PROJECT

POLREC

EURO CLUSTERS

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D2.5
Report on results of completed chemical recycling projects



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Glossary of terms, abbreviations, and acronyms

Partner short name	Partner	Country
POL	Polymeris	FR
CEN	Centro Tecnológico da Indústria de Moldes, Ferramentas Especiais e Plásticos	PT
MAV	Clúster de Materials Avançats de Catalunya	ES
PCD	Plast Center Danmark	DK
WFG	Wirtschaftsförderung Raum Heilbronn GmbH	DE

Table 1: List of partners

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The POLREC project is funded by the European Commission Joint Cluster initiatives for Europe's recovery (Euroclusters) under the Single Market Programme (SMP COSME) grant agreement number 101074434. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or EISMEA. Neither the European Union nor the granting authority can be held responsible for them.

1. Introduction

The POLREC project is a collaborative initiative involving five European clusters, as listed in Table 1. Its primary focus is on promoting sustainable development and the recycling of both high- and low-value polymers, contributing to the goals of the European Green Deal. Specifically, the project supports the ambition of achieving net-zero CO_2 emissions by 2050 and enhancing European strategic autonomy in sourcing raw materials for polymer production.

Over a three-year period, the POLREC consortium investigated how intensified cross-border and cross-sector collaboration among clusters and business networks could help address these environmental challenges. The aim was also to leverage the international business opportunities associated with polymer recycling.

Aim and Scope of the Innovation Open Call

One of the project's central actions was the launch of the POLREC Innovation Open Call, designed to financially support small and medium-sized enterprises (SMEs) with ambitions to reduce the environmental impact of their products. The call specifically targeted companies committed to shifting from traditional disposal methods - such as incineration and landfilling - to more sustainable solutions, including mechanical and chemical recycling of polymer waste.

To further support this transition, the call encouraged the integration of digital tools, as well as the development of improved mold designs and processing aids to optimize the handling and transformation of recycled polymers.

Implementation of the Open Call

Among several planned initiatives, one central activity was the organization and implementation of the open innovation call offering financial support for mechanical and chemical recycling projects. This was designed to stimulate innovation and adoption of best practices across the SME community.

This document constitutes POLREC Deliverable D2.5 – Report on Results of Completed Chemical Recycling Projects. The document includes the main steps of the open innovation call but is concentrated on the Chemical Recycling Projects:

Presentation of the Innovation Open Call – Chemical Recycling

- Preparation of the call
- Launch of the Innovation Open Call
- Evaluation and selection of projects for funding

Summary of Project Outcomes

- Project findings (presented in tabular format)
- Experiences learned during implementation
- New business opportunities
- Future work planned
- Feedback on the POLREC funding support scheme
- Conclusion and reflections on impact

The results of the mechanical recycling projects have been reported in a separate document, named POLREC Deliverable D2.3.

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2. Presentation of the Innovation Open Call – Chemical Recycling

In this call the applicant could apply for a sub-grant targeting the testing of a recycling solution for chemical recycling of plastic or rubber waste, which is presently not being recycled or not recycled effectively.

Any kind of chemical or biotechnological recycling process could be selected. Moreover, any process improving the use of recycled material could be chosen. The desired service-provider(s) and an estimate of the cost for recycling the waste had to be indicated in the application.

The applicant could either indicate their selected service-provider(s) or choose one from the list of service-providers identified by the POLREC partners that was published on the POLREC partners' sites or in the POLREC deliverable: D2.2 Mapping of European plastic waste streams and of European plastic recyclers (see figure 1).



Figure 1: D2.2 Mapping of European plastic waste streams and of European plastic recyclers

The sub-grant allocated should cover part of or the total cost of the service-provider(s). No other expenditure could be covered by the sub-grant.

2.1 Preparation of the POLREC Innovation Open Call

To initiate this work a package of working documents and procedures were developed by the POLREC consortium:

- Application form for the grant
- Guide for applicants
- Evaluation chart
- Sub-grant agreement
- Template for Work Plan

- Online interim interview at mid-term of the project period
- Template for Final Technical Report
- Final review of the technical report forwarded
- Payment documents related to payments in two rates

2.2 Launch of the POLREC Innovation Open Call

The POLREC Innovation Open Call was open from 1 September to 7 November 2023. As sufficient applications were received, a second call was not needed.

SMEs could apply for up to €30,000 per project (maximum €60,000 per SME) based on quotations from service providers. Funded activities had to contribute to reducing CO_2 emissions by lowering the use of fossil-based raw materials.

2.3 Evaluation and Selection of Projects

An evaluation process was established where each application was reviewed by two POLREC partners from different countries. Applications were scored on criteria such as network participation, green business and innovation potential, scientific and technical quality, organisational capacity, scalability, and contribution to the European Green Deal.

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3. The awarded and implemented projects

Within the Chemical category, all 9 projects were completed in full. The distribution of the completed projects by country was as follows:

- France: 3
- Spain: 3
- Portugal: 1
- Denmark: 2

All projects came from countries included in the POLREC partnership.

