# European recyclers' stance on

# CHEMICAL RECYCLING,

# MASS BALANCE,

# AND THE TRUE ESSENTIALS

# to fuel the EU circular economy.

**EuRIC Position paper**
**September 2023**

EuRIC

EPRB European Plastics Recycling Branch*

EuRIC TEXTILES Textiles Re-use & Recycling Branch*

EuRIC MTR Mechanical Tyre Recycling Branch*

# Contents

# European recyclers' stance on chemical recycling, mass balance, and the true essentials to fuel EU circular economy

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Amid ongoing discussions in Brussels, EuRIC, the leading association of material recyclers addresses key questions for emerging technologies to complement existing recycling practices. We offer suggestions for policymakers and chemical recycling advocates to convey a transparent message on achieving circularity for plastics, textiles, and tyres.

## Executive summary in key concepts

**Complementarity -** EuRIC recognizes the role of different recycling technologies in the circular economy of materials.

**Environmental efficiency -** Support for chemical recycling should not overshadow established proven lower-carbon solutions based on mechanical recycling, which still holds a lot of untapped potential.

**Clarity in context –** Enabling chemical recycling is just one aspect of achieving a circular economy. Ecodesign and improving additional value steps between increased collection and increased demand for recycled materials, along with EU-wide end-of-waste criteria harmonization, remain crucial.

**Cooperation -** Effective cooperation among stakeholders shall guide chemical recycling technologies towards waste streams that are not mechanically recycled or to the production of recycled products impossible to achieve by mechanical recycling but in high demand by industries.

**Size does not matter -** Recycling all streams, regardless of their waste tonnage, is essential for maximizing the EU's resource efficiency and protecting the environment and human health.

**Avoid greenwashing -** Chemical recyclers must not misuse mass balance to meet the EU's recycled content targets. Transparency is key to maintaining the recycling industry's credibility and solving the waste crisis.

## Chemical recycling discussion

**To what extent is chemical recycling essential for achieving a circular economy?**

EuRIC acknowledges that chemical recycling serves as a complementary solution alongside other technologies to address persistent challenges in recycling, particularly in the case of plastics, textiles, and to some extent, tyres. Yet, chemical recycling is just one piece of the puzzle. We mustn't overlook upstream solutions and divert resources from existing recycling technologies operating at scale.
Independently of the technology used, some critical aspects need to be addressed:

### Collection and recycling–

- **Plastics**

  Almost half of the total plastic waste in the EU lacks separate waste collection (i.e., residual household waste and residual industrial waste), which is not sorted for recycling but mostly directly sent for landfilling or incineration). From the separate waste collection, 65% is already recycled[1]. However, the challenge lies in accessing for recycling those remaining 15 Mt of end-of-life plastics that are not yet sorted for recycling.

  Mechanical recycling supplies nearly all of the EU's 5.5 Mt of recycled plastics. Chemical recycling, on the other hand, currently treats only 0.2% of collected post-consumer plastic waste. Mechanical recycling still has a lot of untapped potential. According to the Circular Plastics Alliance (CPA) report[2], mechanical recycling could achieve 3.4 Mt of additional post-consumer recycled plastics by 2025, with about 2.8 Mt originating from the packaging sector alone. This means that without chemical recycling, approximately 9.7 Mt of recycled plastics could be introduced to the European market by 2025.

- **Textiles**

  In the EU, only 2.4 Mt of textiles are separately collected annually, while 8.5 Mt (78%) ends up discarded in household mixed waste, leading to incineration or landfill[3]. The Waste Framework Directive's Article 11(1) mandates Member States to establish separate textile collection systems by 2025, potentially adding 65,000 to 90,000 tonnes per year[4]. The separately collected fraction of textiles, not meeting reuse quality standards and/or second-hand market demand, is primarily recycled through mechanical or chemical processes into wipers, non-wovens (short fibres) or cellulose. However, fibre-to-fibre recycling remains at a mere 1% of the total recycling.

