Circular Packaging

Insights into legislation and regulation

TNO innovation for life

Towards a robust European circular plastic value chain

Circular Packaging

Packaging waste regulation

To transition to a circular plastics economy, we must start by questioning whether packaging is necessary. Our motto is “rethink before recycling". At TNO, we take a systemic approach to facilitate the circular plastic transition: including all r-strategies on the R-ladder and involving the entire packaging chain, including consumers. We aim to prioritize the r-strategies with the most impact like refuse, reduce and reuse.

To promote circularity in plastic packaging, policy and regulation is needed, such as the EU’s Packaging and Packaging Waste Regulation (PPWR). In the article below, we take a closer look at the regulatory landscape, the barriers to implementation, and the practical steps needed to advance circular packaging.

Packaging and Packaging Waste Regulation (PPWR)
The EU aims to achieve a fully circular economy by 2050. Circular plastics can only be realized by taking a systemic approach and applying all r-strategies. This includes replacing virgin plastics with circular and/or biobased polymers and reduction of (packaging) waste.

To address this, the EU introduced the PPWR in November 2022; these measures have to be implemented on 12-08-26.

Following a transition period, the PPWR stipulates that by 2030:

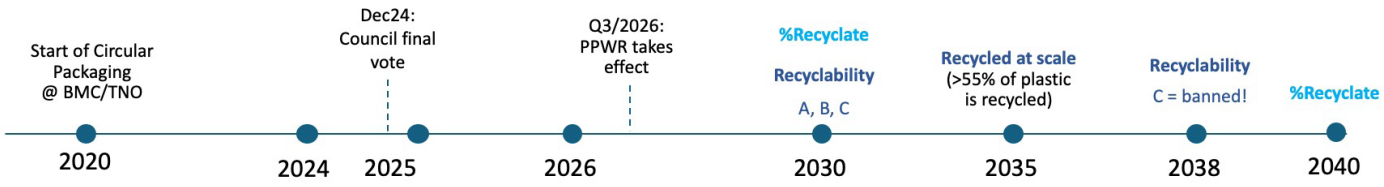
- Packaging waste is prevented and reduced;
- The amount of recycled or bio-based plastic in packaging is (safely) increased;
- The sector is on track to climate neutrality in 2050;
- Application of virgin material in packaging is decreased;
- As of 2035 all packaging must be recycled at scale.

To reach these objectives, new rules will be implemented, including:

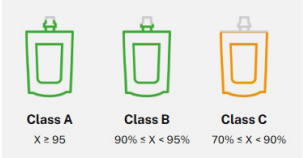
- Packaging must be minimised in both weight and volume;
- Depending on the type of packaging, **10 to 30% recycled content** must be incorporated;
- Restrictions on certain Single-Use Plastics.

CIRCULAR MATERIAL TRANSITION

PACKAGING & PACKAGING WASTE REGULATION



Recyclability



Source: RecyClass

%Recyclate

Type	2030	2040
PET contact sensitive packaging, excl. single-use plastic bottles	30%	50%
Non-PET contact sensitive packaging, excl. single-use plastic bottles	10%	25%
Single-use plastic beverage bottles	30%	65%
Other plastic packaging	35%	65%

Note: Derogations are foreseen for contact sensitive packaging, dangerous goods, and medical.

Regardless of the pace or manner of implementation, these regulations will impact the entire packaging value chain: from raw material producers to packaging manufacturers, brand owners, sorters, recyclers, consumers and all other stakeholders. What challenges lie ahead, and what solutions are within reach?

CHALLENGES AND SOLUTIONS

1. Price
The chemical sector in Europe is under pressure, facing stiff competition from low-cost plastics produced in Asia and the United States. The price of recycled plastic is often higher than that of virgin plastic derived from fossil sources.

Solution:
The European Commission (EC) should implement strict rules regarding the import of cheap and untraceable virgin and recycled plastic from Asia and the United States. These rules can include traceability of origin or minimum requirements regarding sustainable and social impact.
Furthermore, the EU can help in reducing costs of recyclate production. E.g. by subsidising energy prices or implement standardisation of design to reduce the complexity of the processing steps.
Finally, the EU can take measures by increasing tax on virgin plastics or ban/tax waste incineration.