All projects were fully completed by the end of August 2025.

Please see table 2 for further details.

Completed chemical projects					
No.	**Company Name**	**Country**	**Name of Project - Application**	**Project start**	**Project end**
1	**AGON A/S**	Denmark	AGON - Circular lifting slings	01.03.2024	01.09.2024
2	**DLYTE CHEMICALS, S.L.**	Spain	DLYTE CHEMICALS, S.L. - Chemical recycling of dry electrolytes	02.01.2024	13.08.2025
3	**Earth Protex Portugal**	Portugal	Tex2Tex FAASST(TM) Transformation: Revolutionizing recycled synthetic textiles with sustainable surface treatments	15.02.2024	15.11.2024
4	**ECOLLANT**	France	ECOLLANT - Chemical recycling of nylon from tights in a circular loop	03.01.2024	04.01.2025
5	**IMDEX**	Denmark	Imdex - Recycling of End-of-Life Tires	01.04.2024	31.08.2025
6	**José Combalía, S.A.**	Spain	Chemical recycling of polyolefins to obtain high-value added dicarboxylic acids	15.03.2024	14.03.2025
7	**MACHAON SAS**	France	Development and optimisation of pyrolysis for the valorisation of the complex polymeric rejected wastes (RePlastify)	01.03.2024	28.02.2025
8	**QEV TECHNOLOGIES, S.L.**	Spain	Recycling of competition cars and manufacture of parts for luxury cars	01.02.2024	01.02.2025
9	**MARITON SA**	France	Mariton - Recycling of fabric scraps	01.11.2025	30.06.2025

Table 2: Overview of completed chemical POLREC projects

3.1 Presentation of project results

All completed chemical projects are presented in Appendix 1. For confidentiality reasons, the projects are presented in summary form only, and technical details have been deliberately omitted. In table 3 a short overview of the projects is given.

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Completed Chemical Projects				
No.	**Company Name**	**Country**	**Name of Project – Application**	**Short Summary**
1	**AGON A/S**	Denmark	AGON - Circular lifting slings	The project evaluated the recyclability of AGON's polyester straps using Textile Change's chemical dissolution process. The method proved effective in producing high-purity PET, though challenges remain in processing granulate and refining the straps for large-scale recycling. The technology is scalable, with potential for a dedicated polyester recycling plant tailored to AGON's needs.
2	**DLYTE CHEMICALS, S.L.**	Spain	DLYTE CHEMICALS, S.L. - Chemical recycling of dry electrolytes	The project focused on regenerating solid electrolytes used in DLyte® electropolishing by chemically restoring ion exchange resins saturated with metal ions. A pilot plant was developed to automate this recovery process, reducing waste and raw material consumption. Unlike the current waste disposal approach, the future model enables recycling at DLyte Chemicals, supporting a circular economy and lowering CO2 emissions.
3	**Earth Protex Portugal**	Portugal	Tex2Tex FAASST(TM) Transformation: Revolutionizing recycled synthetic textiles with sustainable surface treatments	The Tex2Tex STOMP™ project developed a solvent-based method to remove elastane from polyester textiles without damaging the polyester. The process is environmentally friendly, scalable, and enables partial dye removal, with successful trials confirming its industrial potential.
4	**ECOLLANT**	France	ECOLLANT - Chemical recycling of nylon from tights in a circular loop	ECOLLANT, a Deeptech-labeled start-up, developed an innovative chemical process to recycle polyamide from mixed-fiber textiles like nylon tights. Through the POLREC project, they optimized this process for industrial scale, collaborating with multiple partners for technical audits, lab tests, and process improvements. Successful lab trials led to promising results in material quality, with further scaling and patenting underway.
5	**IMDEX**	Denmark	Imdex - Recycling of End-of-Life Tires	The project explored recycling waste from end-of-life truck and passenger car tires in Denmark, focusing on rubber granules and woven materials. Through pyrolysis, these materials were converted into oil and char, which were analyzed to support future recycling solutions ahead of the 2031 ban on rubber granules in artificial turf.
6	**José Combalía, S.A.**	Spain	Chemical recycling of polyolefins to obtain high-value added dicarboxylic acids	The project developed and optimized ONYRIQ's CYCLOPS technology for chemically recycling poly-olefin waste into valuable dicarboxylic acids. Various polyolefin materials were successfully transformed, characterized, and validated as pre-cursors for new polymers like polyester and TPU. The results confirmed the process's scalability and potential for industrial application.
7	**MACHAON SAS**	France	Development and optimisation of pyrolysis for the valorisation of the complex polymeric rejected wastes (RePlastify)	RePlastify aimed to reduce plastic waste by con-verting complex plastic mixtures into high-quality pyrolysis oil for new polymer production, minimizing landfill and fossil resource use. The project optimized pyrolysis conditions, characterized products, and explored revalorizing wax residues, contributing to a sustainable, zero-waste process.