- **Tyres**

  Tyre collection is not an issue, with 95% of end-of-life tyres (ELTs) collected and treated in the EU[5]. However, approximately 50% of the 3.5 million tonnes of ELTs produced annually are (co-)incinerated, while less than 1% undergo pyrolysis. Significant untapped potential remains in scaling up tyre recycling within the waste hierarchy, where policy intervention is key. Developing new markets for mechanically recycled rubber and complementary technologies, like recovered/recycled carbon black[6] and devulcanized rubber, are key to unlocking this potential.

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[1] PlasticsEurope | *Plastics – The Facts 2022* (2022) –On page 45 via MIXED collection should read via RESIDUAL collection (e.g., residual household waste and residual industrial waste)
[2] CPA Roadmap to 10Mt | *Untapped Potential Report* (2021)
[3] Impact Assessment WFD, SWD 421 (2023)
[4] JRC Techno-scientific assessment of the management options for used and waste textiles (work in progress)
[5] ETRMA | In Europe 95% of all End of Life Tyres were collected and treated in 2019 (2021)
[6] Recovered carbon black is a term applied for the solid product fraction obtained and refined after ELT pyrolysis. Recycled carbon black produced out of tyre pyrolisis oil (TPO) can be called recycled carbon black or sustainable carbon black, here the carbon

## Recycled content-

Binding recycled content targets in new products provides legal certainty, encouraging investments and scaling up for a circular economy. Unlike materials from fossil fuels or natural resources, the price of recycled plastics, rubber, or textiles does not follow the same dynamics. High oil or raw material prices lead to expensive products, while lower prices make them cheaper. This market variability makes recycling investments less attractive compared to raw materials. To create demand and certainty, mechanisms like binding targets, as seen in the Single-Use Plastic Directive (SUP) and proposed for Packaging[7] and Automotive[8], are essential for the recycling industry, be it mechanical or chemical.

EuRIC strongly supports EU policymakers' efforts to improve recycling design and implement binding targets for recycled plastics, together with green public procurement policies (GPP) and taxing of virgin materials, as they are the most powerful incentives for recycling. As a result, recycling targets based on mechanical recycling in the EU continue to rise.

- **Plastics**
  Use of post-consumer recycled content in European converters increased by 117% from 2016 to 2020, reaching 9.9% in 2021 (over 20% growth since 2018)[9]. Apart from packaging, other sectors like automotive, EEE, Building and Construction, and Agriculture also require recycled content targets. EuRIC advocates a 25% recycled content target in the automotive sector[10] as currently proposed by the Regulation for after 2030. Binding targets in these sectors, with a minimum from close-loop recycling, are essential for enhancing ecodesign. European plastics producers also endorse[11] recycled content targets as vital for transitioning to a circular economy in the EU, securing investments' returns.

- **Textiles**
  The EU Textiles Strategy[12] recognizes the importance of having textile products predominantly made of recycled fibres by 2030. EuRIC advocates for the introduction of mandatory recycled content targets for textiles, focusing on post-consumer textile fibres. These targets should differ from the incorporation of other recycled materials (e.g., PET from recycled bottles) into new textiles. By setting minimum fibre-to-fibre recycled content targets, sorting and recycling technologies can be incentivized[13], leading to significant environmental improvements.

- **Tyres**
  Material recovery for end-of-life tyres (ELTs) has increased from 10% to 50% in two decades. Nonetheless, the ongoing evolution of regulatory requirements, which predominantly concentrate on the overall chemical content in recycled rubber products rather than migration, a more suitable parameter for this material, continues to restrict the potential applications for materials derived from tyres. This, combined with the absence of defined targets and incentives for material recovery and the integration of recycled materials from ELTs, is impeding the advancement and investment in ELT recycling efforts. This situation results in a stagnant, and now even

black is produced using conventional (furnace process) carbon black processes using TPO (or refined fraction of TPO) as a feedstock

