Brussels, 07 October 2025

Dissolution Recycling of Plastic Waste: Why it matters

1. Introduction to Dissolution Recycling

Plastic waste remains one of the most pressing environmental challenges of our time, with traditional recycling methods often falling short in addressing complex, contaminated, or multi-material streams. As the European Union intensifies its push toward a circular economy, **dissolution recycling** emerges as a promising solution that bridges the gap between mechanical and chemical recycling. This white paper explores the principles, applications, and policy landscape surrounding dissolution recycling, highlighting its potential to unlock new value from plastic waste while aligning with EU sustainability goals.

a. Definition and key principles

Dissolution Recycling (DR) is a recovery technology for polymers from plastic waste and other polymer containing feedstocks, using solvent-based physical separation processes, which keep polymer chains intact. No chemical reactions are taking place. The solvent is used as a liquid processing aid to purify specific polymers in plastic waste and can be reused. Two different processes exist, which in some cases can occur simultaneously:

- **Process 1**: Dissolution purification of a target polymer (also referred to as "Extraction"), selectively removing that polymer from a mixture. This mixture may be homogeneous, such as a blend of compatible polymers, or heterogeneous, such as a composite or multilayer material composed of chemically or physically distinct components. The process leverages differences in solubility to isolate the desired polymer while leaving other constituents undissolved. The solvent dissolves only the desired polymer, leaving other materials undissolved.

- **Process 2**: Dissolution treatment of a target polymer (also referred to as "Washing"), selectively removing unwanted materials (contaminants) from a heterogeneous mixture (polymer composite) or homogeneous material streams with contaminants by dissolving or extracting unwanted materials from the target polymer/plastic. Washing of plastic waste (with water) is a common pre-treatment and it is not unique to dissolution recycling. In the context of dissolution recycling however, the use of organic solvents makes the removal of contaminants more selective.

Process 1 involves using a solvent to separate and recover specific types of plastic from mixed waste, while Process 2 focuses on removing contaminants from a plastic material using solvents.

b. Purpose within the EU Waste Hierarchy

Within the framework of the EU Waste Hierarchy, DR is considered as physical recycling, contributing directly to the circularity of plastics. As the EU moves towards more sustainable waste management, all recycling technologies, mechanical, dissolution, and chemical, will play complementary roles in addressing different types of plastic waste and achieving different quality standards of recycled materials. Physical recycling processes keep the polymer chains intact and therefore allow a preparation for reuse of this valuable engineering material.

Dissolution recycling enables the recycling of complex and/or contaminated plastic waste streams. Therefore, it can help divert polymeric waste from incineration or landfill, in line with the EU's objectives on waste prevention and resource retention.

Positioned as a solution that complements existing technologies, dissolution recycling maximises the quality and quantity of recyclate output and thus can play a strategic role in achieving the future EU's recycling targets and advancing plastics circularity. All recycling categories and their indicative environmental impact are illustrated in the scheme below.

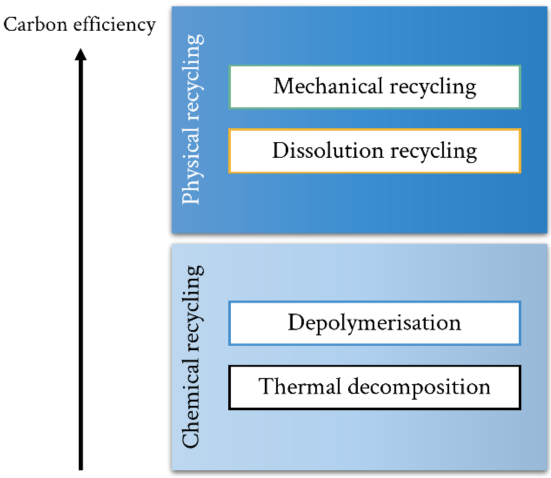

Figure 1: Evaluation of carbon efficiency for recycling technologies based on the actual state-of-the-art (2025).

c. A Simplified Overview of the 2 Process Types

Polymer-targeted **dissolution purification**, which is the more widely implemented DR process, based on extraction, exploits the selective solubility of thermoplastic polymers in specific solvents. More than two-thirds of all polymers produced globally are thermoplastics, which can be repeatedly melted and reshaped. The remaining fraction consists of thermosetting polymers, which are crosslinked and can only undergo thermal decomposition rather than remelting.