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8	**QEV TECHNOLOGIES, S.L.**	Spain	Recycling of competition cars and manufacture of parts for luxury cars	The project successfully recycled carbon fiber from car production waste using thermochemical treatment and developed new automotive parts from the recovered fibers. Though the recycled composites showed lower impact resistance than virgin fiber, they are suitable for non-structural automotive components.
9	**MARITON SA**	France	Mariton - Recycling of fabric scraps	Mariton partnered with Polyloop to explore chemical recycling of their PVC-coated glass fiber fabric scrap. The tests successfully dissolved PVC and purified PE fibers, but glass fiber purification remains challenging due to contamination. Recycled PVC was recovered in high-value granular form, showing potential, though further steps are needed to improve glass fiber recycling efficiency.

Table 3: Overview of the Chemical POLREC Projects

In Appendix I the summaries of the above projects can be found.

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4. Experiences learned during the project period

The POLREC project provided a wealth of experiences across a diverse group of companies, each exploring innovative recycling solutions tailored to their specific waste streams and industrial needs. Throughout the project, participants encountered both significant challenges and important successes that together advanced the collective understanding of chemical recycling, pyrolysis, and fiber recovery.

AGON faced early-stage obstacles with the recycling of polyester granulates, as the granulate form proved difficult to process efficiently in the laboratory, making pilot-scale trials unfeasible without further research. Grinding the granules into powder was suggested to increase surface area for chemical treatment, but existing methods were inadequate. In contrast, polyester straps showed more potential, though refining methods are still needed for effective scaling.

Earth Protex navigated the complexities of chemical recycling in textiles, particularly with varying textile blends that affected process consistency. Their work successfully demonstrated that elastane could be removed without degrading the polyester, and they validated a solvent that meets environmental and industrial criteria. This outcome positions their process as a promising candidate for industrial application, though scaling up remained challenging due to solvent management and process controls.

ECOLLANT's experience emphasized the critical need for thorough strategic preparation when moving from laboratory to industrial scale. Despite difficulties in establishing research protocols with some partners, the company leveraged collaboration with INEVO and PIVERT to refine its chemical recycling process. The project also underscored the importance of proper planning and resource allocation before initiating industrial optimization, a lesson reinforced by unexpected team capacity constraints during the project.

Imdex and Machaon explored pyrolysis-based recycling, gaining deeper insights into the nuances of process parameters like temperature and time, which significantly influence the yields of oils, waxes, and residues. While these companies optimized aspects of their processes, they also faced challenges with result variability, sample contamination, and energy consumption fluctuations, which highlighted the need for stricter process control and equipment calibration.

José Combalía, collaborating with ONYRIQ, succeeded in recycling polyolefins such as LDPE, SBS, and PP into dicarboxylic acids and their derivatives. These were further validated through synthesis into polyester, demonstrating a functional alternative to fossil-based materials. Their collaboration was strengthened by effective communication and mutual visits, which improved understanding of each other's facilities and processes.

DLYTE Chemicals focused on regenerating solid electrolytes used in their proprietary electropolishing technology by chemically restoring the saturated ion exchange resins. Their project aimed to design and build a pilot plant capable of automating the regeneration process, reducing reliance on virgin materials, and enabling a circular approach to electrolyte usage. Although still in development, their work represents a promising step toward minimizing waste and lowering CO2 emissions within the surface treatment sector.

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QEV Technologies made notable progress in the automotive sector by confirming that their waste materials are recyclable using BCIRCULAR technology, leading to high-quality fiber recovery. They also expanded their expertise in formulating and manufacturing composites with recycled fibers, gaining practical knowledge about suitable resins, manufacturing methods, and storage.

Mariton validated the potential of Polyloop's chemical recycling process for transforming fabric scraps into fine particles with environmental benefits. However, they recognized that achieving even finer particle sizes would require industrial-scale equipment.

Across all these experiences, the project reinforced the importance of meticulous preparation, adaptive process optimization, and close collaboration between multidisciplinary teams. The learnings from POLREC not only enhanced technical capabilities but also paved the way for more sustainable and scalable recycling solutions aligned with circular economic principles.

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5. New Business Opportunities

Across industries, the transition to circular economy practices and sustainable production is accelerating, driven by the urgent need to reduce waste, optimize resource use, and comply with evolving environmental regulations. The POLREC initiative has brought together a diverse group of companies, each developing innovative solutions to recycle complex materials - from textiles and composites to plastics and tires - through cutting-edge chemical and mechanical recycling technologies.

These nine companies, each operating within different sectors but sharing a common vision of sustainability, have identified new business opportunities by transforming waste streams into valuable secondary raw materials. Their efforts not only align with environmental goals but also open new avenues for profitability, strategic partnerships, and market leadership in a future where resource efficiency and circular production are key competitive advantages.

The following comprehensive summary details the business opportunities uncovered by each company, followed by the key themes that connect their efforts - highlighting the broader industrial shift toward sustainable innovation, value creation from waste, and the forging of new, circular business models.

