IFPEN POSITION PAPER

What regulatory framework for a rational, efficient and sustainable plastics recycling sector?

Proposals to contribute to the Circular Economy Act

Innovating for a low-carbon and sustainable world

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IFP Energies nouvelles

IFPEN is the French institute for research, innovation and training in the fields of energy, mobility and the environment. Its teams innovate for a low-carbon and sustainable world, covering the entire chain from scientific concepts through to concrete solutions for industry. From processes to equipment, products, software and services, IFPEN's low-carbon innovations are paving the way for the energy and ecological transition and facilitating the emergence of the industrial sectors of the future.

Drawing on expertise developed over the past 80 years, IFPEN has been working for more than a decade on technological solutions for advanced plastics recycling, an area that is set to play an important role alongside mechanical recycling in recovering and re-using complex plastic waste that is difficult to recycle.

IFPEN welcomes the European Commission's initiative to adopt a Circular Economy Act, which is considered to be a cornerstone of Europe's competitiveness, resource security, and climate neutrality.

IFPEN fully supports the Commission's ambition to create a genuine single European market for secondary raw materials, including plastics, the recycling of which is a major ecological and economic challenge. To achieve this goal, this document proposes key areas for development aimed at establishing an efficient and sustainable European plastics recycling industry.

These points for consideration supplement and update the first position paper published by IFPEN on advanced plastics recycling in 2024[1] to promote its deployment in Europe.

[1] *https://www.ifpenergiesnouvelles.com/article/what-regulatory-framework-rational-effective-and-durable-plastic-recycling-sector*

Points to remember

The growing demand for plastics remains a major challenge for Europe, both from an environmental point of view and in terms of resource security. The implementation of an effective circular economy is always based on three fundamental levers: **reduce, reuse, and recycle**, with recycling playing a key role in limiting the use of fossil resources and recovering complex plastic waste.

Mechanical recycling remains the most virtuous approach when closed loops are technically feasible. It should be prioritized whenever it enables the properties of the material to be preserved. It does, however, have structural limitations when it comes to diverse flows, the presence of additives, and increasing quality requirements.

Advanced recycling, which complements mechanical recycling, is an essential tool for treating plastic waste that is difficult or impossible to recycle mechanically. By enabling the removal of additives and impurities and the recovery of purified polymers, it paves the way for higher value-added uses and closed-loop circularity at the polymer level.

However, the large-scale roll-out of these technologies requires considerable industrial investment and recycled material that is structurally more expensive than virgin fossil-based material. Their development can therefore only take place within a clear, coherent and long-term European regulatory framework that provides security for industrial projects.

To this end, several structural levers need to be activated:

- **Reinforce incentives for the use of recycled materials** by extending incorporation requirements beyond packaging (automotive, construction, textiles), setting clear and progressive timetables, and ensuring effective controls in conjunction with dissuasive penalties.
- **Define and harmonize end-of-waste status (EWS)** at the European level, positioning it at the stage of material prepared for recycling, whether mechanical or advanced, in order to streamline flows and facilitate cross-border transfers.
- **Promote circularity at the polymer level**, rather than specifically at the level of objects or consumption channels, in order to scale up flows, reduce costs, and preserve the economic balance of each value chain.
- **Adapt the organization of extended producer responsibility (EPR)** sectors, distinguishing more clearly between collection and sorting challenges (related to usages) and recycling and material recovery challenges (related to polymers), and promoting a more cross-cutting approach at the European level.
- **Establish a robust accounting system for recycled material (mass balance)** that is consistent with European regulations (SUPD[2], PPWR[3]), promoting plastic-to-plastic recycling, and avoiding distortion effects between sectors.

[2] *SUPD: Single Use Plastic Directive*
[3] *PPWR: Packaging and Packaging Waste Regulation*

- **Strictly regulate the term "recycled material" and imports** through certification, traceability, and control systems that guarantee quality equivalent to European standards.

Lastly, the development of plastics recycling should be integrated into a regional circular economy approach, prioritizing the recovery of available resources in Europe and supporting innovation in recycled material characterization and control tools.

