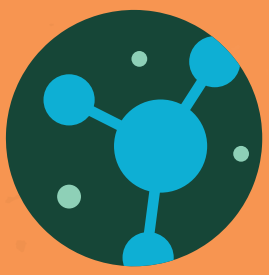


CHEMICAL RECYCLING
AND THE ROLE OF MASS BALANCE

EXPLAINED

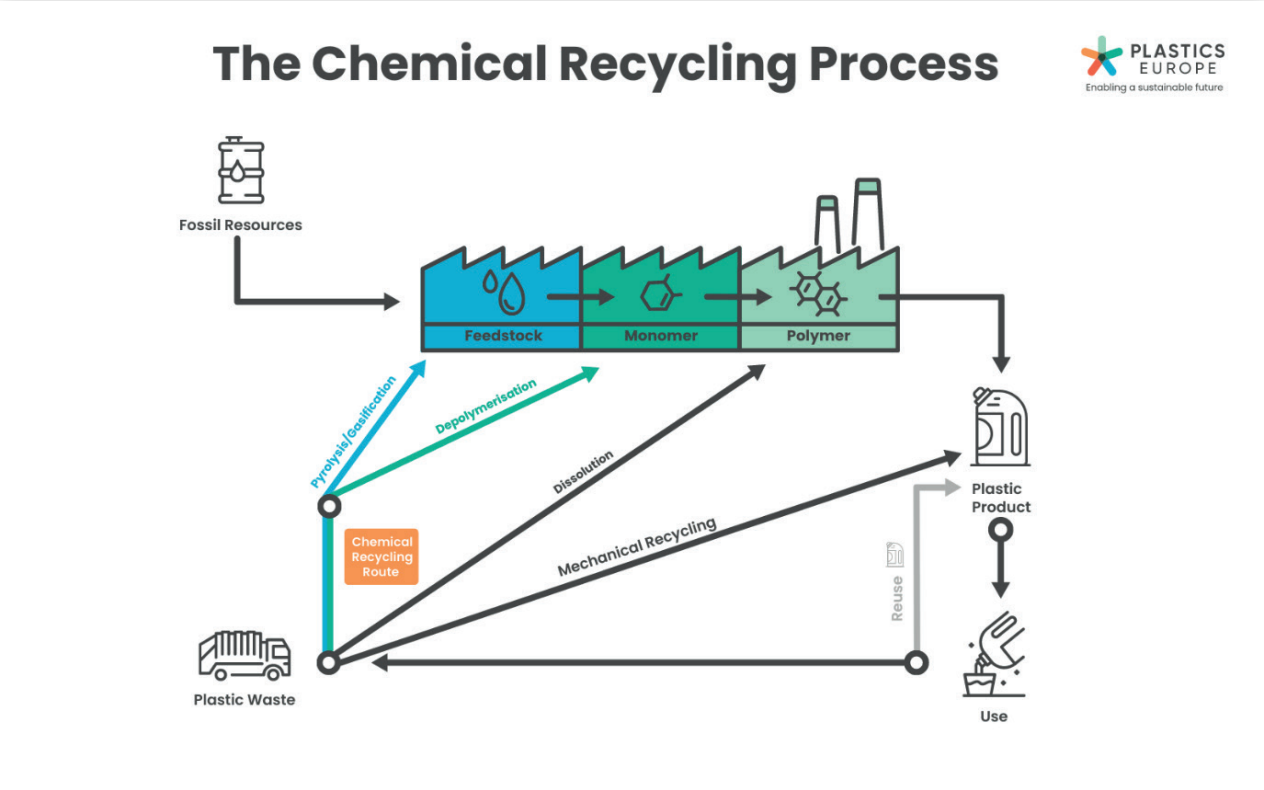
PLASTICS EUROPE

Enabling a sustainable future

WHAT IS CHEMICAL RECYCLING?

Chemical recycling is the term given to a group of technologies that can convert mixed and/or contaminated plastic waste back into 'virgin-like' raw materials. This means that chemical recycling can produce recycled plastics from hard-to-recycle waste that are highly suitable for complex end-applications, such as food contact and medical, or for safety-critical applications (such as automotive), which is not always possible with mechanical recycling.

Chemical recycling technologies, which include pyrolysis, gasification, hydro-cracking and depolymerisation, can make Europe less dependent on (often-imported) fossil-based feedstocks.