The first company, AGON, evaluated the recyclability of its polyester (PET) material through Textile Change's dissolution technology. The project focused on enhancing the efficiency of recycling polyester straps and ensuring the purity of the recovered material. AGON identified a clear business potential by converting waste into recycled polyester, the company could significantly reduce both waste disposal costs and expenses associated with purchasing new polyester. Financial projections suggest that, with further optimization and additional material testing, the recycling plant could become self-financing within a decade. At a production capacity of 2,500 tons of recycled polyester annually, AGON anticipates a market value of 18-21 million DKK, supplemented by cost savings from managing 3,000 tons of polyester waste. This approach offers AGON not only economic benefits but also a sustainable production model that supports the circular economy.

The second company, DLYTE CHEMICALS S.L., has yet to complete its project, with outcomes expected by the end of August 2025. Business opportunities and specific insights will be clearer upon the project's conclusion.

Earth Protex Portugal pursued the Tex2Tex STOMP™ project, focusing on a non-destructive method to recover elastane and polyurethane from post-consumer polyester/spandex garments and to separate polyester from cotton. An additional aspect of the project included exploring dye removal, which could enhance the quality and recyclability of recovered fibers. These developments open multiple business opportunities for Earth Protex, such as integrating this method into existing polyester recycling processes, forming partnerships with textile recyclers and chemical suppliers, and expanding into waste management solutions targeting fiber recovery from both post-consumer and industrial sources. The technology also holds promise for addressing broader textile separation challenges, positioning Earth Protex at the forefront of sustainable textile recycling.

ECOLLANT, a young startup distinguished by its Deeptech label, focused on recycling nylon and polyamide textiles mixed with elastane, specifically targeting end-of-life stockings, socks, and tights. The company's proprietary process was further refined through collaboration with research partners, including tests on industrial polyamide/polyurethane waste. Encouraged by positive results, ECOLLANT

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is engaging with manufacturers seeking sustainable solutions for mixed production waste. This initiative not only enhances environmental performance but also aligns with stringent European and French regulations. ECOLLANT's efforts position the company as a sought-after partner for industries aiming to improve sustainability metrics while creating new value from textile waste.

Imdex addressed the recycling of End-of-Life Tires (ELTs) in Denmark, where about 45,000 tons are processed annually. A waste fraction composed of rubber granules and woven materials remains a challenge, especially with an anticipated 2031 ban on using rubber granules for artificial turf. Imdex is exploring a blend of mechanical and chemical recycling methods to prepare for these regulatory changes. The company plans to provide rubber granules for new applications and collaborate with Waste2Value for chemically recycling ELT-derived oil and woven materials. Looking forward, Imdex sees potential in pursuing pyrolysis technology and partnering with refineries to upgrade ELT oil for use in fuels or as cracker feedstocks. There is also scope for improving the quality of recovered carbon black, which would open new industrial markets and bolster Imdex's long-term competitiveness.

José Combalía, SA implemented the CYCLOPS technology developed by ONYRIQ for chemically recycling polyolefin waste into dicarboxylic acids. These high-value compounds can serve as monomers for producing polyesters, polyurethanes, and polyamides. Business opportunities include partnerships with industries in textiles and packaging to validate and scale the technology. An agreement with ONYRIQ could enable José Combalía to secure profits through shared innovation, while producing dicarboxylic acids creates pathways to participate in the raw material supply chain. The company could either supply polyolefin waste to external recyclers or adapt the technology within its facilities, integrating recycling into more complex industrial systems and thus enhancing operational versatility.

MACHAON SA launched the RePlastify project to reduce the environmental impact of plastic waste by converting complex plastic mixtures into high-quality pyrolysis oil. This oil is characterized to ensure suitability for new polymer production, preventing plastic waste from ending up in landfills and reducing the dependency on fossil-derived materials. The process aligns with zero-waste and circular economy principles. Pyrolysis opens avenues in sustainable waste management, biofuel production, renewable energy, and by-products such as activated carbon. Moreover, it fosters innovation in manufacturing specialized equipment, environmental consulting, and solutions for construction industries. MACHAON SA positions itself to capitalize on the growing demand for sustainable materials and waste valorization.

QEV Technologies, S.L., in partnership with Bcircular, focused on recycling composite waste from racing cars by recovering carbon fiber through a thermal process. The recycled fibers are then transformed into pre-cured non-woven SMC (Sheet Moulding Compound) materials. This initiative is directly aligned with QEV Technologies' mission to develop sustainable electric vehicles. The company now has the capacity to recycle its own production waste, fostering a circular approach within its manufacturing processes. Additionally, offering a new range of sustainable composites for the automotive sector presents a promising market opportunity, especially as environmental standards tighten across the industry.

