view, these technologies should be classified as recovery techniques, and can therefore only contribute marginally to reduce impacts from plastic production.[2]

A lot of **questionable assumptions have been made regarding different recycling technologies** along the study. Mechanical recycling appears as a field lacking investments in recent years, and with a limited room of improvement. However, innovation is ongoing, and allows for higher quality of recycled materials. On the contrary, for pyrolysis and gasification, these assumptions seem overly positive. First, these technologies require a high amount of energy to run and plastic materials leakage is significant as more than half of the carbon content is lost in the process or turned into fuels. This must be equally considered as a leakage of materials from circular management.[3] Secondly, despite industry’s claims to handle all non-recyclable waste, pyrolysis needs rather homogenous input to run: at least 85% of pure polyolefins.[4] Thirdly, the capacity to obtain infinite recycle loops is really uncertain as the material quality does likely change following each recycling round, and should therefore be characterised consistently.[5] Finally, a large amount of input is lost in the process, requiring continuous need of virgin materials to feed the process.

When defining the **recycling system boundaries, the study goes in the right direction** by defining comparable outputs (polymer level) that do not need to undergo further processing before their use in a final product. But this should also apply if the monomers are sold to another company to compare fully different recycling technologies. The study clearly states traceability is between actors, not within the process itself. Such an approach prevents any reliable environmental claims related to a product and undermines customer trust in plastic recycling. Pyrolysis and gasification are the only technologies needing mass balance to

[1] Multi-output technologies produce different types of products, in the case of pyrolysis, it can be recycled material, naphtha, waxes, gas, etc.
[2] DUH, ECOS, ZWE, *Chemical Recycling and Recovery, Recommendation to Categorise Thermal Decomposition of Plastic Waste to Molecular Level Feedstock as Chemical Recovery*, 2021
[3] Öko-Institut, *Climate impact of pyrolysis of waste plastic packaging in comparison with reuse and mechanical recycling*, 2022
[4] Eunomia, *Feedstock Quality Guidelines for Pyrolysis of Plastic Waste*, 2022
[5] ACS, *Technical, economic, and environmental comparison of closed-loop recycling technologies for common plastics*, 2023

claim recycled output, which further supports the categorising of pyrolysis and gasification as recovery techniques.

The proposed ‘quality of recycling’ framework allows to compare the capacity of technologies to handle chemical load in a given secondary material. It however falls short on assessing the process itself. **Assessment of presence, quantity and fate of hazardous chemicals (including their use in and emissions from recycling processes) should be applied to recycling technology and its outcomes** to ensure chemical safety along the value chain.

As regards the JRC study comparing environmental and economic assessment of plastic waste recycling, NGOs welcome the broad analysis of environmental impacts on different chemical recycling techniques since knowledge on their impacts is still poor. However, data basis remains fragmented and mainly relies on industry data, which hampers proper assessment. For gasification, no LCA result was presented at all. Technically crucial issues regarding pyrolysis such as necessary input quality and upscaling are not sufficiently considered in the study. Therefore, before any potential political and public funding support for the uptake of pyrolysis and gasification, we need further research. The economic viability is based on strong assumptions directly admitted in the study. Indeed, future income will depend on the increased crude oil price, which will most likely influence prices of feedstock reacting to the increased crude oil price.

In the current discussions related to the plastic agenda, measures should aim to quickly and deeply reduce emissions from the first production phase. Therefore, measures at the upper part of the waste hierarchy, (i.e. waste prevention, ecodesign and optimal material loops) need to be prioritised and incentivized because of their reduced environmental impact. Then, the present recycling system requires strong improvements. This can only happen based on a reliable and consistent recycling definition, ensuring that **only technologies with a high recycling yield and producing materials from waste feedstock that do not need further treatment prior manufacturing are promoted.** Otherwise such definition may trigger wrong economic incentives for public and private funding towards unproven technologies with high ecological risks and no economic viability now, as rightly pointed out in the studies.