Why are some plastics waste streams more suitable for chemical recycling?

There are several reasons why certain waste streams can only be recycled using chemical recycling technologies.

EXAMPLES OF 'HARD TO RECYCLE' WASTE STREAMS CAN INCLUDE:

1

PLASTICS FROM MIXED WASTE

waste with mixed components such as different thermoplastics polymers that are difficult to separate and sort (e.g., some types of multi-layered packaging, automotive or electronic shredder residues) are unsuitable for mechanical recycling

2

CONTAMINATED PLASTICS

Waste with high levels of impurities (e.g., waste with adhesives or grease, contaminated industrial packaging, etc.) and waste containing restricted or legacy substances which need to be extracted from the recycled plastics are better suited to chemical recycling

3

THERMOSETS PLASTICS

Products such as polyurethane mattresses, fridge insulation, etc. – require chemical recycling

WHAT IS MASS BALANCE AND WHY IS ACCEPTING IT AN ESSENTIAL PRECONDITION FOR CHEMICAL RECYCLING INVESTMENTS?

To facilitate a fast and efficient transition towards incorporating chemical recycled feedstocks in our current infrastructure alongside fossil-based feedstocks, the implementation of the mass balance methodology becomes imperative.

In the complex large-scale installations where plastics are produced, the physical separation of two distinct feedstocks is not possible.

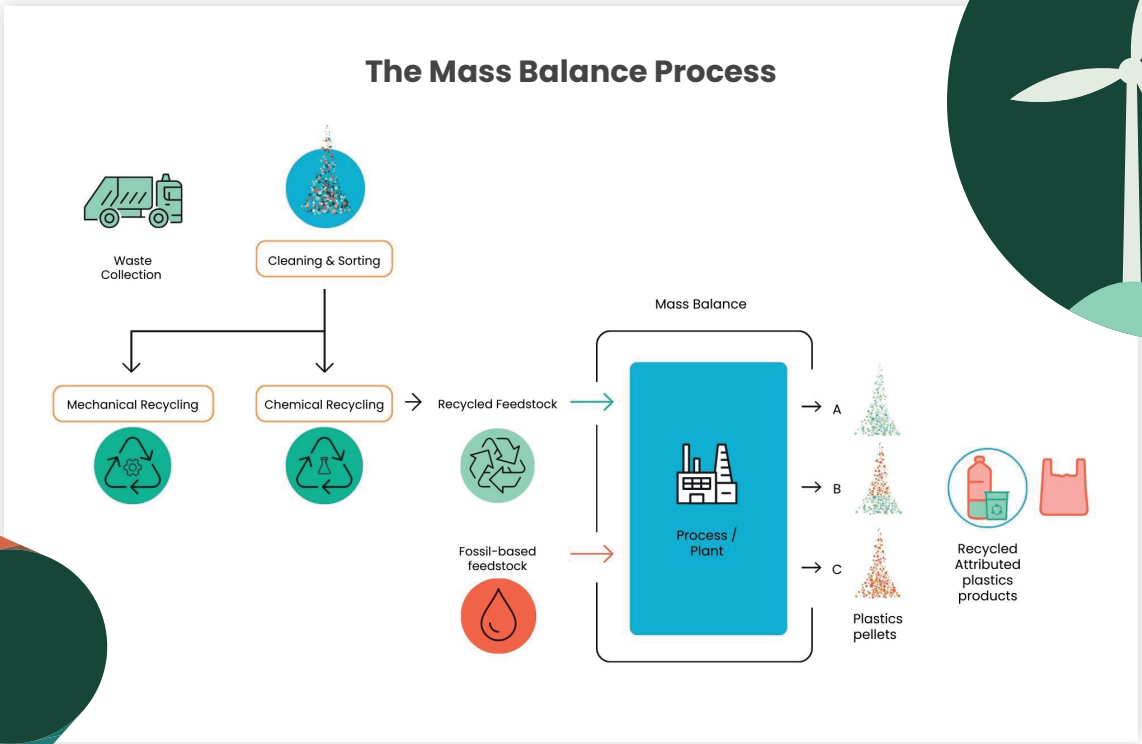
The mass balance methodology enables the use of chemically recycled feedstocks in existing large scale industrial plastics production installations, that are also fed by fossil-based feedstock.