Lastly, Mariton SA sought sustainable solutions for recycling its glass fiber and PVC-coated fabric scraps. By partnering with Polyloop, Mariton explored chemical recycling techniques, including dissolution, filtration, precipitation, and drying to separate fibers from PVC. The results revealed opportunities for reselling recycled PVC for technical textile production, such as extrusion processes. There is also potential for reusing recovered textile fibers in applications like insulation. Mariton's

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initiative represents a disruptive shift in their production approach, embracing sustainability while unlocking new market potentials through recycled materials.

5.1 Key Themes Across the New Business Opportunities

Several recurring themes emerge across these diverse projects, reflecting broader industrial trends and strategic priorities. A foremost theme is the adoption of circular economy models, where companies are increasingly designing systems to convert waste back into valuable resources. This approach not only reduces environmental impact but also transforms waste management from a cost center into a revenue-generating activity.

Another prevalent theme is the integration of advanced chemical recycling and separation technologies, which enable companies to tackle complex and mixed-material waste streams that traditional mechanical recycling cannot process efficiently. This is evident in efforts to recover elastane from polyester blends, extract polyolefins, and recycle composite materials and plastics through pyrolysis and dissolution.

The focus on sustainability-driven innovation is evident across all companies. These businesses are investing in research and development to meet or exceed environmental regulations, while simultaneously creating new product lines and markets. The innovation is not limited to technologies alone but extends to business models and strategic positioning within the value chain.

Strategic partnerships and collaborations are essential across these projects. Whether working with technology developers, research institutions, or industrial partners, collaboration enables scaling of technologies, validation of new processes, and faster market entry for recycled materials and products.

Furthermore, many companies are responding proactively to anticipated regulatory changes, such as the upcoming ban on rubber granules in turf fields or stricter recycling mandates in the EU. This forward planning ensures business resilience and opens opportunities to lead in newly regulated markets.

Lastly, a critical theme is the valorization of waste as a resource, turning sustainability challenges into competitive advantages. By developing capacities to produce high-value outputs like dicarboxylic acids, carbon fiber composites, biochar, and recycled polymers, these companies demonstrate how environmental responsibility can align with economic growth and innovation.

In conclusion, these projects illustrate a robust commitment to sustainability, resource efficiency, and circularity, setting a blueprint for how industries can evolve to meet both ecological and economic imperatives.

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6. Future Work

The companies engaged in the POLREC initiative are collectively entering a critical phase where the focus shifts from experimentation and pilot testing to the industrial scaling and commercialization of their recycling solutions. This transition marks an important step towards embedding circular economy practices within mainstream industrial production, where resource recovery and waste valorization become central components of business strategy.

Across the companies, the primary objective is to scale up recycling technologies that have been validated at laboratory or small pilot scale. This scaling process involves not just increasing production volumes but also ensuring that recycled materials meet stringent quality and durability standards required by industries such as textiles, plastics, automotive, and construction. To achieve this, many companies are planning to produce larger quantities of recycled materials for testing and certification, particularly to prove mechanical strength, purity, and performance consistency in real-world applications.

Process optimization is another major focus area. Companies are working on improving the efficiency of chemical recycling methods, refining reaction conditions, and reducing energy consumption and operational complexity. This includes the development of pre-treatment techniques to better prepare waste streams before recycling, as well as the recovery and reuse of solvents to lower environmental impacts and operating costs. A few companies are also exploring alternative, eco-friendly chemical formulations that can enhance the sustainability of their processes.

Another common direction is the industrialization of recycling technologies through automation and advanced process control. Automation is essential not only for reducing production costs but also for ensuring process stability, reproducibility, and scalability. By minimizing human intervention, companies can streamline their operations, increase throughput, and meet the economic conditions necessary for commercial viability.

Many of the companies are also planning technical and economic feasibility studies to assess the full potential of scaling up their technologies. These studies will inform decisions about infrastructure investments, such as the design and construction of pilot plants or full-scale production facilities. In some cases, companies are envisioning the creation of integrated recycling hubs where multiple recycling processes—mechanical, chemical, pyrolysis, solvolysis—can coexist, allowing for the treatment of diverse waste streams under one roof.

Furthermore, there is a strong emphasis on strategic partnerships and collaboration with industry stakeholders. To successfully implement these technologies on an industrial scale, companies are seeking collaborations with engineering firms, chemical suppliers, waste management specialists, and potential customers in sectors like textiles, automotive, and packaging. These partnerships are crucial for technology transfer, system integration, and securing demand for recycled products.

In parallel, companies are exploring market opportunities for the outputs of their recycling processes, whether in the form of raw materials, such as recycled polyester, polyamide, dicarboxylic acids, and carbon fibers, or value-added products like biochar, pyrolysis oils, and sustainable composites. The development of new markets and applications for these materials is integral to ensuring the economic sustainability of recycling ventures.

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Collectively, the future work across these companies reflects a broader industrial momentum towards sustainability and resource efficiency. By advancing these technologies and embedding them into industrial production, the companies are not only addressing environmental imperatives but also positioning themselves to benefit from emerging markets for recycled and sustainable materials. This signals a shift where waste is increasingly viewed not as an end-of-life challenge but as a valuable resource for new, innovative production cycles, driving both environmental progress and business growth.