After the plastic waste has been pre-processed (e.g. separated, washed, size reduced), it is dissolved in a solvent:

- The target polymer (e.g., PE, PP, PS, PA, PC, PVC, PET, etc) dissolves into the solvent, forming a homogeneous polymer solution.
- Many contaminants (e.g., pigments, fillers, other polymers, stabilisers, or degradation byproducts) remain undissolved. This allows for a physical separation of the desired polymer from various unwanted insoluble substances by filtration.
- The target polymer is then precipitated from the solution (by different methods) and can be collected in a very pure form while soluble contaminants (additives, polymer degradation products, etc.) remain in the solution that is separated and undergoes further processing, including solvent recovery.

The target polymer in the waste stream dissolves into the solvent,
insoluble contaminants are removed while the polymer remains dissolved. The polymer solution has a sufficiently low viscosity to enable the application of conventional separation methods such as filtration.

The temperature and/or pressure are adjusted so that the polymer precipitates. The clean polymer is recovered from the solution, separating it from the solvent and remaining soluble impurities.

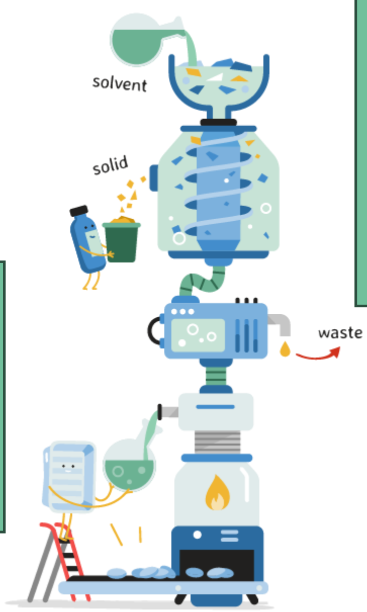

Figure 2: Dissolution purification process.

In some cases, the dissolution process involves two stages: in the first stage, soluble contaminants are removed while the polymer remains insoluble. In the second stage, the temperature and/or pressure are adjusted so that the polymer becomes soluble in the solvent, while the remaining contaminants stay insoluble. This 2-step process is relevant for semi-crystalline polymers for example.

Dissolution treatment of a target polymer is a "washing" pre-treatment method, that selectively removes unwanted materials and substances from a heterogeneous mixture by dissolving or extracting unwanted materials, which are soluble in the chosen solvent, from the target polymer/plastic.

The plastic waste is treated with a solvent that selectively dissolves impurities and additives, while the target polymer remains solid.
The contaminated solvent is separated from the polymer through filtration or decantation.
The polymer is recovered in its original form, now free from soluble contaminants, and the solvent is regenerated.

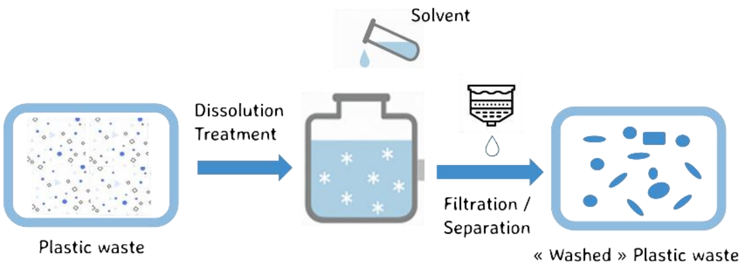

Figure 3: Dissolution treatment process.

2. Technology in practice: application by waste stream

a. Packaging: reaching food contact grade

Dissolution recycling offers a purification route for post-consumer plastic packaging waste, enabling the recovery of polymers with high levels of purity. This is particularly relevant for applications that demand strict quality standards, such as food contact materials, cosmetics, toys and others, as the process can remove non-intentionally added substances (NIAS).

During processing, pre-processed packaging waste containing target polymers like PE, PP, PS, ABS, PA, PC, PVC or PET, is subjected to a solvent-based treatment that selectively dissolves the intended polymer. Unwanted components, such as inks, additives, and barrier layers, remain insoluble and can be separated. The purified polymer can then be precipitated, recovered, and reprocessed.

