Interreg Danube Region

Co-funded by the European Union

Plan-C

Strategy development for the circular transformation of the entire value chain on a holistic level

Deliverable D.3.2.3

Responsible Partner: Business Upper Austria

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1 Introduction

The plastics industry is at a critical turning point, facing mounting environmental and economic challenges that demand a shift from the traditional linear model of production, use, and disposal toward a circular economy. Circularity in plastics means designing products and systems that prioritise reuse, recycling, and long-term value retention, reducing waste and conserving resources. This transformation is not only essential for sustainability but also for compliance with evolving regulations, such as the EU target to recycle 50% of plastic packaging by 2025.

Despite these ambitions, many countries in the Danube Region struggle with weak recycling infrastructure, outdated waste systems, and gaps in technical expertise. Regulatory pressures, consumer expectations, and oversight from international bodies add complexity, while economic uncertainties—such as fluctuating markets, tariffs, and geopolitical risks—disrupt supply chains. Technological barriers, including inefficient recycling processes and contamination issues, further hinder progress.

Embracing circular principles offers significant benefits. **Environmentally,** it reduces plastic pollution and conserves natural resources. **Economically**, it lowers production costs and creates new business opportunities through innovative models like recycling, remanufacturing, and product-as-a-service systems. These approaches not only minimize waste but also generate continuous revenue streams and strengthen competitiveness. Initiatives such as Plan-C demonstrate the feasibility of circularity, providing practical solutions and fostering collaboration across sectors to drive sustainable industrial development.

This report explores how strategy development and transformation roadmaps can guide plastics processors toward circularity, outlining key challenges, regional differences, and actionable measures to achieve a resilient and resource-efficient plastics value chain.

1.1 Plan-C Project

Moving PLastics and mAchine iNdustry towards Circularity (Plan-C) is an ambitious initiative aimed at transforming the plastics and machine industries in the Danube Region towards a circular economy. The project brings together 14 partners from countries including Germany, Austria, Czechia, Slovakia, Hungary, Serbia, Bosnia and Herzegovina, Romania, and Moldova.

By fostering transnational cooperation among plastics processors, producers, and the machine industry, Plan-C seeks to develop innovative solutions that emphasize reuse, recycling, and long-term value retention. The core objectives of Plan-C include:

- Co-creating circular plastic solutions through collaboration and design thinking, resulting in practical prototypes and guidelines for SMEs.
- Redesigning machinery for reuse and recycling, covering the entire lifecycle and exploring digital opportunities.
- Developing a transnational action plan that aligns with EU regulations and national strategies, ensuring long-term impact through policy integration and SME support.

Plan-C aims to address significant barriers such as weak recycling infrastructure, outdated waste systems, and gaps in expertise. By promoting reuse, repair, remanufacturing, and smart recycling, the project aspires to accelerate clean growth in manufacturing sectors and strengthen business competitiveness across the region.

1.2 Objective

The goal of the initial macro-regional workshops was to accelerate the transition of the plastics and machine sectors in the Danube Region toward a circular economy by identifying barriers to circularity and co-creating practical solutions. They aimed to engage stakeholders in a collaborative process to map critical lifecycle stages and uncover systemic hurdles.

Additional macro-regional workshops were organized to propose actionable “lifts” that enable circular practices. This included fostering cross-sector dialogue between machine producers and plastics processors to ensure holistic solutions.

The scope of these workshops covered the entire product lifecycle. The methodology emphasised regional diversity, ensuring that insights reflect local realities while contributing to a unified transnational strategy.

The ultimate goal was to generate knowledge and strategies that feed into the Plan-C transformation roadmap and transnational action plan, providing a foundation for policy recommendations, investment priorities, and collaborative projects that support circularity across the plastics value chain.

2 Methodology

The macro-regional workshops were designed as interactive sessions to identify hurdles for circularity within the plastics and machine sectors. The approach followed a structured yet collaborative format, encouraging participants to actively engage in problem-solving. At the outset, participants were divided into two groups - one representing machine producers and the other plastics processors - regardless of their actual roles. This role-play method fostered empathy and cross-sector understanding.

The sessions began with a brief introduction to the Plan-C project and an icebreaker to create an open and creative atmosphere. Participants then mapped the key lifecycle stages of a product, such as production, operation, end-of-life, and repurposing, and ranked these stages by importance. This exercise provided a clear framework for identifying where circularity faces the greatest resistance.

Next, participants brainstormed specific hurdles within these stages, documenting them on notes. Through the “Note Game,” these hurdles were shared and discussed, promoting dialogue and deeper insight into systemic challenges. The participants ranked the importance of each lifecycle stage. Afterwards, the groups switched tables to review the other group’s hurdles and propose potential solutions, referred to as “lifts.” This step encouraged collaborative thinking and generated a wide range of ideas, from practical measures to visionary concepts.

In multiple regions, results from the initial macro-regional workshops described in D.3.2.1 and D.3.2.2 were used as input for final workshops for identifying “lifts”. Where time allowed, the feasibility and usefulness of proposed solutions were assessed, helping prioritise actions for future implementation. All results were documented through photos and written summaries. These insights will feed into the transnational action plan, ensuring that identified hurdles and lifts translate into concrete measures and projects aimed at accelerating the transition to a circular economy.

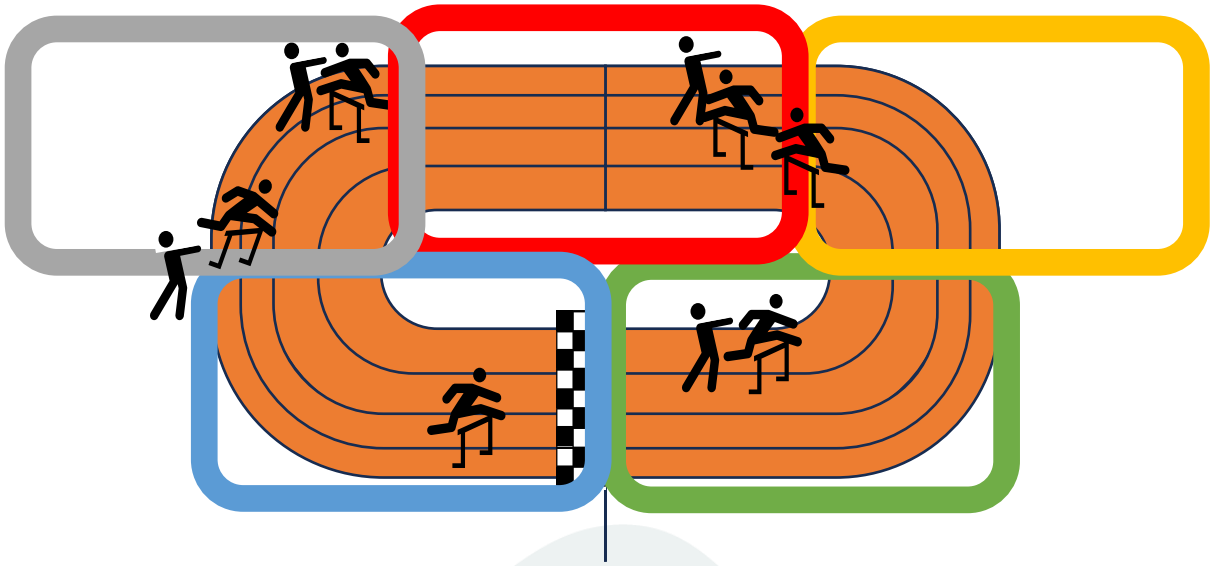

Figure 1: A visual aid for the "race towards circularity"