This avoids the cost and time delay involved in building separate production facilities and value chains for chemically recycled plastics, thereby allowing the quick scale-up of chemical recycling capacities.

The mass balance methodology sets rules to ensure that recycled content is evaluated through the entire value chain and attributed to products in a way that is both auditable and transparent.

To ensure integrity, all materials and products are certified through a third-party certification scheme, such as ISCC Plus (International Sustainability and Carbon Certification) or REDcert.

Mass balance is already recognised for use in sectors like renewable energy and wood, and for fair trade in cocoa and chocolate, allowing for the efficient mixing of sustainable content into existing industrial processes.



WHY IS CHEMICAL RECYCLING IMPORTANT?

Chemical recycling is essential for transitioning Europe's plastic system from linear to circular via a net zero business model by 2050. Without using chemical recycling, it will not be possible to recycle all kinds of plastic waste, or to produce enough high-quality recycled plastics for complex applications including products which need to meet high standard requirements, such as food contact, regulated or high safety standards.

The window of opportunity for integrating this vital technology into Europe's existing industrial infrastructure – in time to meet the EU's 2030 circularity targets – is closing.

Urgent action is needed, especially given long investment and planning timelines, and the complexity of adapting the infrastructure of some of Europe's largest chemical plants.

HOW DOES CHEMICAL RECYCLING COMPLEMENT MECHANICAL RECYCLING?

To realise the vital importance of chemical recycling, it is helpful to understand the strengths and limitations of mechanical recycling.

Mechanical recycling is a recycling technology that can be sorted into single thermoplastic waste streams (e.g. plastic bottles).

During the mechanical recycling process, plastic waste is sorted, shredded into flakes, washed and re-melted into granules, which are then transformed into new products. Eventually, after a certain number of recycling cycles, the polymers can degrade.

While mechanical recycling should remain the preferred choice, it is not technically feasible to recycle some types of plastic waste using this technology or to produce enough high-quality recycled plastics for certain complex applications.

Currently about 65%[1] of post-consumer plastics are either incinerated for energy recovery or sent to landfill. Alternative recycling technologies such as chemical recycling, can be part of the solution to this problem.

1 *Plastics –the facts 2022*

WHY DO SOME PEOPLE OPPOSE CHEMICAL RECYCLING?

Some common concerns about chemical recycling are based on its energy requirements and yields compared to mechanical recycling. However, chemical recycling is intended to recycle complex or 'hard to recycle' waste streams that are currently being incinerated for energy recovery or sent to landfill, and to produce high-quality recycled plastics that are not always achievable with mechanical recycling.

The benefits of chemical recycling over landfill and incineration are clear. As the European Commission's Joint Research Centre confirmed in 2023, chemical recycling is always more beneficial than incineration from a climate change perspective[2].

Another study has found that chemical recycling processes could save the Netherlands around 1.5 Mt of CO2 per year[3].

It is also important to understand why chemical recycling is more energy-intensive and has a different yield compared to mechanical recycling. In a nutshell, 'hard to recycle' waste requires a longer and more complex process to be recycled. Creating high-quality recycled content from mixed or unclean waste streams involves more steps. Complex waste streams are likely to include more non-plastic waste, which can reduce yield.

As chemical recycling technologies mature, they are expected to become more energy efficient.

Mass-balance attribution rules can also have an important impact on the effective quantity of recycled plastics generated from a defined quantity of waste.

2 JRC Publications Repository - Environmental and economic assessment of plastic waste recycling (europa.eu)
3 https://cedelft.eu/method/chemical-recycling-of-plastics/

WHAT IS THE POTENTIAL TO SCALE UP CHEMICAL RECYCLING?

According to the ReShaping Plastics report – and considering the further development of mechanical recycling made possible by improved product design, sorting efficiency, etc – the chemical recycling market could grow to 7.3 Mt of recyclate by 2050. This would allow for the treatment of a quarter of the total plastic waste generated. The report also highlights that together, mechanical and chemical recycling can achieve up to 69% circularity levels with an associated GHG reduction of 55% compared to 2020.

4 The European Commission is working on the basis of the recommendations included in the "Study to develop options for rules on recycled plastic content for the implementing act related to single-use plastic bottles under Directive (EU) 2019/904", prepared by Eunomia – Available here.

5 Companies having declared recycling-to-feedstock projects in February have updated the investment plans considering a fuel-exempt scenario.

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