[7] **Proposal for a revision of EU legislation on Packaging and Packaging Waste** (2022)
[8] European Commission | Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on circularity requirements for vehicle design and on management of end-of-life vehicles, amending Regulations (EU) 2018/858 and 2019/1020 and repealing Directives 2000/53/EC and 2005/64/EC (2023)
[9] PlasticsEurope | Plastics – The Facts 2022 (2022)
[10] EuRIC | EuRIC call for Recycled Plastic Content in Cars (2020)
[11] European plastics producers call for a mandatory EU recycled content target for plastics packaging of 30% by 2030 (2021)

[12] COM(2022) 141 final
[13] OVAM |ECODESIGN CRITERIA FOR CONSUMER TEXTILES (2023)

decreasing, end-market for recycled rubber from ELTs. The construction sector presents an ideal opportunity for using recycled rubber, such as rubberized asphalt together with many other applications[14], and recycled content targets should be explored in this direction. For the automotive sector, the largest consumer of rubber, EuRIC advocates a 20% recycled content target for Original Equipment Manufacturer (OEM) rubber parts from ELTs recycled rubber by 2030. Additionally, achieving a 10% recycled content target for tyres by 2030 is also feasible and should be pursued.

## Design for recycling-

While standards should be open to accommodate new technologies, the importance of limiting them to address recycling at technology readiness level 9 (TRL9)[15] is crucial. Otherwise, standards might not serve their purpose effectively (i.e., technologies under TRL9 might find their way in the market or not) to reach recycling targets.

From a chemical perspective, effective toxic-free product design would significantly limit the need to apply energy-intensive technologies like chemical recycling in waste treatment[16]. A link of the Ecodesign for Sustainable Products Regulation (ESPR) to the REACH revision is crucial to improve the monitoring of substances of concern in products. This approach enables end-of-life products to be efficiently recycled and reused multiple times, contributing to a truly circular economy. On top of that, preventing hazardous chemicals in product design is essential already at product level. This is certainly the case for products like tyres, which act as a major contributor of microplastics releases into the environment and subsequent environmental pollution[17].

Standardization also plays a crucial role in promoting the regulation of substances found in products and waste, especially when dealing with legacy substances. In this regard, until a hazard-free product design is achieved, adopting a risk-based approach for products incorporating recycled materials is essential. This involves setting concentration limits for the use of recycled materials in products based on a realistic scientific assessment of the potential risks associated with their intended use—not solely relying on their toxicity to humans (i.e., hazard). To achieve higher recycling rates, it is vital to consider an EU laboratory test battery with validated concentration limits for substances of concern. These limits should be determined based on the migration of total content, considering the specific material (i.e., plastic, textiles, or rubber) or application (e.g., consumer or industrial use, food or non-food contact). By employing this approach, we can better ensure the safe and sustainable use of substances in products and materials while promoting effective recycling practices.

## End-of-waste (EoW)-

EuRIC strongly advocates for harmonized EU-wide End-of-Waste (EoW) criteria for plastics, textiles, and rubber[18]. Harmonized EoW criteria create a level playing field, eliminating market barriers and promoting trust in recycled materials, driving the transition to a truly circular economy.

Although this work has started for plastics and textiles at the JRC level, no date is envisioned for rubber recycled from end-of-life tyres (ELTs). In this case, the whole value chain from tyre manufacturers to recyclers agrees that this is necessary to open new markets and foster innovation[19].

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[14] Flooring, acoustic mats, rail Infrastructure, playground safety tiles, ramps, anti-vibration, flooring, rubber pavement, protection for roofs, shockpads
[15] Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)
[16] In line with the EU *Chemicals Strategy for Sustainability: Towards a Toxic-Free Environment* (2020)
[17] PEW | EU Proposes First Measures to Limit Plastic Pollution From Vehicle Tyres (2022)
[18] EuRIC | *Top 5 Priorities of the Recycling Industry for the Period 2019-2024* (2019)
[19] EuRIC & ETRMA | *A united tyre value chain calls for immediate EU-wide end-of-waste criteria for recycled rubber* (2022)

**How can we address feedstock competition for waste to unlock the potential for both mechanical and chemical recycling?**

Mechanical and chemical recycling must coexist to address different fractions of waste. The market will find a balance between the two technologies, considering factors like quality and output (i.e., product) diversity. Legislation should set requirements on post-consumer recycled content to incentivize technological developments and promote circularity, as already seen in some plastics sectors (e.g., beverage bottles under the SUP Directive).