3 Strategy Development with Plastics Producers and Machine Manufacturers

To transfer the problems and create joint solutions aiming at designing a circular plastics value chain with both plastics producers and machine manufacturers, transnational workshops combining the target groups were held. These workshops were implemented by the following macro-regional groups: Austria / Germany (Baden Württemberg); Bosnia and Herzegovina / Hungary / Republic of Serbia; Czech Republic / Slovak Republic; Moldova / Romania. The goal was to define "lifts" to the "hurdles" identified by the plastics processors with the design of processing machines (D.3.2.1) and the plastics processing machine manufacturers with the use of recycled plastics (D.3.2.2).

3.1 AT|Austria / DE|Germany, Baden-Württemberg

The Austrian and German partners, Business Upper Austria, AWS, and Technology Center Horb, held their joint macro-regional workshop online via a communication program.

The most important lifecycle stages central to the circularity of plastics and machines were redefined to include "Design & engineering", "Use phase / operation of machines", "End-of-life & waste management", and "Market & regulation". The four stages were evaluated as of similar importance. Based on the discussions, participants identified a set of impactful measures. Measures aimed at extending machine lifetimes through retrofit programs were considered key technological components. A more unified approach to language use in the plastics and machine industries was emphasised as a key component for better cooperation, as certain terms can be used quite differently in the two areas. For better usage of new technologies, clueing product designers into the technical possibilities via cooperation between innovators/researchers and producers was suggested.

Overall, the workshop highlighted that structural challenges in production and logistical inefficiencies are the main obstacles to circularity. Strategic efforts should therefore prioritise design innovation, material optimisation, and improved collection and sorting systems, while supporting companies in meeting regulatory demands and investing in circular technologies.

Participants also identified which actions could be implemented immediately and which depend on currently missing economic or technological conditions. Short-term actions include establishing cross-value-chain working groups, initiating pilot retrofits and implementing new traceability tools. In the medium term, retrofit programs should be scaled. Regional sorting and collection pilots would help improve material quality. In the long term, the aim is to develop a Europe-wide harmonized traceability system similar to the Austrian Electronic Data Management model (eGovernment platform standardizing cooperation between companies and authorities and facilitating implementation of legal obligations), expand recycling infrastructure, and create robust verification methods for recycled content.

3.2 BiH | Bosnia and Herzegovina / HU | Hungary / RS | Republic of Serbia

The partners from Hungary, Serbia and Bosnia and Herzegovina—represented by organisations such as FITT, ICMF, Innoskart and Omnipack / DBH—held their joint macro-regional workshop online. Building on earlier sector-focused sessions, participants revisited the lifecycle stages most relevant to circularity in plastics and machine industries. Discussions showed that circular progress depends strongly on aligned design choices, technological adaptability, material availability and supportive economic and regulatory conditions. These aspects were treated as equally important foundations for transforming value chains.

Based on the workshop exchange, participants identified several impactful measures across both sectors. In machine manufacturing, design-for-circularity, retrofitting and performance upgrades were highlighted as key technological levers, alongside closer cooperation between machine producers and plastics processors. In the plastics sector, priority was placed on improving material quality and supply, introducing targeted incentives to close the cost gap between virgin and recycled materials and aligning product design with real recycling capabilities. Training, capacity building and knowledge transfer were emphasised as essential elements in both areas.

Overall, the workshop underlined that structural challenges, particularly inconsistent material flows, technological limitations and fragmented coordination, remain major obstacles to circularity. Strategic efforts should therefore focus on improving design alignment, strengthening process adaptability, upgrading collection and sorting systems and ensuring that companies can meet regulatory requirements while adopting circular technologies.

Participants also distinguished which measures can be implemented immediately and which depend on additional economic or technological conditions. Short-term actions include integrating circular design principles, initiating pilot retrofits, improving coordination between waste management and industry and providing technical guidance for handling recyclates. Mid-term actions involve scaling retrofit programs, upgrading sorting systems and redesigning products and machines for better compatibility with recycled materials. In the long term, the goal is to deploy advanced recycling technologies, establish integrated end-of-life systems and build stable public–private partnerships, ultimately aiming for harmonised circular frameworks and closed material loops across the region.

3.3 CZ|Czech Republic / SK|Slovak Republic

The Slovak and Czech partners, SPK, TUKE, UTB and Plastr, held their joint workshop in Demänová, Slovakia. Building on the outcomes of earlier workshops, the group revisited the most relevant lifecycle stages for plastics and machinery. For the plastics sector, “Design (materials & technology)”, “Manufacturing processes”, and “End-of-life” were identified as key stages, while the machinery sector prioritised “Design”, “Construction”, and “Recycling”. These stages were evaluated as similarly important, as each significantly shapes long-term circularity potential.

Based on the discussions, participants identified a set of impactful measures. Plastics processors emphasised the need to rationalize production processes, define recycled-content ratios, and strengthen design-for-recycling principles. Addressing labour shortages through dual education, targeted recruitment and continuous training was highlighted as essential. Improvements in raw-material quality, legislative clarity around end-of-life regulations and better consumer engagement were also noted. For machine producers, functional engineering and design were described as crucial technology levers, supported by stronger technical education, internal innovation and better communication across the value chain. Research and development, automation and financial incentives were identified as ways to make recycling more technically and economically feasible.

Overall, the workshop highlighted that structural challenges, particularly unclear legislation, shortages of specialised personnel and the financial burden of new technologies, remain the main obstacles to circularity. Strategic efforts should therefore prioritised design innovation, modernisation of manufacturing technologies, optimisation of logistics and material use and improved end-of-life systems. Strengthening education pathways and simplifying regulatory frameworks were considered essential to supporting companies in meeting circularity expectations.

