CIRCULAR FOAM

D 8.6 Policy recommendations

Author:

Dorota Pawlucka and consortium partners

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Technical References

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Project Coordinator	Dorota Pawlucka, Covestro Deutschland AG dorota.pawlucka@covestro.com
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Executive Summary

While innovative chemical recycling solutions for rigid polyurethane (PUR) foam have been technically proven effective, achieving meaningful environmental and economic impact requires urgent coordinated policy intervention across multiple governance levels. The key recommendations include promoting a technology-open portfolio of chemical recycling solutions with regulatory acceptance equivalent to mechanical recycling, recognizing the mass balance approach for sustainability claims, establishing clear EU rules for chemical recycling recognition and supporting flexible infrastructure development that accommodates multiple complementary technologies including collection and sorting system for secondary materials and the corresponding logistics. The document stresses that proper regulations are critical for enabling the upscaling from technology demonstration to commercial deployment, enabling the circular economy transformation through an integrated systemic approach that combines enhanced waste management, eco-design, process optimization, and circular economy networks that implement reverse value chains in an economically viable manner, supported by robust data frameworks and digital traceability tools, such as digital material passports for products.

Introduction

The CIRCULAR FOAM project has successfully demonstrated solutions for building a full circular value chain based on innovative chemical recycling technologies for rigid polyurethane foam, proving the technical feasibility of transforming End-of-Life (EoL) foam from cooling appliances into high-quality recycled feedstock. However, the transition from demonstration to commercial deployment faces significant regulatory and economic barriers that require coordinated policy intervention. These policy recommendations address the full spectrum of challenges identified through the project's circular ecosystem approach. The recommendations foresee an alignment on EU, national, and regional level - recognizing that successful deployment of CIRCULAR FOAM technologies requires harmonized action from waste management regulations and technology recognition to industrial-urban infrastructure development as well as market demand creation. By implementing these prioritized policy measures, policymakers can establish the enabling conditions that are necessary to scale the CIRCULAR FOAM innovations across different EU markets, supporting both the EU Circular Economy Action Plan objectives and the transition towards a truly circular economy that keeps valuable materials in productive use while reducing dependence on virgin fossil feedstock.

Problem Statement

The European Union faces many critical waste management challenges. One of them concerns the waste streams of rigid polyurethane foam materials used in appliances, metal panels and insulation boards that are used in buildings. Currently, when these materials reach their EoL there is no viable circular economy solution, resulting in large waste streams that are sent to landfill or incineration rather than being recovered as valuable resources.

This leads to enormous environmental burdens and economic losses: one million tons of rigid PUR foam waste annually could potentially be diverted from disposal to the generation of new feedstock, with associated 2.9 million tons of CO_2 emissions that could be avoided from 2040 onwards through proper circular solutions, according to the calculations made by the consortium.

Mechanical recycling for rigid PUR foam from EoL waste is not a suitable option due structural limitations given by the material's crosslinked structure and complex composition. The absence of coordinated waste management systems, suitable collection and sorting infrastructure, information at EoL

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and innovative chemical recycling processes creates a systemic failure in closing the material loop for these valuable polymer resources.

Suitable regulatory framework conditions that prepare the ground for the development and introduction of new technologies, clear waste classifications, and sufficient market incentives would accelerate the development of circular ecosystems for rigid foam materials. Currently, the European industry is suffering from continued dependence on virgin fossil feedstock for new foam production while valuable EoL materials are wasted. This problem directly contradicts EU Circular Economy Action Plan objectives and climate neutrality goals, representing a significant missed opportunity to demonstrate industrial circular economy solutions at scale with potential to reduce carbon emissions and resource dependency in the critical construction- and appliance sectors.

The CIRCULAR FOAM project addressed this challenge by developing a full systemic solution based on innovative chemical recycling processes (chemolysis and smart pyrolysis) to obtain high-quality recycled feedstock (polyols and amines) that can be fed into the existing efficient production processes replacing fossil-based virgin materials, thereby closing the material loop for rigid polyurethane foam.

Policy recommendations for the deployment of the CIRCULAR FOAM results

The CIRCULAR FOAM innovative chemical recycling solutions for rigid polyurethane foam that were developed in the project have technically proven to be effective options. However, to achieve a breakthrough at scale with significant benefits for the environment, society and the economy requires coordinated policy interventions across multiple governance levels to facilitate successful deployment and scale-up of the technologies. This report is intended to derive policy recommendations from the results of the innovation project. Fast implementation of the following policy measures based on this report is urgent.

1. Promote technology-open portfolios of chemical recycling solutions with regulatory parity to mechanical recycling

Policymakers must recognize and support diversified chemical recycling technologies as equivalent alternatives to mechanical recycling, enabling the deployment of different complementary approaches based on waste stream characteristics.