## Specificity of the material-

The nature of the material determines whether mechanical or chemical recycling is needed for end-of-life treatment.

Plastics come in various types of polymers. Thermoplastics, comprising around 75% of global plastic production, can be mechanically recycled and used in open and closed-loop systems. However, thermosets like epoxies and polyurethanes, found in durable and heat-resistant products such as cars and electrical appliances, cannot be mechanically recycled. Innovative technologies are essential to address the recycling challenges posed by these plastic types.

For textiles, mechanical recycling is suitable for cotton, polyester, and other single-component waste streams. Yet, for lots of apparel made from blended fabrics, finding a recycling solution is paramount to reduce textiles sent for incineration or landfilling. Thus, chemical recycling can complement mechanical recycling for textiles that are no longer suitable for re-use and whose fibres cannot be recovered mechanically.

In the case of rubber, by implementing different measures as previously discussed (i.e., recycled content in goods containing rubber and design for recycling) a 100% material recycling rate for rubber from end-of-life tyres (ELTs) in the EU (i.e., double the current 50%[20]) can be achieved, limiting in this way exports of ELTs to non-EU countries[21]. Additionally, chemical recycling, particularly pyrolysis, can further process quality mechanically recycled rubber from ELTs to generate outputs like recovered/recycled carbon black for closed-loop recycling. Pyrolysis oil, and purified and refined fractions of the pyrolysis oil, from waste tyres can also be utilized as a more sustainable raw material source for plastics production (e.g., nylon, polyurethanes) than traditional raw materials.

## Quality and quantity of feedstock-

Similar to mechanical recycling, the market reality has shown limitations for enabling chemical recycling because it also requires well-designed, properly sorted, and cleaned (i.e., pre-treated) plastic waste to produce quality output materials matching manufacturers' requirements.

In some cases, like for tyres, chemical recycling also depends on a prior quality mechanical treatment to separate rubber, steel, and textiles. Therefore, chemical recycling's

[20] This will be even lower in the forthcoming years as the *COMMISSION REGULATION (EU) …/… of XXX amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles* will remove 30% of the ELT rubber market from entry into force in 2032 once approved by Parliament and Council.
[21] EuRIC | *Mechanical tyre recycling factsheet* (2022)

complementarity in the tyre recycling sector lies in producing different outputs like recovered/recycled carbon black to help close the loop in the tyre industry.

For plastics and textiles, improving collection is crucial regardless of the recycling technology, as quantity impacts the economics of the process. Recycling requires large feedstock and a constant supply. Additionally, the need for further treatment of by-products, low output yields, and high energy consumption in chemical recycling are often overlooked aspects that affect its economic viability.

As chemical recycling facilities scale up, competition for feedstock with mechanical recyclers becomes a concern. If chemical recycling facilities can't deliver on a large scale to complement mechanical recycling, they may resort to using feedstock indiscriminately, putting complementarity at risk and compromising established lower-carbon recycling systems.

## Using feedstock where it has the highest environmental benefit-

In a fully realized circular economy, the priorities should be designing for reuse, repair, and mechanical recycling. This sequence is favored due to its lower environmental impact, higher material yields, and lower implementation costs. To align with this approach, products should be intentionally designed for easy reuse, repair, and mechanical recycling.

Chemical recycling should only come into play for materials that cannot be efficiently handled through mechanical recycling. Therefore, chemical recycling should specifically address:

- **Plastics:** feedstock lacking mechanical recycling solutions[22] and facing uncertain positive investment prospects within the expected legislative timeframe[23] for recycling, and a very limited amount of degraded and contaminated plastics and rejects from mechanical recycling facilities.

  E.g.,
  - Thermosets – All applications
  - Packaging – Multilayers (flexibles & rigids; all polymers), PS for food and non-food contact, PET trays
  - POP (persistent organic pollutants)-containing non-compliant polymers – All applications (mostly WEEE & ELVs)
  - Plastic waste highly contaminated that otherwise would be incinerated

And competition must be avoided with the following polymers/applications where mechanical recycling solutions already exist at full industrial scale and demonstrated positive investment prospects within the anticipated legislative timeframe.