Participants also distinguished immediate actions from those dependent on future economic or technological conditions. Short-term actions include in-house staff training, partnerships with universities, recruitment drives, process optimisation, technical upskilling and increased public outreach. Mid-term actions focus on scaling dual-education systems, modernizing technologies, strengthening legislation for hiring foreign experts and expanding design-for-recycling approaches. In the long term, fully functional lifelong learning systems, new national end-of-life and deposit-refund legislation, the development of resource-light technologies and broad adoption of bio-based materials will be necessary to achieve lasting circular transformation.

3.4 MD | Moldova / RO | Romania

The Romanian and Moldovan partners, ICMPP, CLUSTERO, and SORINTEX, held their joint workshop online. Participants revisited the most relevant lifecycle stages for circularity and redefined them to focus on waste collection, waste sorting, reintegration of recycled materials, design for circularity, and the reuse or repurposing of plastics and textiles. These stages were evaluated as equally important due to persistent gaps in local collection systems, sorting capacity, and limited uptake of circular design practices.

Based on the discussions, participants identified a set of impactful measures. Improving waste collection and sorting infrastructure was highlighted as essential for increasing recycling rates and material purity. Legislative efforts to limit non-recyclable plastics, together with incentives for recyclers and companies adopting circular solutions, were seen as key drivers for change. The workshop also emphasised the importance of early-stage circular design, greater cooperation between ministries, municipalities, businesses and research organisations, as well as the introduction of circular economy education programs ranging from kindergarten to post-secondary levels. Practical reuse options for textiles—such as repurposing them for insulation or construction material—were also considered promising.

Overall, the workshop showed that structural challenges—particularly insufficient collection systems, limited sorting capabilities and weak integration of recycled materials—remain major obstacles to circularity in Romania and Moldova. Strategic efforts should therefore prioritise improving material flows, strengthening design-for-circularity practices, expanding sorting and recycling infrastructure and fostering multi-stakeholder cooperation to align policy, industry and research.

Participants also distinguished immediate actions from those requiring further economic or technological conditions. Short-term actions include launching public awareness campaigns, setting up local textile and plastic collection points, improving basic community-level sorting practices and initiating small-scale cooperation projects between recyclers and research institutions. Mid-term actions focus on scaling sorting systems, expanding dedicated collection centres, improving logistics and redesigning products to support circularity. In the long term, the aim is to establish national integrated collection infrastructure, develop large-scale automated sorting facilities, adopt biodegradable alternatives and implement national-level circular economy education and regulatory reforms.

4 Summary and Comparison

The macro-regional workshops revealed key differences but also similarities between the regions.

4.1 Prevalent Problems

The workshops revealed a set of recurring challenges shared across all participating regions. These challenges consistently hinder progress toward circular value chains and appear regardless of national context.

- All regions report that material quality and availability are insufficient, leading to unreliable recyclate streams and inconsistent processing performance. AT/DE noted that waste stream traceability and contamination seriously undermine recycling efforts, similar to concerns in HU/RS/BiH, RO/MD and CZ/SK.

- All regions experience design misalignment, where products and machinery are not created with recyclability or circularity in mind. AT/DE highlighted design and engineering as one of the most decisive lifecycle phases, mirroring the priorities in all other regions.

- Every region identified significant skills shortages and lacking technical knowledge. The AT/DE partners emphasised a need for better cooperation and shared terminology, while CZ/SK stressed dual education and technical training as urgent.

- Legislative complexity and unclear regulatory frameworks are key problems everywhere. AT/DE described contradictory rules and weak enforcement as major barriers, which is consistent with RO/MD (missing legislation), HU/RS/BiH (policy/industry mismatch) and CZ/SK (unclear EOL legal structures).

- Fragmented value-chain cooperation is a universal problem. RO/MD stressed the need for coordinated stakeholder action, as did every other region.

4.2 Impact on the Production Chain on a Holistic Level

The identified challenges do not act in isolation but influence every stage of the value chain. Together, they create systemic disruptions that weaken circularity and reduce the stability of production processes across all regions.

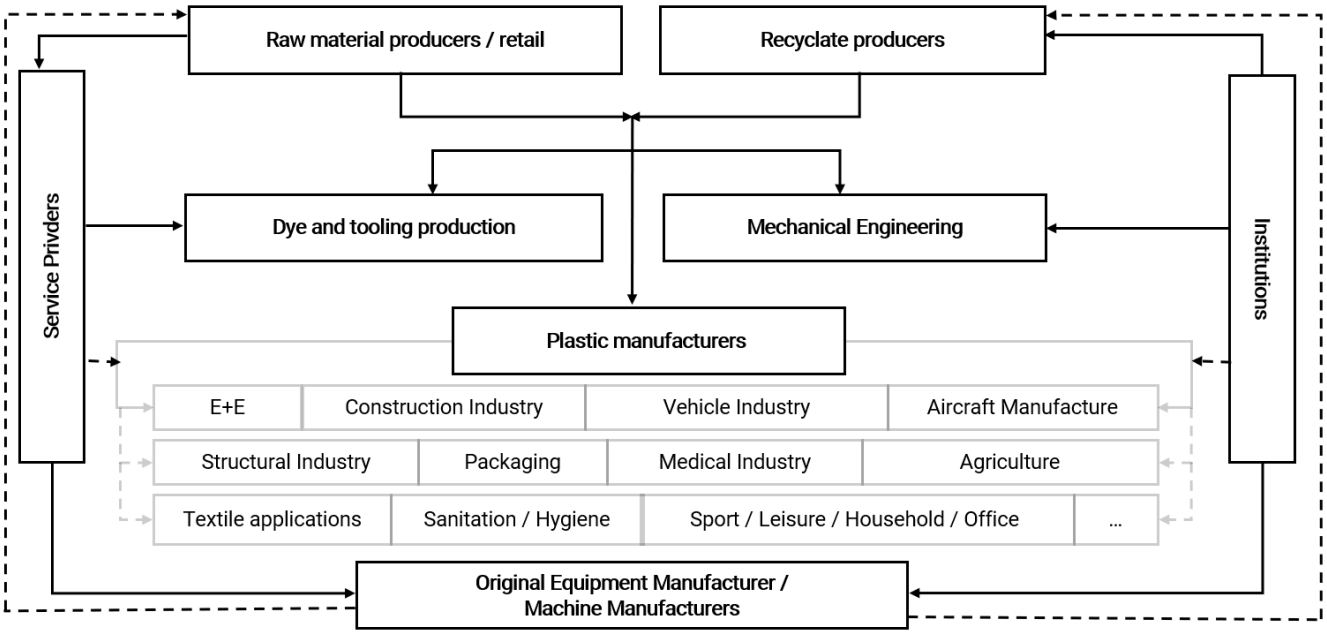

Figure 2: A diagram visualizing the plastics value chain.