Recycling incentives

Recycled material is in general more difficult to obtain and more expensive than virgin fossil-based material. It is therefore important to encourage its use and develop a specific market for recycled plastics. Mandatory incorporation rates associated with the SUPD and PPWR adopted for packaging at European level, or the eco-modulation measures currently in the process of being adopted in some countries (France, 2026), are important steps in this direction. However, it is vital to pursue these efforts and increase pressure to promote the use of recycled materials. This involves:

- extending the incorporation rate imposed on packaging to other sectors, such as the automotive or construction sector, for example.
- implementing a more ambitious timetable, with more specific targets in the sectors already concerned (such as packaging, for example), thanks to the inclusion of more frequent intermediate targets (2030, 2035, 2040, 2045, 2025 for the PPWR, for example).
- asserting the territorial dimension of the circular economy, by promoting (where possible) the recovery of available resources in Europe (as suggested in the eco-modulation scheme proposed in France for 2026, or in the SUPD).
- implementing controls to verify compliance with regulation and, above all, introduce dissuasive penalties for those who fail to comply with regulatory requirements.

The complementary nature of mechanical recycling and advanced recycling

Advanced recycling, complementary to mechanical recycling to recover and re-use plastic waste, consists in chemical or physical transformation of end-of-life plastic through deformulation, depolymerization or conversion. The different advanced recycling processes make it possible to remove additives and other impurities present in waste and recover the initial plastic, thus promoting closed-loop recycling.

Advanced recycling should not be opposed to mechanical recycling. Indeed:

- the environmental impacts of mechanical recycling (see Fig.1) are generally less significant than those of advanced recycling. When **closed-loop** mechanical recycling solutions exist, they should therefore be favored and encouraged.

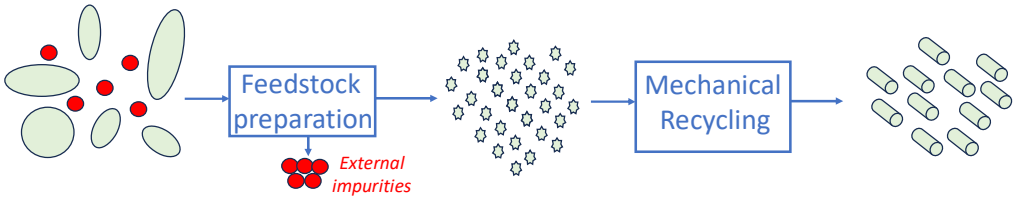

***Figure 1**: Mechanical recycling*

- open-loop mechanical recycling with downcycling/compounding, which degrades the material and makes it less recyclable, should be avoided wherever possible when advanced recycling solutions exist.
- advanced recycling (see Fig.2), like mechanical recycling, requires **preparation of the feedstock to be recycled** (see Fig.3) prior to the transformation processes, enabling

removal of any external impurities[4] that could pollute the recycling streams (...). **This step is essential for decontamination,** which relies on conventional operations such as sorting, milling and washing for example, **and for shaping the material** to facilitate recycling. This therefore represents an opportunity for existing mechanical recycling operators to expand their business by also contributing to the preparation of feedstock for advanced recycling units.

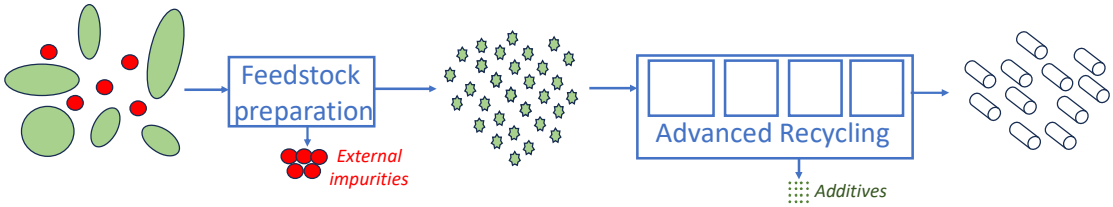

***Figure 2**: Advanced recycling*

- advanced recycling makes it possible to eliminate additives[5] contained in plastic (through discoloration, depigmentation, and removal of plasticizers, for example). Accordingly:
  - the plastic to be treated in these processes may contain numerous additives, making it possible to process inputs that cannot be mechanically recycled. However, advanced recycling unit inputs are no more contaminated by external impurities than the inputs destined for mechanical recycling if they have undergone an appropriate preparation stage.
  - **plastic from advanced recycling is therefore potentially much purer than mechanically recycled plastic, allowing for a far wider range of applications and greater value generation.**
- lastly, for new emerging sectors (such as textile recycling), which are less mature than the packaging recycling sector, for example, it is important to be aware that their deployment (for collection, sorting, **but also and above all for the preparation of the feedstock to be recycled**) will require time and very substantial investments.