E.g.,

- Packaging: PET bottles, rigids PP and PE for food and non-food contact, commercial and industrial flexibles PE for non-food contact, PS rigids

[22] When technology based on mechanical recycling does not exist, chemical recycling processes should demonstrate a reduced carbon footprint compared with the production of virgin resins.
[23] When technology based on mechanical recycling does not exist, chemical recycling processes should demonstrate a reduced carbon footprint compared with the production of virgin resins.

- PP, ABS and polyolefin fraction from mixed plastics in end-of-life vehicles. This is in line with the JRC's scientific assessment[3], where post-consumer plastic used in new vehicles could increase 8-fold (i.e., up to 710 kt) by 2035 by simple means of mechanical recycling. Technical or safety parts for which recycled plastic materials are excluded together with PUR grades might be a complementary option in the coming decade to add to that target through chemical recycling.
- PP and PE non-POP and POP-compliant waste from WEEE

- **Textiles**: the initial step invariably involves the mechanical removal of specific items, such as zippers and buttons, as a standard practice. Mechanical recycling technologies are effective for processing blended fabrics in an open-loop approach. However, in closed-loop recycling, it's preferable to work with mono-fibres (single-component) textile waste, especially when the colour is uniform and in high demand, such as black textiles. To enhance fibre-to-fibre recycling, chemical recycling holds significant potential, particularly for non-single component waste streams like blended fabrics and when colour removal is necessary to meet the requirements of the output market.

- **Tyres**: mechanical recycling of tyres is essential to obtain a clean rubber fraction from steel and textiles, regardless of the subsequent technology used for recycled rubber granulate. The market will find a balance between both routes, mechanical and chemical, if existing policies will promote both open-loop and closed-loop applications. To achieve this, a legislative framework beyond the current landfill prohibition is needed to keep end-of-life tyres in the EU for material processing and prevent export for incineration as it is the current trend[24].

Without clear targets for chemical recycling complementarity, the EU risks cannibalizing the existing circular economy for certain waste streams. Furthermore, feedstock competition may lead to less environmentally friendly solutions. Chemical recycling must prove its ability to effectively handle contaminated and degraded plastics, like legacy additives in PVC and thermosets, as well as hazardous substances in tyres and textiles.

Before incentivizing any chemical recycling technology, a thorough evaluation of its environmental and health impacts, as well as economic feasibility, must be conducted at an industrial level. This evaluation should include energy and electricity use, as well as the further utilization of raw materials as feedstock.

## Post-consumer vs Post-industrial waste–

Independent of the technology applied, binding targets for recycled content should be set based on the recycling of post-consumer waste. While both post-consumer and post-industrial streams are a waste, the behavior is different. Whereas post-industrial waste depends on the efficiency of industrial processes, and it is a very well-controlled waste in terms of environmental impacts, dealing with post-consumer waste means reducing the environmental and human health impacts of end-of-life products. A focus on post-consumer will incentivize design for recycling while it will hasten the development and upscaling of technologies for almost impossible-to-recycle products and materials that are now in the market.

[3] JRC | Towards recycled plastic content targets in new passenger cars and light commercial vehicles (2023)
[24] EuRIC | EuRIC urgently demands the European Commission to halt the export and incineration of tyres collected in Europe outside its borders (2023)

**How can we effectively address mass balance to prevent greenwashing and ensure we focus on real solutions for material circularity?**

Chemical recycling needs a stable regulatory framework for investments, just like mechanical recycling. EuRIC has been advocating this for a decade. Some chemical processes mix waste-derived intermediates with virgin material, making direct allocation challenging. Hence, mass balance accounting (MBA) is supported to track outputs and prevent carbon leakage (e.g., production of fuels instead of new materials).

Concerning the MBA, EuRIC believes that the term recycling must not be diluted by a "carte blanche" to chemical recyclers through an inventive MBA approach.