The output material could meet the technical and regulatory requirements for food contact use. Therefore, the technology has the potential to be applied under Regulation 2022/1616 after approval. This supports the production of high-quality recyclates from packaging waste, contributing to material circularity.

b. Electronic and electrical equipment: valorising contaminated feedstock

Plastic waste from electronic and electrical equipment (EEE) is typically complex, containing additives, fillers, and legacy substances. Dissolution recycling enables the targeted extraction of polymers from these mixed plastic streams while separating and removing unwanted chemicals such as brominated flame retardants regulated under the POPs Regulation.

In this application, polymers such as acrylonitrile butadiene styrene (ABS), polycarbonate (PC), or high-impact polystyrene (HIPS) are selectively dissolved and separated from contaminants. The process can be tailored to accommodate the variability of feedstocks, to recover valuable materials like metals, pigments, fillers, and to remove the targeted chemicals.

By enabling the recovery of clean polymers from contaminated or additive-rich waste fractions, dissolution recycling contributes to the efficient management of EEE by preparing polymers for reuse, that today are directed to incineration.

c. Automotive Industry

Plastic waste derived from End-of-Life Vehicles (ELVs) presents a significant recycling challenge due to its heterogeneous composition. These waste streams often contain complex composite materials, including a variety of thermoplastic polymers such as polypropylene (PP), polyamide (PA), and polyurethane (PU), which are frequently combined with fillers, reinforcements, and legacy additives. The presence of such additives, particularly some restricted halogenated flame retardants, often leads to incineration.

Dissolution recycling offers a solution by enabling the selective solubilization of target thermoplastic polymers from ELV waste matrices. Through the use of tailored solvents and process conditions, this method can effectively separate polymers from non-polymeric components and hazardous additives. For example, flame-retardant-laden plastics can be treated to isolate clean polymer fractions while removing regulated substances such as brominated flame retardants, in compliance with the Stockholm Convention and the EU POPs Regulation.

By recovering high-purity polymers suitable for reuse in similar or identical applications, dissolution recycling not only diverts ELV plastics from incineration but also supports circularity in the automotive sector. This approach enhances resource efficiency and contributes to the sustainable management of ELV-derived plastic waste, aligning with broader goals of reducing environmental impact and conserving material value.

d. Building & Demolition Industry

Plastic waste from building and demolition waste (B&D) often contains thermoplastics contaminated with legacy additives such as brominated flame retardants (from insulation materials) and phthalate plasticizers (from flooring) or heavy metals such as lead and cadmium, that are now all restricted under specific regulations. Dissolution recycling offers a targeted solution by selectively dissolving polymers such as PVC or XPS from complex waste matrices, enabling the separation of the polymer from these undesired substances without altering its chemical structure. The process can be tailored to accommodate the variability of post-consumer construction waste and to isolate specific contaminants.

Additionally, DR can support the building and construction sector by enabling the recovery of polymers from additive-rich materials that are currently excluded from circular use. This aligns with the objectives of the upcoming Construction Products Regulation (CPR), which is expected to introduce recycled content targets and stricter sustainability requirements for construction materials.

By recovering purified polymers from additive-rich fractions, dissolution recycling enables the reintegration of materials that are currently excluded from circular use, reducing reliance on incineration or landfill and supporting the transition to a more resource-efficient construction sector.

3. Unlocking the potential: benefits and considerations

a. Environmental and economic opportunities

Dissolution recycling offers a strategic pathway to increase the volume and quality of recycled plastics, particularly from waste streams that are currently considered as unrecyclable. By enabling the recovery of polymers from complex or contaminated sources, dissolution recycling contributes to reducing the reliance on virgin materials, conserving resources, and lowering greenhouse gas emissions associated with plastic production.