- In all regions, poor waste collection and sorting systems reduce the reliability of recycled feedstock, disrupting manufacturing efficiency and decreasing circularity. RO/MD in particular emphasised missing infrastructure, while AT/DE described this as a critical systemic weakness.
- Misaligned design decisions negatively impact each phase of the value chain. AT/DE showed that early design choices strongly determine recyclability, and CZ/SK and HU/RS/BiH confirmed that shortcomings here cascade into manufacturing problems and EOL limitations.
- Lack of skills limits the ability of companies to adopt advanced technologies, operate machinery designed for circular processes and maintain consistent production quality. This is reflected across all four regions.
- Regulatory uncertainty slows strategic investment in infrastructure, technology and product redesign. AT/DE stresses this especially in relation to enforcement gaps and unstable frameworks.

4.3 Identified Measures: How Plastics Processors Can Help Machine Producers

Plastics processors play a crucial role in enabling machine producers to develop equipment that functions effectively in a circular production environment. Their operational insights, material knowledge and training capacities help machine builders understand real-world challenges and anticipate future needs. By working together, both sectors can accelerate technological adaptation and strengthen the entire value chain.

- Plastics processors can offer machine producers detailed insights into real processing conditions, including material contamination, recyclate variability and customer quality expectations. AT/DE emphasised the need for better cross-industry communication and shared terminology, which would help machine producers design better-aligned solutions.

- They can participate in joint value-chain working groups and pilot projects, enabling machine producers to gather real-world feedback and adapt machine design for recycled materials. HU/RS/BiH highlighted the importance of transnational pilot cooperation.

- Plastics processors can support workforce development by engaging in dual-education initiatives, vocational training cooperation and shared upskilling activities. CZ/SK stressed the importance of such programs for both sectors.

- Processors can help machine producers by clearly signalling future material trends (e.g., higher recyclate ratios, use of biodegradables), allowing machine builders to anticipate technical requirements. This aligns with AT/DE discussions about developing market uptake and enabling conditions for recyclate use.

- In RO/MD, it was noted that sharing real energy-consumption data from production lines would help machine producers better target efficiency improvements in equipment design, addressing a key regional challenge.

4.4 Identified Measures: How Machine Producers Can Help Plastics Processors

Machine producers can strongly support plastics processors by developing technologies that make circular production more stable and reliable. Their innovations in machine design, retrofitting and operator training help processors work more efficiently with recycled materials. By aligning machinery capabilities with the needs of modern circular processes, machine producers enable plastics processors to improve quality, reduce waste and increase overall system resilience.

- Machine producers can design machines that better tolerate fluctuations in recyclate quality, through modularity, enhanced sensors, adaptive processing controls and improved maintenance concepts. This need was strongly emphasised in both AT/DE and HU/RS/BiH.

- They can provide retrofit and upgrade programs that extend the lifetime of equipment, reduce circularity barriers and enhance energy and resource efficiency. AT/DE highlighted retrofits as key levers to enable circularity. RO/MD participants stressed the importance of machine producers offering clearer guidance on how equipment capabilities support circular product design and eco-design practices.

- Machine producers can deliver professional training for operators, technicians and designers, directly supporting plastics processors in managing recycled materials and maintaining process stability. CZ/SK identified skill development as a top priority.

- They can design new machines with easier disassembly, repair and recycling pathways, lowering end-of-life impacts and supporting circular product cycles. AT/DE recognized design and engineering as the most influential lifecycle phase for long-term sustainability.

4.5 Short-term Measures (0–6 Months / Immediate)

- Cross-value-chain coordination & awareness
  - Set up/strengthen cross-value-chain working groups and joint problem-solving formats (national and transnational).
  - Run targeted awareness campaigns and share best practices to build acceptance for recyclates among customers and the public.

- Design, retrofit & operations
  - Integrate basic design-for-circularity principles into new products and machinery; start "retrofit quick checks" and first pilot retrofits.
  - Optimised existing production workflows and energy use; implement quick operator upskilling and in-house trainings.

- Material flows & traceability
  - Improve basic documentation/traceability of waste and recyclate streams at company level (templates, simple digital tools).
  - Launch localized collection points (plastics/textiles) and basic community/company sorting improvements.

- Human capital
  - Promote dual-education pathways and talent recruitment, initiate university partnerships and outreach to schools.

- Market positioning
  - Start a "Made in Europe" quality/sustainability positioning to support market uptake of circular solutions.

- Policy "do-now" asks
  - Engage authorities on enforcement gaps (e.g., import controls, misdeclaration) and practical SME guidance.

4.6 Mid-term Measures (6–24 months / Partial enabling conditions required)

- Scaling retrofits & circular tech
  - Scale retrofit programs; standardize retrofit packages for common machine types.
  - Expand service-based models (maintenance, refurbishment, performance).

- Design & product acceptance
  - Align customer specifications and acceptance criteria to process recycled materials.
  - Redesign products/equipment for higher recyclate compatibility and disassembly/modularity.

- Waste systems & feedstock reliability
  - Run regional sorting/collection pilots.
  - Develop local sorting depots.
  - Improve logistics, and pilot producer take-back.
  - Establish waste-trading mechanisms to address local material shortages.

- Governance & regulation
  - Prepare policy/industry recommendations focused on stronger enforcement, import controls, and simplification for SMEs.
  - Begin aligning regulation with technical recycling limits/definitions.

- Skills & institutions
  - Institutionalise collaboration formats (clusters, transfer teams).
  - Integrate dual-education/university partnerships more fully.

4.7 Long-term Measures (24+ months / Major new conditions required)

- System-wide traceability & verification
  - Implement harmonised, cross-border traceability systems (EDM-like), with unified coding/classifications and robust recycled-content verification (incl. mass-balance/auditing).

- Infrastructure & advanced technologies
  - Expand European sorting and recycling infrastructure, including AI-driven, automated facilities.
  - Deploy advanced recycling where environmentally and economically justified.
  - Achieve fully circular machine lifecycles (remanufacturing, reuse, take-back).
  - Develop resource-light technologies and universal designs.

- Policy & market stability
  - Establish stable, long-term policy signals and cross-border enforcement governance to enable investment.
  - Reform EOL and deposit-refund frameworks where needed.
  - Embed circular performance criteria in procurement and market standards at scale.
  - Solidify a recognized “Made in Europe” circularity standard.

- Human capital & culture
  - Implement lifelong-learning systems and fully functional adult-education laws.
  - Embed circularity in standard training and qualifications.