Therefore, for those waste streams for which a better recycling alternative to chemical recycling exists:

- To instill trust in the chemical industry, an honest reporting of the recycled content based on the rolling average, or proportional approach, needs to be performed. If such a reporting is economically not viable because the amounts of polymeric recycled input are too small for its practical implementation, this clearly highlights that chemical recycling is still a technology in need of more research to deliver on its promises.
- A credit method will clash with EU's efforts to avoid greenwashing. The plastic/plastic waste crisis is also caused by the lack of information and awareness of the public and governments. A credit method would allow the plastic industry to communicate that a product for which there is no recycling solution, be it for lack of a proper collection and separation system or lack of technology, contains up to 100% recycled content, when in fact it might have none[25] or a very low amount[26].
- A credit system, if not restrained, will increase mistrust in the market and from consumers and it will be detrimental in the long term to achieve a truly circular economy because, such a system, will water down the efforts on product ecodesign and perpetuate the problems of recycling.

  EuRIC proposes that priority should be given to:

- A level playing field between different technologies according to environmental impact.
- Consistency between recycled content claims and the real physical recycled content:
  - Mass balance approach should show the lowest deviation from physical recycled content (i.e., like it applies to outputs from mechanical recycling)
  - No form of credit transfer between recycling sites should be considered.

As a result, in order of preference, mass balance accounting should be based on:

1. A rolling average method.
2. If this is not possible, a credit method based on a proportional allocation[27].
3. Where outputs obtained from chemical recycling that end up being used for fuel must never be credited to the recycling rate[28].

[25] ZWE | *Recycled plastics balancing on a thin line with the 'mass balance approach'* (2021)
[26] European Commission | *Discussion note developing mass balance accounting for chemical recycling for the TAC meeting on 19 june 2023* (2023)
[27] EUNOMIA | A Comparative Assessment of Standards and Certification Schemes for Verifying Recycled Content in Plastic Products (2021)
[28] In line with the definition of recycling in the WFD: recycling' means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but **does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations**

Allocation methods based on a polymer only and fuel used excluded are simply greenwashing because it would allow companies to claim and market products made from recycled materials regardless of whether it is true and will not help to diminish the major problem of the waste crisis.

The previous recommendations should apply strictly to waste streams where chemical recycling competes directly with other recycling technologies and doesn't perform better in terms of life cycle assessment (LCA) criteria compared to alternative recycling options.

However, in cases where chemical recycling represents the only viable option for certain waste streams:

EuRIC recommends a straightforward reporting approach for recycled content using an MBA based on fuel use exclusion allocation method. This means that recycled content credits can be freely allocated to all products except those used as fuels. This method aligns with the circular economy goals, reduces environmental impacts, and encourages investments without disrupting efficient circular value chains.

## Recommendations-

To foster a circular economy, EuRIC proposes to:

- Focus on design for recycling and recyclability assessment, linking it to end-of-life treatment including collection and sorting and other intermediate steps of the value chain.

- Consider chemical recycling as complementary to mechanical recycling for certain plastics applications that can't be mechanically recycled today. Chemical recycling is also valuable for end-of-life tyres (ELTs) when producing recovered/recycled carbon black and devulcanized rubber for various industries. Closed-loop recycling for textiles is another potential application.

- Create a framework for using post-consumer recycled material in new production cycles (e.g., plastics, textiles, tyres), regardless of the technology used. Implement measures like mandatory recycled content, GPP, or taxing virgin materials to promote recycling.

- Speed up standardization methods for recycled materials, prioritizing a risk-based approach[29] over total chemical content in their outputs and applications.

- Recognize an EU-wide End-of-Waste status for plastics, ELT-derived rubber, recycled/recovered carbon black, and textile.

- Oppose using mass balance accounting (MBA) with a fuel use exclusion allocation method for chemical recycling when superior recycling options are available. We advocate for a transparent and rigorous credit-based approach to protect the circular economy's integrity. However, an MBA with fuel use exclusion allocation may be considered only if no better recycling alternatives exist.

[29] For legacy substances until all products put on the market are designed to be recycled