The environmental benefits are matched by growing economic potential. Dissolution recycling creates value from waste fractions that may otherwise go unused or be destined for low-value applications. It supports the production of more (high quality) recyclates, which can serve demanding markets such as packaging, automotive, electronics, or construction. As demand for high-quality recycled plastics increases in line with recycled content targets (e.g. PPWR, ELVR), dissolution technologies are well-positioned to meet this need.

b. Benefits of the technology

Dissolution recycling offers several key advantages that make it a valuable solution for advancing plastics circularity. The process achieves a high yield with plastics waste, as it preserves the polymer chains and enables efficient recovery from complex or contaminated waste streams under relatively mild conditions. The quality of the output is another major benefit as recovered polymers retain their physical properties and can meet the requirements of relevant product legislation, including standards for food contact. Additionally, the physical nature of the process allows for physical traceability of the material throughout the recycling chain (following the concept of “same in and same out”), enabling clear identification and documentation of the recycled polymer’s origin, composition, and processing history, as well as allowing compatibility with clams at product level. Recyclates produced through dissolution technologies can use the calculation method ‘controlled blending’ as full physical traceability is enabled in the process. Design for recycling is of utmost importance to enable good quality output from recycling.

c. Advancing infrastructure capabilities

To support the growth and effectiveness of dissolution recycling, it is crucial to advance infrastructure facilities across Europe. This involves not only upscaling existing recycling plants but also establishing new facilities equipped with state-of-the-art dissolution-based technologies. By doing so, the capacity to process plastic waste efficiently and produce high-quality recycled polymeric materials is enhanced. An advantage of dissolution recycling in terms of infrastructure is its compatibility with existing supply chains, polymer processing facilities, and waste collection systems, as it is a polymer-to-polymer recycling method.

This approach does not compete with existing physical recycling technologies such as mechanical recycling. Instead, it complements them by intervening at the point where mechanical methods reach their limitations. It enables the application of various physical separation techniques, which are well-established in the processing of other materials, to polymer blends, composites, and multilayer structures, thereby expanding the scope of recyclable plastic materials. Importantly, mechanical recycling, dissolution-assisted treatments (e.g., washing), and full dissolution recycling all belong to the same category, Physical Recycling, and together they open new segments of polymeric plastic waste that can be prepared for reuse as recyclates.

Several ongoing projects across Europe are already paving the way for this transformation. These initiatives are spearheaded by industry leaders and supported by collaborative efforts. A map highlighting key projects that are contributing to the advancement of dissolution recycling infrastructure is presented in Table 1.

Table 1: Current and future dissolution plants in Europe, classified by location, company, polymer and year of start-up.

Year	Location	Dissolution plant(s)	Country	Resin
2019	Merseburg	LyondellBasell	Germany	LDPE, PE/PA
2021	Freising	Fraunhofer-Creacycle	Germany	PVC, multilayer, PS
2022	Grevenbroich	LÖMI/GAW	Germany	PE
2023	Terneuzen	Trinseo	Netherlands	PC
2023	Génissieux	Polyloop	France	PVC
2024	Rotterdam	Obbotec - SPEX	Netherlands	HDPE, PP/PET/Alum, PP/LDPE/copper
2024	Pfinztal	Fraunhofer-ICT	Germany	PE, PP, PS, ABS, PVC, PC, PA, PET, PLA, composites pack., ELV-WEEE
2025	Terneuzen	PS Loop	Netherlands	PS
2025	Rijswijk	TNO, Mobius, Braskem	Netherlands	PE, PP, ABS
2027	Livingston	Reventas	United Kingdom	HDPE
2028	Antwerp	PureCycle	Belgium	PP
2030	Jemeppe-sur-Sambre	INEOS	Belgium	PVC

4. Policy and Regulatory Framework in the EU

a. Policy recommendations to support deployment

To effectively deploy DR across Europe, several key policy recommendations must be implemented.

Dissolution Recycling (DR) should be formally recognized as a distinct technology within recycling frameworks. More broadly, there is a need to establish "Physical Recycling" as a separate category for processes that preserve the chemical structure of polymers and produce recyclates as output. This category includes mechanical recycling, dissolution recycling, delamination, and melt-filtration, all of which rely on physical separation rather than chemical transformation.

The DR process involves selectively dissolving polymers from plastic waste in organic solvents to remove contaminants and recover high-quality polymers without involving chemical reactions. Therefore, it should not be confused with chemical recycling, which decomposes polymers into monomers or solid, liquid and gaseous feedstock molecules through chemical reactions. Unlike mechanical recycling, which involves shredding and extrusion but does not selectively dissolve polymers to remove contaminants, DR offers a unique method for obtaining high-quality recyclates. Thus, it should be distinctly categorized to ensure appropriate regulatory support and recognition.