The development of feedstock preparation processes (see Fig.3) for the purposes of recycling (mechanical or advanced) is essential to promote the recycling of plastics, tires and textiles. The common European market for recyclable materials will then be able to evolve and grow, in conjunction with the development of mechanical and advanced recycling facilities. **To promote the growth and widespread adoption of recycling in Europe, it is therefore essential that materials prepared for recycling can circulate unhindered to recycling facilities in different European countries.**

[4]*External impurity: material other than the plastic to be recycled in the waste stream (metals, paper/cardboard, glass, organic matter, plastic materials other than those intended for recycling, etc.)*
[5]*Additive: substance other than the polymer contained in the plastic (added intentionally or unintentionally)*

***Figure 3**: Feedstock preparation in plastics recycling*

End-of-waste status (EOW)

There is an urgent need to define and harmonize regulations on end-of-waste status (EOW) at the European level, as well as rules concerning the cross-border transfer of recyclable materials within Europe. To date, the JRC has released two reports:

- the first, published in June 2024, concerns plastics recycling but only addresses processes that do not alter the chemical structure of polymers. Consequently, advanced recycling methods involving chemical transformation, such as PET depolymerization, currently being developed on an industrial scale, are still awaiting regulatory proposals.
- the second, published in February 2025, concerns the textile sector, but the proposals made lead to EOWs that depend on recovery methods (reuse, mechanical recycling, advanced recycling) and are therefore unsatisfactory.

A recent draft act[6] was then issued by the European Commission on December 23rd, 2025 to propose end of waste status for plastic recycling but unfortunately, it covers only mechanical recycling and dissolution route which do not alter the polymeric chains of the plastic. **Unfortunately, depolymerization routes and conversion routes which are presently fully developed and commercially available are still not included in this new proposal. It is therefore essential to also define end of waste status for depolymerization and conversion in the final act.**

In order to ensure coherence between the various recycling streams (mechanical recycling, advanced recycling) adapted to the value chains of different economic sectors (tires, textiles, plastics), **we recommend positioning EOW status when the material has been prepared and allows for the transformation of the material** (physically or chemically) during recycling.

[6] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14848-Plastic-waste-EU-wide-end-of-waste-criteria_en

It should be noted here that material preparation is an expensive operation that significantly increases its value. This step will therefore only be carried out to meet market demand for inputs that feed into recycling facilities.

With an identical EOW status when the material has been prepared for physical or chemical transformation during the recycling of tires, textiles and plastics, waste stream management will be harmonized, facilitated, and improved.

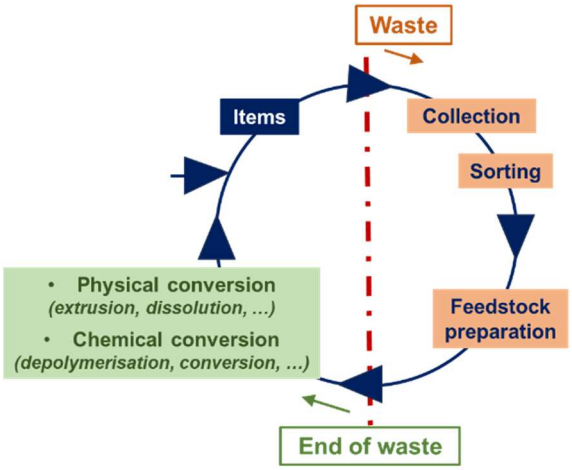

***Figure 4**: End of waste status proposal downstream feedstock preparation*

Circularity at polymer level

Recycling operations are very closely related to the chemical nature of each polymer. However, a given polymer may be present in different usage sectors. For example, PET is widely present in both packaging and textiles. As for PVC, it is found in the furniture and construction industries, among others. Polyolefins are present in most consumer industries.

Advanced recycling makes it possible to obtain purified polymers and therefore enables, for example, the manufacture of packaging from polymers sourced from other industries. **With the emergence of advanced recycling, larger circularity loops are possible at the polymer level, regardless of item and usages sector.**

The possibility of supplying advanced recycling facilities with streams from several consumption sectors, to produce recycled polymers that can be used in these sectors, **will reduce processing costs by increasing the volume of streams**. In some cases, this can also **compensate for the limited capacities of certain outsourced industrial players** that would be unable to reincorporate recycled materials on a large scale in Europe (in the textile industry, for example, the capacity of spinning mills to reincorporate recycled materials is currently very limited).