Why this matters:

Different materials require fundamentally different recycling approaches due to their different chemical structures and properties. Polyurethane foams cannot be processed through conventional mechanical recycling because they cannot be crushed and melted like other plastics. The CIRCULAR FOAM project evaluated two different recycling technologies chemolysis and smart pyrolysis. After three years of development, it came out that only the smart pyrolysis process could fulfil the requirements for an economic and ecologic process. The research confirmed that the chemical composition and purity of the waste streams determine the choice of the optimal technology. Multiple commercial technologies must therefore be available and deployed to handle varying contamination levels effectively. Regulatory acceptance of chemical recycling with the same status as mechanical recycling is essential to enable this flexible, technology-open approach that maximizes resource recovery across diverse waste streams.

The chemical composition and the purity of the waste streams determine the choice of optimal technology.

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2. Establish legal recognition of mass balance approaches for chemical recycling

The mass balance approach—an accounting methodology that tracks and allocates materials, environmental impacts, and economic values throughout recycling systems—must receive formal legal recognition to unlock the circular economy transformation for chemical recycling.

Why this matters:

Current regulatory ambiguity around mass-balance crediting creates a critical investment barrier that prevents the deployment of technically feasible chemical recycling facilities. Legal recognition would eliminate regulatory risk, making investments bankable and creating clear value propositions for recycled products through verifiable certification that justifies price premiums.

This regulatory certainty would trigger a transformative positive investment cycle: guaranteed market demand driven by mandatory recycled content requirements; economies of scale that make circular solutions cost-competitive and systematic industrial transformation away from linear business models. The policy would directly catalyse a €8 billion investment in chemical recycling in Europe by 2030[1], creating a self-reinforcing cycle where regulatory clarity drives private investment, scales circular technologies, and transforms industrial ecosystems from extractive linear models to regenerative circular system.

The mass balance approach is needed as the feedstock which is provided by chemical recycling will initially only be a fraction of the feedstock from traditional sources and needs to be processed in the same world-scale plants to ensure minimization of cost and facilitate acceptance by customers by moderate premiums for recycled materials.

3. Mandate design for circularity requirements and digital material passports (DPP) for products

Policymakers must encourage design for circularity coupled with digital material documentation systems to enable optimal material recovery and quality in recycling processes.

Why this matters:

Early design decisions for both materials and products represent cost-effective intervention point in the circular economy. Without proper design for circularity, advanced recycling technologies cannot achieve cost-efficient material recovery and feedstock quality, fundamentally limiting circular material flows.

Design decisions made during product development determine the effort needed for future disassembly and therefore determine the potential for recycling. Products and materials designed for circularity reduce virgin material use, minimize environmental impact, and enable companies to meet increasing EU regulatory and customer demands for circular products, including product-level data requirements introduced through DPP frameworks. Proper design reduces material stream complexity and improves recovered PUR quality, ensuring circular material flows throughout value chains.

Currently, material composition data for EoL material is usually unavailable or hard to access, unreliable, and fragmented—particularly in construction materials but also for materials used in appliances, highlighting the need for harmonised and standardised data systems. Unknown additives, such as

[1] Plastics Europe estimates that planned chemical recycling investment in Europe will grow from €2.6 billion in 2025 to €8 billion by 2030 (see press release)

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flame retardants, risk contaminating entire recycling batches when the composition of the material is unclear.

Products designed for disassembly enable efficient parts replacement and repair before recycling, extending product lifespans and reducing waste management costs. A clear and accessible documentation of material composition and suitable dismantling procedures, made available through interoperable digital traceability systems and product passports, enables more effective sorting and recycling processes. The CIRCULAR FOAM project's QR-code systems linked to blockchain technology demonstrate how stakeholders can communicate material data anonymously while maintaining control over data sharing, enabling access to material information for high-quality recycling throughout 10–50-year product lifecycles.

4. Establish optimized collection and sorting systems

Policymakers must mandate the realization of a separate collection of insulation materials from the demolition of buildings to make the further processing of this material economically viable. While the collection and dismantling of appliances is highly developed in many countries, collection systems for insulation materials from demolition are rarely existing.

Why this matters:

Collection and sorting systems are critical elements of the circular solution for end-of-use insulation foam that determine both the quality and quantity of materials available for recycling while directly impacting the economic viability of the entire value chain.

Significant cost reductions can be achieved by optimizing the initial collection, conditioning, and logistics processes—such as separate collection of insulation foam at demolition wastes, pre-compressing materials on-site and creating additional revenue streams for by-products. These processes can be improved through data availability at EoL, where stakeholders can better allocate resource by having information on their characteristics and determining the best process and further use. Saved incineration costs when collecting and recycling polyurethane foam contribute to the economic incentives for improved collection systems.