Table 1: A tabular overview of the proposed measures.

higher priority

higher priority

	Short-Term	Mid-Term	Long-Term
Most Partners	• Growing technical talent through training, dual education, university partnerships and skills programs.	• Integrating design-for-circularity into products and machinery • Establishing or strengthening cross-value-chain working groups and joint cooperation formats. • Improving waste collection and sorting systems • Using retrofits and equipment upgrades	• Redesigning equipment/products for recyclate compatibility, modularity and easier disassembly. • Need for clear, stable regulation and reduced contradictions. Ease of recyclate handling is needed.
Multiple Partners	• Running awareness campaigns and aligning customer expectations • Improving links between waste management, recyclers and industry • Integrating circularity into school curricula	• Supporting innovation-friendly public procurement • Expanding maintenance, refurbishment and circular services • Using waste trading mechanisms to address shortages of recyclates	• Developing traceability/documentation tools for waste streams
Singular Partners	• Engage authorities on enforcement gaps (e.g., import controls, misdeclaration) • Setting up textile collection points • Reforming national hiring laws to allow foreign experts (unique to SK–CZ) • Implementing a functional Adult Education Act	• Setting up local textile sorting systems • Biodegradable alternatives at industrial scale	• Developing modular machine designs for easier future upgrades. • Creating standards and certification schemes for circular machinery. • Implementing textile-specific reuse pathways

4.8 Differences Between the Regions

Although all regions share common challenges, each of them faces distinct conditions that shape their priorities and solutions. These differences highlight how local infrastructures, policy environments and workforce realities influence the pace and direction of circular transformation.

- The **AT/DE** region places the strongest emphasis on regulatory coherence, enforcement and fair market competition, stressing import controls, traceability and harmonised standards as top priorities. It also uniquely highlights the need for unified terminology and communication across sectors.

- The **HU/RS/BiH** region focuses on balancing ambition with feasibility and emphasises technological adaptability and joint cross-border cooperation as essential to progress.

- The **RO/MD** region differs by placing strong emphasis on fundamental waste-management deficiencies, missing infrastructure and public awareness deficits across society. Education from early childhood onward plays a much larger role there than in the other regions.

- The **CZ/SK** region stresses labour shortages, legislative rigidity and a strong need for modernisation, especially in relation to technological upgrades, R&D and participation in EU policymaking.

5 Conclusion

All workshops show that clear and practical solutions for circularity already exist. The most important solution is to improve design. Early design choices decide how well plastics and machines can be recycled. Austria and Germany stressed this strongly, and all other regions confirmed it. Companies should integrate design-for-recycling, modularity and retrofit-ready principles as standard practice.

Better cooperation is another essential solution. Every region emphasised that plastics processors, machine producers, waste managers and regulators must work more closely together. Joint working groups, shared terminology and cross-border pilots can speed up the progress. AT/DE and HU/RS/BiH highlighted the value of joint roadmaps and mixed expert groups.

Modernising technology is key. Machine producers can offer retrofits, upgrades and automation tools that improve recyclate handling. AT/DE named retrofits as a major lever. HU/RS/BiH saw retrofit pilots as an immediate action. CZ/SK pointed to modernisation and AI as long-term solutions.

Strengthening material flows is another shared priority. Regions recommend better waste collection, more sorting capacity and improved traceability. RO/MD proposed local collection points and small-scale sorting steps as early actions. AT/DE stressed digital tracking and harmonised classifications to improve quality and transparency.

Improving skills is essential for implementing circular technologies. Dual-education programs, training partnerships and knowledge-transfer activities can close skill gaps. AT/DE highlighted the need for clearer communication and shared understanding. CZ/SK emphasised dual education and lifelong learning systems. HU/RS/BiH stressed training on circular design and material handling.

Regulatory improvements must support these actions. AT/DE called for clearer rules and stronger enforcement. RO/MD identified the need for laws that support recyclable and biodegradable materials. CZ/SK asked for reforms to simplify hiring and improve EOL regulations. These measures create stability for long-term investments.

Together, these solutions create a clear path forward: improve design, strengthen cooperation, modernise technology, secure material flows, build skills and stabilise regulation. All regions agree that these steps can unlock circularity in both plastics processing and machine production.

6 Annex

6.1 AT|Austria / DE|Germany, Baden-Württemberg

Interreg Danube Region

Co-funded by the European Union

Plan-C

Strategy development for the circular transformation of the entire value chain on a holistic level

Deliverable D.3.2.3 - RECORD SHEET

Business Upper Austria

AWS – Austria Business Service

Technology Center Horb

All interregional groups are responsible for evaluating and completing this check list, which contains individual parameters that should be evaluated and recorded during workshop D.3.2.2. In some cases, short statements are sufficient; in other cases, please provide an evaluation comment, upload files, photo documentation, etc.

Involved Partners:	e.g. Austria/Germany TZH Horb, Assia Buchmann Biz-Up, Jennifer Quoc & Vanessa Ikic AWS, Raffael Wolff
Participants:	Cloeren GmbH, Ultra Polymers, SWS Packaging, Michael Kunstofftechnik, Ultra Polymers, KC Plastics Cluster, FCIO, SKZ, ICT Fraunhofer, BMIMI, Plastics Europe
Date of proceeding:	12.12.2025
Place of proceeding:	Online via Teams

Input from Workshop topic:
Hurdles & Lifts Machine Producers and Plastics Processors have previously identified hurdles in the circularity of their products. Ways to “lift” each other over said hurdles have been proposed.
Short description of the workshop, possible images, photos, etc.:
Input from the previous workshops was used to derive a roadmap towards circularity. Possible starting points for cooperation were established. A transnational roadmap for cooperation shall be established.

Deriving a Roadmap from the Workshop results:

Which sectors of a product's lifespan were most important? Which area should be focused on?
The discussion highlighted that multiple life cycle stages are equally decisive, with strongest emphasis on: • **Design & engineering (incl. machine and product design):** decisions on material diversity, recyclability, retrofit readiness, and compliance are made here and strongly determine circular feasibility later • **Use phase / operation of machines:** retrofit and upgrading are key levers to extend life cycles and enable circular business models, but require willingness and investment • **End-of-life & waste management:** collection, sorting, and the quality and traceability of waste streams are crucial—especially for mechanical and chemical recycling routes and for removing contaminants (odour, hazardous substances) • **Market & regulation (cross-cutting):** fair competition, stable regulation, enforceable standards, and import controls impact the entire life cycle and can either enable or undermine circular solutions Overall, the life cycle was treated as a system, where weaknesses in enforcement, infrastructure, or market control (e.g., misdeclared imports) disrupt circularity across all phases. The strongest priority is to establish enabling and reliable framework conditions that make circularity economically viable and practically implementable: • **Regulatory clarity, consistency and enforcement:** reduce contradictory rules (e.g., waste classification), provide stability, and strengthen controls against misdeclared imports and "fake" recyclates from non-European countries • **Fair competition and protection of European innovation:** address pressure from heavily underpriced imports (materials and machinery) to safeguard industrial viability and investment capacity • **Quality, traceability and data for waste/recyclate streams:** improve monitoring systems (e.g., digital tracking/EDM-like approaches), develop suitable classifications/keys, and ensure recyclates are safe and usable (contaminant control) • **Joint value-chain collaboration:** the plastics and machine industries should act more as one ecosystem, strengthening networks and joint projects to solve waste stream and uptake barriers • **Market uptake & user expectations:** increase customer awareness, reduce overly strict quality expectations for recyclates, and support technology openness (including incentives and innovation-friendly public procurement) • **Communication & education:** improve the image of plastics and start awareness-building early (training, education, universities), while showcasing best practices and positioning "Made in Europe" as a quality and sustainability standard