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7. Feedback on POLREC funding support scheme

The The POLREC funding support scheme has been widely appreciated by participating companies as a valuable enabler for advancing recycling innovations and sustainability projects, particularly for small and medium-sized enterprises with limited resources. Across the board, companies highlighted that the scheme provided essential financial support, streamlined administrative processes, and a pragmatic approach to funding, allowing them to focus on technical development rather than bureaucratic hurdles.

A common positive reflection was the simplicity and efficiency of the application and reporting processes. Several companies emphasized that the administrative requirements were notably lighter than in traditional funding schemes, making participation more accessible for smaller enterprises with limited administrative capacity. For example, AGON praised the straightforward application process and the role of the local POLREC partner, Plast Center Danmark, whose industry knowledge significantly facilitated their project. Similarly, ECOLLANT and Imdex found the cascade funding process clear, concise, and well-tailored for smaller organizations, with ECOLLANT specifically appreciating the guidance provided by POLYMERIS.

The scheme's financial support was pivotal in enabling companies to conduct experimental work, optimize processes, and explore new business opportunities with minimized financial risk. Earth Protex Portugal pointed out that the funding allowed for multiple experimental iterations, access to specialized laboratory resources, and collaborations with industrial partners. Likewise, QEV Technologies emphasized that without this financial backing, it would have been impossible for many companies, including themselves, to pursue environmentally focused innovations such as applying circular economy principles to production waste.

Several companies also noted the scheme's role in facilitating new partnerships and collaborations, such as the connection between Imdex and Waste2Value, which was initiated through POLREC support and could evolve into a long-term business relationship.

Nonetheless, companies also identified areas for improvement. A recurring suggestion was the need for greater flexibility in project timelines, especially for R&D activities where experimental results can necessitate adjustments in scope and schedule. ECOLLANT specifically recommended more adaptable timing to accommodate the dynamic nature of laboratory work. Some companies, like José Combalía, suggested that receiving the full funding amount upfront rather than in installments would alleviate financial strain, especially when research costs are immediate and significant.

Another frequent recommendation was to introduce a second phase of funding for successful projects, enabling participants to progress from research and development to industrial scaling and market implementation. QEV Technologies highlighted the value of continued support for projects that demonstrate technical success, ensuring that innovations are not stalled at the prototype stage but can be commercialized effectively.

Further suggestions included clearer guidelines, simplified applications, faster evaluation timelines, and enhanced administrative support. MACHAON SA pointed out that while cascade funding effectively fosters creativity and supports niche projects, clearer decision-making processes, additional capacity-building resources, and more transparent fund allocation would improve the overall experience and impact of the program.

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In conclusion, while the POLREC funding support scheme is broadly seen as an efficient and highly beneficial mechanism for driving sustainability and circular economy projects, companies suggest that future iterations could be further strengthened by offering more flexible timing, upfront funding, expanded support for scaling innovations, and simplified participation frameworks. These enhancements would not only ease participation for small enterprises but also help ensure that promising innovations reach full industrial application and market readiness.



8. Conclusion of the project work

The POLREC project is a European collaboration promoting polymer recycling in line with the European Green Deal, with a strong emphasis on advancing chemical recycling solutions. A central initiative was the POLREC Innovation Open Call, which provided financial support to SMEs developing technologies that reduce the environmental impact of plastic and polymer waste. The focus was on shifting from traditional disposal methods to innovative recycling processes, especially chemical recycling, essential for handling complex and currently non-recycled waste streams.

Out of 31 projects funded, 9 focused specifically on chemical recycling. These addressed challenging materials such as polyolefins, nylon, polyester, elastane blends, PVC-coated fabrics, carbon fiber composites, and end-of-life tires. Solutions explored included pyrolysis, solvolysis, chemical dissolution, and recovery of valuable chemical building blocks. Each project aimed to transform difficult waste into high-value secondary raw materials, contributing to circular economy practices.

The chemical recycling projects generated significant advancements. For example, DLYTE Chemicals developed a method to regenerate solid electrolytes used in electropolishing, enabling circular use of ion exchange resins and reducing waste. José Combalía advanced the recycling of polyolefin waste into dicarboxylic acids, precursors for new polymers like polyesters and TPUs. MACHAON SA optimized pyrolysis to convert complex polymeric waste into high-quality pyrolysis oil, offering an alternative to landfilling. ECOLLANT refined a chemical recycling process for nylon recovery from tights, addressing the difficulty of mixed-fiber textiles. Other projects, such as those by Imdex and QEV Technologies, focused on pyrolysis and thermal treatments for recycling tires and carbon fiber composites respectively.

Throughout these initiatives, process optimization, scalability, and energy efficiency emerged as key themes. The projects demonstrated technical feasibility but also encountered challenges such as ensuring process consistency, managing energy consumption, and dealing with waste contamination. This highlighted the need for strict process controls and advanced capabilities to transition from laboratory research to industrial production.