2. Availability of high-quality recycled plastic
Forecasts indicate that by 2030, there will be insufficient supply of high-quality recycled plastic to meet demand. The core issue lies in the business case and future investments. Lack of standardization in packaging design and fragmented waste management results in high processing costs to produce high-quality recyclate.
Combining this with low virgin and recyclate prices in Asia and the US leads to a low-profitable business. Changing policy and an unclear future outlook on changing these challenges, hampers the development and scaling of necessary technologies and limits recycling capacity. Recyclers are willing to scale up but cannot compete with cheap, high-grade virgin plastics from Asia and the US.

Solution:
Legislation should promote the quality of recyclate by implementing guidelines for standardization of product design (design for circularity) and by encourage investment in optimized waste sorting and discourage incineration and export of plastic waste.
A higher priority must be placed on mandating the use of recycled content in packaging and on simplifying the recovery of packaging materials for recycling.

Developing a product passport can also help ensure that virgin materials are not falsely marketed as recycled. Since the PPWR favours recycled content, there is a financial incentive to mislabel materials. This risk must be mitigated through technical verification tools.

3. Limits on recyclate use in food and healthcare packaging
Another major challenge is that the use of recyclate in contact-sensitive packaging is highly limited under current EFSA (European Food and Safety Authority) regulations, which significantly limits its applicability in food and cosmetics sectors.
Limited recycling technologies and polymers (mechanical recycling of PET) are approved to be applied in contact-sensitive packaging. Approval of new recycling technologies take a very long time, hampering innovation.

Solution:
To accelerate the availability of high-quality recycled materials for contact-sensitive packaging, advanced recycling technologies are needed including a timely assessment by EFSA which is essential to ensure their swift integration into the market.

4. Changing functional properties
Incorporating recycled content can alter the functional properties of plastics, such as, for instance, the sealing performance and the tear resistance. It can also lead to less consistent and predictable processability resulting in quality issues in high-end applications, in particular for contact sensitive packaging where strict quality standards and EFSA regulation apply.

Converters and producers often struggle to find recycled materials with the right specifications and formulations must be adjusted. The development and testing of these new recipes take time and money.

Solution:
All parties in the value chain from polymer producers, converters, to recyclers must collaborate to establish a circular plastic value chain with the right quality. New cooperations and business models need to be explored to determine which investments are both economically viable and sustainable. Life Cycle Assessments (LCAs) or scenario analyses can support this process.

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5. Biobased materials
Replacing fossil-based polymers with biobased polymers for packaging is another way to fullfill the requirement for the incorporation of recyclate into packaging. The availability of biobased polymers is low and, with some exceptions, replacement of fossil-based plastics is not straightforward.

Solution:
Focus the development of bio-based polymers on advanced specialty functional materials, with a high-value and low-volume, to create a bio-based platform that can be expanded to higher-volume applications at a later stage.

6. IAS and NIAS
A safety concern in plastics lies in the presence of NIAS (Non-Intentionally Added Substances). While IAS (Intentionally Added Substances) in virgin plastics, such as monomers, colourants and additives are quite known, regulated and predictable, NIAS can arise unintentionally through degradation, reactions during production or contamination.
In recyclates this risk is amplified: residues from previous use, cross-contamination and by-products of recycling make the material's composition far less predictable.

Solution:
Analysis and risk assessment, supported by advanced screening technologies and controlled recycling streams need to be in place.

7. Acceptance
It is often said that consumers will not accept minor imperfections or variations. Therefore, brandowners and retailers are hesitant to change product design if that means altering the look and feel of the product.

Solution:
Educate and inform consumers, get them involved about design choices and how they influence the circular plastic transition.

Together, we can make a difference
As we strive towards a fully circular plastic economy, all stakeholders need to collaborate for successful implementation of innovative solutions, particularly in the scope of circular packaging. By focusing on design for circularity we can significantly reduce the environmental impact of plastics.

To support innovation and validation in this area, companies can test and develop new packaging solutions at Brightlands Circular Space in Geleen, a unique open innovation hub equipped with state-of-the-art facilities for circular plastics and sustainable material development.

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