In short: **stable rules + enforcement + fair markets + traceable material flows + coordinated stakeholder action** were seen as the decisive focus to unlock circularity.
Which measures were deemed the most useful?
• **Stronger enforcement and controls** on imports (recyclates and machinery), incl. correct declaration and checks against "fake recyclates" and contamination to prevent non-compliant materials from entering European recycling streams • **Stable, coherent regulation** (less contradictory rules, clearer waste classification/definitions; reduced complexity especially for SMEs) • **Incentive-based policy instruments** ("reward more, punish less"), incl. **innovation-friendly public procurement** to create lead markets for circular solutions • **Retrofit & life-extension programs** for machinery, supported by investment readiness and viable service/business models • **Improved traceability and data systems** for waste/recyclate streams (digital tracking/EDM-like systems, better coding/classification) • **Value-chain collaboration and joint action** (plastics and machine industry acting as one voice; stronger stakeholder networking to place and manage waste streams) • **Market uptake measures**: customer education, more technology openness, and more realistic quality requirements for recyclates (potentially supported by policy incentives) • **Communication, best practices, and education** to address the negative image of plastics and build circular thinking early (training/education)
Which measures were deemed the most feasible?
• **Stakeholder networking and joint projects** across the value chain (processors, machine builders, recyclers, associations) - can start immediately with existing structures • **Awareness-raising and customer education** (incl. showcasing best practices) to reduce misinformation and increase acceptance of recycled materials • **Retrofit assessments and pilot retrofits on existing machinery**, plus development of related service offerings/business models (step-by-step implementation) • Workshop-based roadmapping (company transformation roadmaps using shared templates) to define actionable next steps with firms • **"Made in Europe" positioning and communication** as a quality/sustainability differentiator (industry-led, low regulatory dependency) • **Pragmatic simplification guidance for SMEs** (e.g., clear checklists/interpretation support for compliance) even before legislation changes • **Improved documentation/traceability at company level** (starting with available digital tools), as a practical first step toward broader system solutions
Is there anything that could be tackled immediately? Which measures need conditions that are not currently present in economy/technology? Define short-term, mid-term and long-term actions.
Yes (short-term / 0–6 months): • Strengthen **stakeholder networking** and joint working groups (processors, machine builders, recyclers, associations)

- **Awareness raising & customer education** (facts, best practices, "total value" of recyclate vs. virgin)
- **Retrofit quick assessments** + first pilots; develop retrofit-related service/business offers
- Run **company roadmap workshops** using the shared concept + record sheet; define concrete next steps
- Improve **basic traceability/documentation** of waste and recyclate streams at company level (available digital tools/templates)
- Start **"Made in Europe"** positioning and communication (quality, compliance, service, sustainability)

Which measures need conditions that are not currently present (economy/technology)?
Main missing conditions:

- **Effective enforcement and controls** on imports (misdeclared recyclates, contaminants; underpriced machinery)
- **Stable and coherent regulation** (less contradictory rules, clearer waste definitions/classifications, SME-feasible requirements)
- **Sufficient infrastructure and usable feedstock quality** (sorting/collection quality; recycling capacity if exports are restricted)
- **Harmonised traceability systems** (cross-border data/standards; agreed coding/classification; auditing approaches e.g., mass balance)

Action plan

Short-term actions (0–6 months)

- Set up **value-chain coordination** and joint problem-solving formats
- Deliver **targeted communication** + best-practice examples to improve acceptance of recyclates
- Start **retrofit pilots** and define a "retrofit-ready" checklist
- Implement **roadmap workshops** and capture actions in record sheets
- Introduce **basic stream documentation** (quality, contaminants, origin, use cases)

Mid-term actions (6–24 months)

- Scale **retrofit programs** and circular service models
- Align **customer specs and acceptance criteria** for recycled-material processing (more technology openness)
- Develop **policy/industry recommendations** focused on enforcement, import controls, and simpler SME compliance
- Improve **waste stream quality** through regional sorting/collection pilots and agreed KPIs

Long-term actions (24+ months)

- Establish **system-wide traceability / EDM-like systems** with harmonised classifications and cross-border governance
- Expand **European recycling infrastructure and capacity** to manage volumes domestically
- Implement **robust verification and monitoring** of recycled content (incl. auditing/mass balance where relevant)

- Strengthen a durable **“Made in Europe” circularity standard** linked to measurable performance

Documentation on Miroboard: Plan C- Workshop 3 - Miro

Constructing a Pathway to move forward → assign measures to their appropriate track sections (sorted by importance)			
	Shortterm	**Midterm**	**Longterm**
Section 1: Policy & Fair Competition (Framework + Enforcement) highest priority	• Consolidate a joint industry position on urgent enforcement gaps (imports, misdeclaration, contaminants) • Engage policy/authorities with clear "doable now" asks (controls, guidance for SMEs)	• Implement stronger import controls and market surveillance (recyclates + machinery) • Improve regulatory coherence (reduce contradictions, clearer waste definitions/classification)	• Establish harmonised cross-border governance for enforcement and market monitoring • Create stable long-term policy signals that enable investment (predictable rules)
Section 2: Market Uptake & Demand Activation (Customers + Procurement)	• Awareness raising for customers (recyclate-value, realistic expectations, best practice) • Start "Made in Europe" positioning	• Align customer specs and acceptance criteria for recycled-material processing • Promote innovation-friendly public procurement as a lead-market instrument	• Embed circular performance criteria in procurement and market standards at scale • Establish "Made in Europe" as a recognized circularity/quality benchmark
Section 3: Circular Technology & Retrofit (Machines + Life Extension)	• Run retrofit quick checks; select pilot machines and define a retrofit roadmap • Develop retrofit-oriented service/business offerings (upgrades, maintenance, performance)	• Scale retrofit programs and standardise retrofit packages for common machine types • Integrate eco-design / circular design features into new machine development	• Mature circular machine systems (modularity, remanufacturing, take-back, digital support) • Broad deployment of circular business models across the sector
Section 4: Material Streams, Quality & Traceability (Waste/Recycle Control)	• Improve company-level documentation of material streams (basic traceability templates) • Identify and prioritise critical contaminants/issues (e.g., substances limiting use)	• Regional pilots to improve sorting/collection quality and supply reliability • Introduce better classifications/keys for relevant waste streams (where feasible)	• Implement system-wide traceability / EDM-like approaches with harmonised coding • Robust verification frameworks for recycled content (incl. auditing/mass balance)