The POLREC initiative also uncovered new business opportunities for SMEs in chemical recycling. Companies identified prospects in entering high-value markets for recycled monomers, specialty chemicals, and advanced materials. There is now a concerted effort to scale up technologies, build pilot plants, and establish partnerships with industries such as automotive, textiles, and packaging.

Participants praised the funding scheme for its essential support and simplified administrative process, making it easier for SMEs to focus on technical development. However, suggestions for improvement included providing upfront funding, offering more flexible timelines, and introducing a second funding phase to help successful innovations reach commercial scale.

In summary, POLREC significantly advanced chemical recycling capabilities, addressing some of the most complex polymer waste challenges in Europe. The project demonstrated how chemical recycling can play a critical role in achieving circular economic objectives by turning waste into valuable resources, contributing to environmental sustainability and the development of new industrial value chains.

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PROJECT INFORMATION

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Programme	Single Market Programme (SMP COSME)
Call	SMP-COSME-2021-CLUSTER
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Project duration	36 months

PROJECT CONSORTIUM

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9. APPENDIX I – Summaries of POLREC chemical projects

In this section a short presentation of all implemented and completed chemical recycling projects is given. Due to confidentiality reasons the projects are not presented in full length and technical details are omitted.

9.1 Summary of AGON A/S – Circular lifting slings

The project aimed to assess the recyclability of AGON's polyester straps using Textile Change's chemical recycling technology. The objective is to improve recycling efficiency, validate material purity, and confirm the compatibility of the method with AGON's needs. Various PET strap types both used and unused were tested. The recycling process included three pretreatment steps, followed by decolorization, dissolution, and precipitation of PET. Manual shredding preceded chemical treatments. Throughout the process, samples are analyzed for mass loss, brightness percentage (ISO 3688), and spectroscopic response. All materials fully dissolved, indicating effective breakdown. Brightness improved after decolorization but decreased slightly post-precipitation. Minor mass loss confirmed impurity removal. Purple dyes were successfully extracted, shown by increased absorption in UV-VIS spectra. The study confirmed the technical feasibility of high-purity PET recovery from AGON straps through controlled chemical processes.

9.2 Summary of DLYTE CHEMICALS, S.L. – Chemical recycling of dry electrolytes

The POLREC project focused on regenerating solid dry electrolytes used in DLyte® electropolishing systems by recovering and reusing the ion-exchange resin. Initially planned as a single "all-in-one" regeneration unit, the concept evolved into a modular system comprising specialized vessels, offering greater flexibility and reduced costs. In Task 3, various tests were conducted, including equipment functionality checks and chemical regeneration trials. The resin regeneration process successfully reduced metal ion saturation levels from approximately 20% to nearly 0%, confirming effective ion-exchange performance. Electrolytes produced using the regenerated resin showed chemical properties comparable to those made from virgin resin. However, limitations arose due to structural degradation of resin particles caused by prior use, which affected the integrity and performance of the regenerated product. In Task 4, the main conclusion was that chemical regeneration is feasible and effective, but a 100% substitution of virgin resin is not practical. A blend of regenerated and virgin resin is recommended to maintain product quality and reliability. These findings underscore the potential for more sustainable and circular production processes within the DLyte® system.

9.3 Summary of Earth Protex Portugal – Tex2Tex FAASST (TM)

The FAASST™ project investigated the use of bio-based surface treatments to enhance recycled textile performance, focusing on reducing microfiber shedding and improving durability. Originally targeting industrial polyester, the project shifted to recycled polyester/cotton blends due to market alignment. Various sustainable coatings—using crosslinkers, cyclodextrins, and polysaccharides - were applied to multiple fabric types through conventional finishing methods. Testing included plling resistance, abrasion, bursting strength, and microfiber release under simulated use and washing. Results showed that coatings F5 and F7 improved pilling and visual quality, although mechanical durability was sometimes

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reduced. Key lessons included the need for solubility and pH stability in early formulation phases, and the importance of interdisciplinary coordination. Challenges such as early gelation and weaker fabric resistance highlighted opportunities for better binder systems and stronger anchoring. Overall, the project confirmed the technical feasibility of sustainable finishes, while setting the stage for further development and industrial upscaling.

9.4 Summary of ECOLANT – Chemical recycling of nylon form tights in a circular loop

The ECOLLANT project aimed to scale up a green chemical process for recycling nylon from discarded tights, focusing on extracting polyamide using clean solvents. Task 1 centered on optimizing the lab-scale method for industrial feasibility, involving technical audits and collaborations with partners like INEVO and PIVERT. In Task 2, a detailed experimental plan was executed, with tests conducted under varying temperatures and conditions to refine reaction kinetics and material flow, resulting in measurable improvements in efficiency and material recovery. Laboratory analysis confirmed the quality of recovered polyamide, with favorable batches sent for rheological testing. Task 3 reflected on lessons learned, including successful integration of cross-disciplinary expertise and setbacks like misaligned partnerships. A key achievement was creating a robust roadmap for industrialization, despite challenges in protocol development and unforeseen delays. The project validated ECOLLANT's ability to move toward large-scale circular recycling of complex textiles.