The concept of "polymer circularity" must also be respected throughout the recycling process to avoid the transformation of one polymer into another, thereby preventing economic interference between the value chains of different polymers, which could hinder the development of recycling for some of them. It is therefore necessary to foster processes that enable the production, through recycling, of the same polymers as those present in the initial waste, including conversion routes involving pyrolysis or gasification,

A need to rethink Extended Producer Responsibility (EPR) policies?

Extended Producer Responsibility (EPR) policies are already in place in many sectors in France and several other European countries. Europe is considering drawing inspiration from these models, an **ideal opportunity for rethinking and optimizing the governance of plastics circular economy.**

As we have just seen in the previous section, advanced recycling enables circularity at the polymer level, making it possible to use polymer in consumption sectors other than its original sector. **However, collection and sorting are currently highly dependent on the consumption sectors of the various polymers.**

Under such circumstances, **it is therefore worth considering setting up a structure to manage the development of recycling, probably at European level**, working closely with the polymer/plastics industries, to enable better cross-functional support for recycling (project assistance, use of recycled materials) and to manage the compliance of recycled materials as a function of uses (see Fig.5). Moreover, this will also prevent the compartmentalization of recycling activities in each consumption sector. **EPR policies could then focus solely on collection and sorting upstream, essential operations that depend more specifically on consumption sectors**.

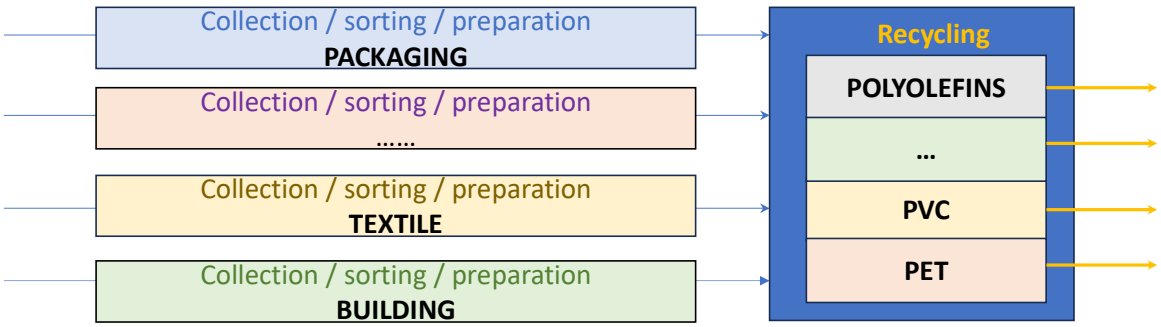

Figure 5: *possible evolution of plastic recycling management as a function of industries and polymer*

Mass Balance, control of recycled material labeling and import

There is an urgent need for methods to trace the quantities of recycled material produced. The implementing decree of the SUPD relating to mass balance is therefore eagerly awaited. It will need to be confirmed and aligned with upcoming regulations, such as the PPWR.

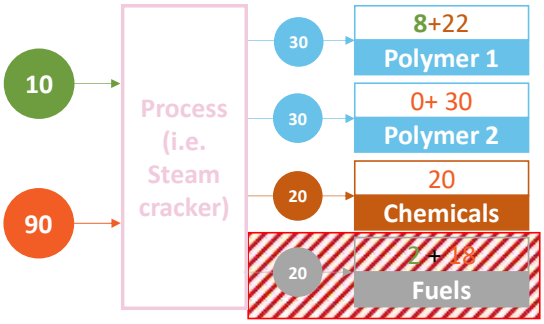

Figure 6: *Mass balance accounting with fuel exempt*

The circular economy fits naturally within a local framework. It is therefore necessary to promote the integration of the entire recycling chain within the European framework (from waste collection to the integration of recycled materials into industrial production) wherever possible.

In order to claim a designation of recycled material content, it is essential to establish certifications and control methods, particularly for tracking the source (geographical, sector), content, and composition of recycled material through to its re-use. Imports of recycled materials must be subject to controls or certifications to ensure that their production quality is equivalent to that achieved in Europe.

Plastic materials, once formulated, are complex materials, sometimes requiring lengthy and highly sophisticated analysis methods to characterize them. To these ends, **research efforts must now be supported to develop methods and tools for:**

- **testing the composition of plastics more quickly and efficiently**
- **differentiating and quantifying the recycled materials used in their composition.**

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