Section 5: Collaboration, Skills & Culture (Ecosystem + Capacity Building**)**	• Set up cross-value-chain working groups and joint projects (fast start, low barrier) • Start training/knowledge formats (SME compliance help, technology openness)	• Institutionalise collaboration formats (clusters, transfer teams, solution-uptake series) • Build structured education modules (vocational training, universities)	• Establish durable cooperation platforms and long-term joint innovation pipelines • Embed circular thinking in standard training and professional qualification pathways

6.2 BiH | Bosnia and Herzegovina / HU | Hungary / RS | Republic of Serbia

Strategy development for the circular transformation of the entire value chain on a holistic level

Deliverable D.3.2.3 - RECORD SHEET

Foundation for Innovation, Technology and Transfer of Knowledge

Innovation Center, Faculty of Mechanical Engineering

Omnipack First Hungarian Packaging Technology Cluster

Innoskart Business Development Nonprofit Kft.

All

interregional groups are responsible for evaluating and completing this check list, which contains individual parameters that should be evaluated and recorded during workshop D.3.2.2. In some cases, short statements are sufficient; in other cases, please provide an evaluation comment, upload files, photo documentation, etc.

<table>
<tr><td>Involved Partners:</td><td>FITT, ICMF, Innoskart, Omnipack</td></tr>
<tr><td>Participants:</td><td>
<table>
<tr><th>Institution/organisation</th><th>Country</th></tr>
<tr><td>FITT</td><td>BiH</td></tr>
<tr><td>FITT</td><td>BiH</td></tr>
<tr><td>Employers' Association Gračanica</td><td>BiH</td></tr>
<tr><td>The chamber of economy of Tuzla Canton</td><td>BiH</td></tr>
<tr><td>Ministry of Economy of the Tuzla Canton</td><td>BiH</td></tr>
<tr><td>Hungarian Plastics Association, Hungary</td><td>HU</td></tr>
<tr><td>Business incubator Novi Sad doo</td><td>RS</td></tr>
<tr><td>FEFA Faculty</td><td>RS</td></tr>
<tr><td>Chamber of Commerce and Industry of Serbia</td><td>RS</td></tr>
<tr><td>Hungarian Economic Development Agency</td><td>HU</td></tr>
<tr><td>ICMF</td><td>RS</td></tr>
<tr><td>Faculty of Mechanical Engineering, University of Tuzla</td><td>BiH</td></tr>
<tr><td>Plastoflex</td><td>BiH</td></tr>
<tr><td>Secretariat for Environmental Protection, City of Belgrade</td><td>RS</td></tr>
<tr><td>Chamber of Commerce and Industry of Serbia</td><td>RS</td></tr>
<tr><td>ICMF</td><td>RS</td></tr>
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<tr><td>Date of proceeding:</td><td>11.12.2025</td></tr>
<tr><td>Place of proceeding:</td><td>Online</td></tr>
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Input from Workshop topic:
Hurdles & Lifts Machine Producers and Plastics Processors have previously identified hurdles in the circularity of their products. Ways to “lift” each other over said hurdles have been proposed.
Short description of the workshop, possible images, photos, etc.:
The “Macro-regional Workshop on Strategy Development for Circular Value Chain Transformation” was organised with the aim of jointly addressing key barriers to circular transformation in the plastics and machine-manufacturing sectors. The workshop brought together representatives of public authorities, chambers of commerce, industry associations, business support organisations, academia from Bosnia and Herzegovina, Serbia and Hungary. Building on the results of the first two sector-focused workshops, participants were divided into two mixed working groups. One group focused on barriers related to plastics production and processing, while the other addressed challenges in the machine-manufacturing sector. Discussions were highly practical and based on real market conditions, technical constraints and regulatory frameworks. Emphasis was placed on distinguishing between ambitious circular economy targets and what is currently feasible from a technological, economic, organisational and market perspective. As the output of the workshop we have concrete and experience-based solution proposals (“lifts”). At the end all identified lifts from both sectors were presented in a wrap-up session.

Deriving a Roadmap from the Workshop results:

Which sectors of a product's lifespan were most important? Which area should be focused on?
Which measures were deemed the most useful?
In the machine-manufacturing sector, the most significant measures were those that strengthen the sector's enabling role in circular value chains and maximise resource efficiency over the equipment life cycle. The measures deemed most significant include: • Applying design-for-circularity principles in machinery development, particularly to improve compatibility with recycled and alternative materials. • Upgrading and retrofitting existing equipment to better support circular production processes. • Strengthening cooperation between machine manufacturers and downstream industries, especially plastics processors, to better align technical requirements. • Creating incentives for durability, maintenance, refurbishment and extended service life of machinery. • Providing training and knowledge transfer, enabling greater process flexibility and adaptation to circular inputs. These measures reflect the shared view among participants that circularity in the machine-manufacturing sector depends largely on early design choices, continuous technological adaptation and closer cross-sector cooperation. For the plastics sector, the most significant measures were those that address structural bottlenecks across the value chain, particularly in material availability, quality and end-of-life management. The measures considered most significant include: • Introducing targeted financial incentives and compensation mechanisms to address the price gap between virgin and recycled materials. • Strengthening coordination between waste management systems and industrial demand, in order to secure more stable and higher-quality recyclable material streams. • Developing realistic and harmonised regulatory frameworks that reflect the technical limits of recycling processes. • Aligning product and material design with actual recycling capabilities, focusing on applications where recycled content is technically viable. • Implementing systemic end-of-life solutions, including waste-to-energy options where material recycling is not feasible. Overall, the discussion emphasised that progress in the plastics sector depends on better alignment between policy ambitions, industrial reality and the practical limits of current recycling systems.
Which measures were deemed the most feasible?
In the machine-manufacturing sector, the most feasible measures were those that can be introduced gradually and cost-effectively, often by building on existing practices. The measures deemed most feasible include:

- Training and skills development related to circular design and processing of recycled materials.
- Design-for-circularity integration in new machinery, without radical changes to existing production lines.
- Cross-sector cooperation and knowledge exchange between machine manufacturers and downstream users.
- Retrofitting and incremental upgrades of existing equipment.
- Service-based approaches, including maintenance and performance optimisation.