9.5 Summary of Imdex – Recycling of end-of-life tires

The project explored recycling waste from end-of-life truck and passenger car tires in Denmark, focusing on rubber granules and woven materials. Through pyrolysis, these materials were converted into oil and char, which were analyzed to support future recycling solutions ahead of the 2031 ban on rubber granules in artificial turf.

The project investigated the pyrolysis of three rubber waste streams – two types of end-of-life tires (ELTs) and one stream of woven material consisting of polyester and nylon (PA). The pyrolysis was carried out at 500 °C to recover valuable products. Each fraction from the pyrolysis was analyzed to determine the quantity and quality of the oil and chars. These fractions were analyzed by the use of titrator, ICP, XRF, TGA, FTIR, and GC-MS.

Due to variability in product composition and content of PA developing possible poisonous gases many safety precautions were added to the existing pyrolizer.

Taken these aspects into consideration the work demonstrated a sustainable waste-to-resource approach with valuable implications for circular rubber management and pyrolysis scale-up.

9.6 Summary of José Combalía – Chemical recycling of polyolefins to obtain high-value added dicarboxylic acids

The POLREC project developed a method to chemically recycle polyolefins into dicarboxylic acids using CYCLOPS technology. Experiments showed that polyethylene and polypropylene waste can be efficiently transformed under mild conditions. Reaction time and acid concentration were key to

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optimizing yield and acid composition. The recycled acids were successfully used to synthesize polyesters and thermoplastic polyurethanes. Results confirmed the process as a viable alternative to fossil-based materials. Collaboration between José Combalía and ONYRIQ ensured smooth technical and administrative execution. The project highlighted the potential for new industrial applications and business models. Future work will focus on further optimization and scaling up. The team emphasized the value of upfront funding for better research support. Overall, the project proved both technically and commercially promising.

9.7 Summary of MACHAON SAS – RePlastify

The *Re-Plastify* project investigated the pyrolysis of three plastic waste streams—dirty CITEO LDPE, clean CITEO LDPE, and agglomerated plastics—at 500 °C and 550 °C to recover valuable products. Each feedstock was characterized using TGA, FTIR, elemental analysis, and GC-MS, followed by pyrolysis to yield oils, waxes, char, and off-gases. A secondary pyrolysis of collected waxes demonstrated a reduction of 86.5% in wax mass, confirming further valorization potential. Key insights included the critical impact of temperature on product yields, with olefins dominating the hydrocarbon output. Energy profiling revealed that 70–75% of furnace consumption occurred during heating, guiding future efficiency improvements. The project highlighted waxes as a viable resource rather than waste and emphasized the need for precise process control, robust analytical methods, and strict handling protocols to ensure data reliability. Despite variability in product composition and occasional contamination, the work demonstrated a sustainable waste-to-resource approach with valuable implycations for circular plastic management and pyrolysis scale-up strategies.

9.8 Summary of QEV TECHNOLOGIES – Recycling of competition cars and manufacture of parts for luxury cars

The project aimed to recycle carbon fibre composite waste from racing cars and repurpose it into automotive components. Task 1 focused on recovering carbon fibre from QEV Technologies' waste using BCIRCULAR's thermal recycling process, which successfully separated the fibre and produced a pre-cured non-woven SMC for part fabrication. The final demonstrator part was manufactured using an autoclave to replicate QEV's standard production method. In Task 3, key lessons included validating the recyclability of QEV's waste and gaining insight into formulating SMCs with recycled fibre. Although the recycled composites had slightly lower impact resistance than virgin ones, results showed they were viable for non-structural applications. The project highlighted the importance of resin selection, process conditions, and fibre quality. It also revealed operational strengths of the recycling process and potential for integrating circular materials into high-performance vehicle manufacturing.

9.9 Summary of MARITON SA - Recycling of fabric scraps

Mariton aimed to find a sustainable solution to recycle their fabric scraps by collaborating with Polyloop for chemical recycling. The project involved testing three fabric types (Copaco, Mermet, and Ferrari) using selective dissolution, filtration, and precipitation to isolate usable materials. All tests confirmed that PVC formulations dissolved effectively, allowing for the recovery of formulated PVC grains. Glass fiber purification proved challenging, especially due to insoluble plastic residues and pigments, while PE fibers were successfully purified. Test durations were short (1.5 days per sample),

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indicating the method's efficiency. Key insights showed that pre-sorting and further washing steps improve recyclability. Task 3 highlighted that Polyloop's technical approach is environmentally impactful and transforms waste into reusable fine particles. However, optimization with industrial-scale equipment could improve particle thinness and overall material purity. Overall, the results demonstrate technical viability for recycling complex fabric waste into high-value, circular materials.

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