



Fifty years: chemical recycling's fading promise

Executive summary
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Chemical recycling¹ is being presented as a potential fix for the plastic waste crisis, but cracks are starting to show. As the Global Plastics Treaty negotiations intensify and the EU pushes for a 'competitive' circular economy, questions are mounting on whether chemical recycling is truly the tantalising solution it claims to be to solve the climate and plastic waste crises. With the EU's commitment to prioritise the scale-up of secondary materials to reduce reliance on virgin plastics, chemical recycling faces significant criticism over its scalability, environmental impact, and economic viability.

Broadly, chemical recycling is defined as "the process of converting plastic waste by changing its chemical structure and turning it back into substances that can be used as raw materials for the manufacturing of plastics or other products. The industry claims chemical recycling can be used for difficult-to-recycle plastic waste, which would otherwise result in incineration or landfill".²

The industry argues this 'game-changer' technology 'can contribute to a circular economy for plastics', reducing the need for fossil fuels and solving the problem of plastic waste.³

However, there is an increasing concern from outside the industry that chemical recycling may not deliver all that it promises, as shown by the lawsuit filed in the US by the Californian General Attorney against ExxonMobil and by the back out from Shell's withdrawal from its commitment to use 1 million tonnes of plastic waste a year in its global chemicals plants by 2025.^{4,5}

For this industrial landscape overview, two prominent experts dedicated to reducing the petrochemical industry's reliance on fossil fuels were interviewed. The first was Jean-Paul Lange, a former senior principal science expert at Shell, whose mission over the last 25 years was to defossilise the petrochemical industry. The second was Stephen Salve Doliente, a Doctor of Philosophy in Chemical Engineering at Imperial College London, whose work is also focused on transitioning the chemical industry away from the use of fossil fuels.

Both experts agree that pyrolysis - by far the most common form of chemical recycling⁶ - is currently only a form of "partial recycling". They also agree that the technology has proved expensive and complex and that any successful commercialisation will require huge financial and regulatory support and time. Currently,

¹ In this document, and for easier understanding, ZWE uses the term "chemical recycling" as proposed by the chemical industry, i.e. including technologies like pyrolysis and gasification. However, ZWE does not classify these technologies as "chemical recycling", but as "chemical recovery". See our [previous position paper](#) for further information.

² Plastics Europe. 2023. "[Chemical Recycling • Plastics Europe.](#)"

³ Plastics Europe. 2023. "[Chemical Recycling • Plastics Europe.](#)"

⁴ Noor, Dharna. 2024. "[California Sues ExxonMobil over Alleged Role in Plastic Pollution Crisis.](#)" The Guardian. September 23, 2024.

⁵ Noor, Dharna. 2024. "[Shell Quietly Backs Away from Pledge to Increase 'Advanced Recycling' of Plastics.](#)" The Guardian. July 17, 2024.

⁶ British Plastics Federation. 2024. "[Chemical Recycling / Non-Mechanical Capacity.](#)" British Plastics Federation. 2024.

petrochemical refineries can only accept a tiny fraction of the oil produced by chemical recycling because it is heavily contaminated.⁷

Lange believes that chemical recycling can lead to a scenario in 50 years' time where up to 50% of the global plastic stream will be made of recycled plastics. **For pyrolysis, he predicts in 50 years, one-third of the carbon entering the steam cracker will be fossil and two-thirds recycled.**

To make this a reality, the industry says it requires a legal recognition of mass balance for chemical recycling to become commercially successful, which raises concerns over transparency along the value chain.^{8,9}

Doliente, who worked on a joint project modelling a **successful defossilisation of the global petrochemical supply chain, found that the number one intervention was a reduction in the consumption of plastics and fertilisers.**

On the other hand, Lange claims there is no “problem ramping up production, as long as we deal with the waste responsibly”.

Reducing plastic pollution requires systemic solutions that target the producers and authorities responsible, not just individual consumers. This is where industry diverges from the views of the European Union and the UK governments, both of which have signed the Bridge to Busan, a declaration stating that virgin polymer production must “match ambitions for a circular economy for plastics while aligning with the Paris Agreement goal of limiting warming to 1.5°C”. In other words, it must be reduced.¹⁰

Upon an information request to the European Commission concerning a meeting between the major European chemical companies and the EU Commission in April, European Commission Vice-President Maroš Šefčovič expressed his hope that the producers would “share goals on limiting the production of primary plastic polymers”. However, notes from the meeting reveal the petrochemicals “would not share the same understanding on the limiting of primary plastic polymers and addressing hazardous chemicals”.¹¹

Currently, chemical recycling strategies appear closely linked to maintaining high levels of virgin plastic production. Indeed, the process requires a vast quantity of virgin oil to produce ‘recycled’ plastic that contains a drop of pyrolysis oil; in other words, this recycling approach will not substantially reduce overall plastic production.

This strategy opposes the EU’s “waste hierarchy”, enshrined in the Waste Framework Directive, which prioritises waste prevention over both recycling and recovery.

⁷ Beyond Plastics, IPEN, [Chemical Recycling: A Dangerous Deception – Why Chemical Recycling Won't Solve The Plastic Pollution Problem](#), 2023

⁸ [“How the EU Can Enable a Circular Economy in Plastics Packaging.”](#) 2022. POLITICO. December 1, 2022.

⁹ [“Infinite Plastic Recycling: The Technology Is Ready, but What about Legislation?”](#) 2023. POLITICO. June 28, 2023.

¹⁰ Bridge to Busan. 2024. [“Bridge to Busan.”](#)

¹¹ [“Cabinet of Executive Vice-Presid.”](#) n.d. Accessed November 15, 2024.

Waiting decades for a technology to mature, which in the meantime relies on the continued increase in virgin production, cannot be considered a viable and sustainable option. Fossil fuels must stay in the ground.

Recommendations

- The Global Plastic Treaty as well as EU legislation more generally shall explicitly incorporate the established EU waste hierarchy framework, – i.e. emphasising first waste prevention and reuse, followed by recycling, – to reduce disposal and incineration in accordance with their environmental impact and resource efficiency.
- Decision-makers must implement comprehensive measures such as production cap to systematically reduce virgin polymer production to align with the Paris Agreement to achieve climate neutrality by 2050.
- By exercising their governance rights and fiduciary responsibilities, shareholders shall compel corporate entities to implement systematic reductions in production volumes.
- The recycling process should deliver safe, non-toxic, and decontaminated products, by-products, and waste without dilution practices with virgin feedstock.
- When defining recycled content for plastic, the methodology should ensure transparent and reliable claims based on weight (using segregation and controlled-blending models).
- Public funding should not be given for the construction of pyrolysis and gasification plants, as the environmental value of these techniques still needs to be proven, and the risks exceed the benefits.



Zero Waste Europe (ZWE) is the European network of communities, local leaders, experts, and change agents working towards a better use of resources and the elimination of waste in our society. We advocate for sustainable systems; for the redesign of our relationship with resources; and for a global shift towards environmental justice, accelerating a just transition towards zero waste for the benefit of people and the planet.
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