Dissolution recycling is well-aligned with emerging regulations such as the Packaging and Packaging Waste Regulation (PPWR) as it can contribute to the recycled content targets with high recyclate yields. DR can reduce the concentration of hazardous substances, ensuring compliance with REACH and the POPs Regulation.
Furthermore, dissolution recycling can be integrated into existing waste management infrastructure, making it possible to maximize the use of current systems. It expands the scope of mechanical recycling by enabling the processing of polymer blends and composite materials that cannot be recycled today.

By adopting these policy measures, Europe can accelerate the transition to circular plastics. Deployment and recognition of dissolution recycling can act as a key enabler in achieving the EU Green Deal, the Circular Economy Action Plan, the Clean Industrial Deal, and a more sustainable plastics economy.

b. Call for harmonised standards

To fully realize the potential of dissolution recycling, it is imperative to establish harmonized standards across the European Union. However, its widespread adoption is hindered by the lack of standardized guidelines and regulatory frameworks, as well as lack of scientific recognition and awareness.

We call upon policymakers, industry stakeholders, and regulatory bodies to recognize dissolution recycling as a viable and essential recycling technology. Harmonized standards will also facilitate collaboration and create a level playing field for all market participants. However, dissolution recycling has been prominently absent from key industry standards, such as ISO 15270:2008 ("Plastics – Guidelines for the recovery and recycling of plastic waste") and EN 17615:2022 ("Plastics – Environmental Aspects – Vocabulary"). This omission may be interpreted as a form of market exclusion, potentially hindering innovation and the broader adoption of advanced recycling technologies.

Dissolution recycling currently operates in a regulatory and definitional grey area, both within the EU and internationally. There is no clear, harmonized definition that adequately reflects its distinct characteristics and technological potential. It is sometimes even classified as chemical recycling or described as the only physical process for polymers.

The absence of regulatory clarity creates a substantial barrier to investment. In the absence of a clear and harmonized legal framework, companies active in the circular economy are discouraged from committing significant, strategically aligned resources to the development and scaling of dissolution recycling. Establishing legal certainty would foster investor confidence and accelerate the deployment of dissolution recycling. A coherent and supportive regulatory framework is essential to enable industry stakeholders to allocate resources effectively and to scale innovations that are critical for meeting Europe's climate objectives and advancing resource efficiency.

Notably, work is underway at the international level to address this gap. ISO Technical Committee 61 (TC61) / Subcommittee 14 (SC14) is effectively reviewing ISO 15270, with a new focus group ISO 15270 3a, Physical Recycling. This group of experts aims to formally define all known physical polymer recycling processes additional to mechanical recycling, including dissolution recycling (based on the well-known "extraction" separation method, also called dissolution purification).

Now is a pivotal moment: as standard sections such as ISO 15270-3 are still under development, European stakeholders have an opportunity to shape global definitions and ensure that dissolution recycling is recognized as a distinct and valuable polymer recycling pathway in the category/class "physical recycling" within the broader circular plastics economy.

5. Conclusion

Dissolution recycling represents a transformative approach within the EU circular economy, offering significant advancements in the management and valorisation of the polymer engineering materials in plastic waste. By integrating this technology, we can achieve higher purity levels in recycled polymers, making them suitable and reusable as recyclates for demanding applications such as food contact packaging, automotive and electronic equipment. The environmental and economic benefits are substantial.

To conclude, dissolution recycling involves:

- Achieving high purity recyclates, suitable for sensitive applications, and with high yields.
- Decontamination processes compatible with REACH and the POPs regulation.
- Physically traceable recyclates enabling compatibility with claims at product level.
- Enabling the recovery of polymeric waste streams that are currently classified as non-recyclable.
- Creating new market opportunities and driving economic growth.
- The requirement for advancements in infrastructure capabilities.
- The need for robust policy support and harmonised standards across the EU and globally.

As we move forward, fostering innovation and collaboration among stakeholders will be essential. Dissolution recycling will help drive progress towards a greener and more sustainable future, addressing both environmental and economic challenges effectively.