5. Support circular value chains

Policymakers must support the realization of infrastructures, e.g. by providing space and permissions for recycling facilities, collection and sorting systems, by supporting the realization of demonstration facilities and by creating favourable conditions for businesses.

Why this matters:

Circular economy transformation requires synergistic approaches because the transformation of entire value chains from linear to circular is not possible when only some elements are addressed.

Support of complete demonstration systems consisting of waste sorting and processing and recycling facilities is needed to ensure that the technical risk of all relevant technologies is reduced, and the overall solution is optimized with respect to cost and environmental footprint.

Fiscal mechanisms should be used to support the setup of recycling systems for insulation materials from demolished buildings because the costs of collection and separation are relatively high. One option would be to add a levy on new insulation material that finances the collection and separation of EoL material as it is done for cooling appliances. This levy could be dropped for insulation material

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from recycled or bio-based feedstock to create a price incentive for the consumers to use insulation material from recycled or bio-based feedstock. In case such measures are implemented, care must be taken that all insulation materials, not only polyurethane foams, are charged in a fair manner, reflecting the effort needed to avoid incineration or landfilling of EoL materials.

6. Implement comprehensive communication and systematic awareness raising

Comprehensive communication campaigns should influence consumers to prioritize products with recycled polyurethane content and to collect rigid foam waste from small renovation activities, as the volume of waste is critical for achieving the scale needed for economically viable recycling operations for these materials.

Why this matters:

Awareness raising campaigns can help to unlock the full potential of polyurethane foam circularity, addressing two critical concerns of consumers. First, consumers must be convinced to accept products containing recycled polyurethane content, without fear of contamination and reduced performance compared to foam from the fossil production route and prefer it because of the lower CO_2 footprint. This requires transparent labelling, data sharing and clear quality standards that build trust and counter greenwashing concerns. Second, not taking end-of-use cooling appliances to certified collection points must become socially unacceptable throughout Europe and the citizens must be convinced to collect insulation foam also from smaller construction activities and take it to specialized collection points.

7. Establish harmonized multi-level governance frameworks with coordinated EU, national, and regional circular economy policies

Policymakers must create synchronized policy frameworks across EU, national, and regional levels that align regulations, harmonize market mechanisms, and coordinate infrastructure development to eliminate policy fragmentation and maximize circular economy synergies. This also applies to public funding mechanisms and priorities to derisk private investments.

Why this matters:

Policy fragmentation across governance levels creates regulatory uncertainty, market barriers, and inefficient resource allocation that prevents the systemic transformation required for circular economy success.

- **EU level: Regulatory alignment and market creation**

EU policymakers must ensure effective translation of EU regulations into national laws by clarifying the extended producer responsibilities and EoL status definitions to distinguish between waste and raw material classifications. The permitting of trans-border transports of secondary resources to trusted treatment centres must become more efficient. Digitalisation can make a significant contribution here.

- **National level: Implementation support and market development**

National policymakers must observe and translate EU regulations into coherent national frameworks, coordinate implementation across ministries, and prevent conflicting regulations between governance levels. Tax reforms promoting recycled products, long-term public procurement contracts for recycled plastics, supporting national circular business models and standardized permitting processes for circular economy facilities are essential.

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- **Regional level: Infrastructure and collaboration**

Regional authorities should increase the support for circular economy activities at industrial scale and the necessary investments in their area. This includes streamlined permitting processes, co-funded demonstrator facilities and planning approaches that connect collection, processing and distribution networks. Regional investment mechanisms should support these integrated systems to prevent fragmented development that creates operational inefficiencies and market access barriers.

Conclusion

The CIRCULAR FOAM project has successfully demonstrated the technical feasibility of chemical recycling technologies for rigid polyurethane foam, proving that innovative solutions, such as chemolysis and smart pyrolysis can transform EoL foam into high-quality recycled feedstock equivalent to virgin materials. However, achieving breakthrough deployment at scale requires urgent, coordinated policy intervention across multiple governance levels to overcome the "valley of death" between technical feasibility and commercial deployment. The project identified that regulatory frameworks are the essential catalyst for market transformation, necessitating a comprehensive systemic approach that integrates technology-open chemical recycling portfolios with regulatory parity to mechanical recycling, mandatory separate collection systems, harmonized waste classification enabling cross-border transport, Digital Product Passport implementation, and market demand creation through public procurement and economic incentives. Fragmented single measures are insufficient - successful circular economy transformation demands synchronized action spanning EU-level waste management regulations, national funding mechanisms and tax reforms, and regional infrastructure development, supported by enhanced stakeholder awareness and acceptance of the potential of chemical recycling to replace fossil-based virgin materials. The urgency of implementing these policy recommendations is underscored by the possible significant environmental and economic benefits - including potential reductions of 1 million tons of waste and 2.9 million tons of CO_2 emissions annually by 2040. To realize this potential, coordinated and unbiased political action on all levels is required.

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