For the plastics sector, the most feasible measures were those that can be implemented within existing institutional, technical and market frameworks, without requiring major structural changes.

The measures considered most feasible include:

- Targeted financial incentives and subsidies for the use of recycled materials, building on existing support schemes.
- Improved coordination and information exchange between waste management actors and plastics producers.
- Technical guidance and training for handling recyclates and managing material variability.
- Incremental improvements in collection and sorting systems, rather than complete system overhauls.
- Waste trading mechanisms to compensate for insufficient local material availability.

Is there anything that could be tackled immediately? Which measures need conditions that are not currently present in economy/technology?
Define short-term, mid-term and long-term actions.

Machine-manufacturing sector
Short-term actions (can be tackled immediately)

- Integrate design-for-circularity principles into new machinery development.
- Deliver training and skills development related to circular design and material processing.
- Strengthen cooperation between machine manufacturers and downstream industries.
- Support incremental retrofitting and performance optimisation of existing equipment.

These actions can be introduced within current market and technological conditions.
Mid-term actions (require partial enabling conditions)

- Develop modular and adaptable machine designs enabling easier upgrades.
- Expand service-based business models, including maintenance and refurbishment.
- Launch joint pilot and demonstration projects with research institutions and users.
- Introduce standards and certification schemes for circular machinery.

These measures require coordinated investment, market acceptance and institutional support.
Long-term actions (require conditions not currently present)

- Establish fully circular machine life cycles, including remanufacturing and reuse.
- Integrate circular performance criteria into procurement and investment decisions.

- Build long-term value-chain partnerships supporting closed-loop systems.

These actions depend on structural market changes, long-term demand and supportive policy frameworks.

Plastics sector

Short-term actions (can be tackled immediately)

- Improve coordination and information exchange between waste management actors and plastics processors.
- Introduce or adjust targeted financial incentives to support the use of recycled materials.
- Provide technical guidance and training on handling recyclates and managing material variability.
- Focus on applications where recycled materials are already technically viable.

These actions can be implemented using existing institutional frameworks and do not require major technological changes.

Mid-term actions (require partial enabling conditions)

- Upgrade collection and sorting systems to improve waste quality and homogeneity.
- Support product and material redesign to increase compatibility with recycled content.
- Establish stable waste trading mechanisms to secure sufficient material volumes.
- Adjust regulatory frameworks to better reflect technical recycling limits.

These measures require moderate investment, regulatory alignment and stronger cross-actor coordination.

Long-term actions (require conditions not currently present)

- Deploy advanced recycling technologies where environmentally and economically justified.
- Integrate systemic end-of-life solutions, combining material recycling with waste-to-energy approaches.
- Achieve stable circular material loops through long-term public–private cooperation.

These actions depend on significant investment, long-term policy stability and technological maturation.

Constructing a Pathway to move forward → assign measures to their appropriate track sections (sorted by importance)			
	Short-term	Midterm	Longterm
Alignment of design, materials and technical reality.**Early design decisions were identified as the most impactful lever across both sectors.*	Integrate design-for-circularity principles in products and machinery	Redesign products and equipment to increase compatibility with recycled materials	Achieve systemic design alignment across value chains
Strengthening production and technological adaptability. **Technology adaptability enables circularity but requires phased investment and learning.*	Training and technical guidance for processing circular materials	Retrofitting and upgrading existing production equipment	Deployment of advanced circular production technologies
Improving material availability and end-of-life systems. **Material availability and quality were key bottlenecks, especially in the plastics sector.*	Better coordination between waste management and industry	Upgrading collection, sorting and waste trading system	Integrated circular end-of-life systems (recycling + waste-to-energy)
Economic and regulatory enabling framework. **Economic and regulatory conditions strongly influence feasibility and scaling.*	Targeted financial incentives and subsidies	Regulatory alignment with technical recycling limits	Stable long-term policy and investment frameworks
Cooperation, awareness and market uptake. **These measures support and amplify technical and systemic changes over time.*	Strengthen inter-industry cooperation and networking	Certification, eco-labelling and market recognition	Cultural shift towards circular products and solutions

Strategy development for the circular transformation of the entire value chain on a holistic level

Deliverable D.3.2.3

Responsible Partners:

SPK, TUKE, UTB, Plastr

All interregional groups are responsible for evaluating and completing this check list, which contains individual parameters that should be evaluated and recorded during workshop D.3.2.2. In some cases, short statements are sufficient; in other cases, please provide an evaluation comment, upload files, photo documentation, etc.

Involved Partners:	Slovakia, Czech rep.
Participants:	SPK, TUKE, UTB, Plastr
Date of proceeding:	21.11.2025
Place of proceeding:	Demänová, Slovakia

Input from Workshop topic:
Hurdles & Lifts Machine Producers and Plastics Processors have previously identified hurdles in the circularity of their products. Ways to “lift” each other over said hurdles have been proposed.
Short description of the workshop, possible images, photos, etc.:
Input from the previous workshops was used to derive a roadmap towards circularity. Possible starting points for cooperation were established. A transnational roadmap for cooperation shall be established.

Deriving a Roadmap from the Workshop results:

Which sectors of a product's lifespan were most important? Which area should be focused on?

Based on the workshop activities and the scoring system used to prioritised different sectors, we have identified the key areas of focus for both Plastics and Machinery.

1. Plastics Sector

From the five initial areas evaluated, the following three were prioritisedd as the most critical to the product's lifespan:

- **Design (Material & Technology):** Focusing on the selection of sustainable materials and advanced technological solutions right at the inception.
- **Manufacturing Process:** Optimizing production to ensure efficiency and minimize environmental impact.
- **End of Life (EOL):** Addressing what happens to the product after its primary use to ensure a circular approach.

2. Machinery Sector

In the Machinery category, the prioritization was determined by the highest number of points assigned during the workshop. The top three areas are:

- **Design:** Establishing a strong foundation for the machine's functionality and longevity.
- **Construction:** Ensuring the physical build meets high standards of durability and performance.
- **Recycling:** Prioritizing the ability to reclaim and reuse components and materials at the end of the machine's utility.

Which measures were deemed the most useful?

Based on the workshop findings, we have identified specific barriers and the most effective solutions (measures) across the prioritised sectors for both Plastic Processors and Machine Producers.

1. **PLASTIC PROCESSORS**

A. Design (Material & Technology)

- **Environmental Impact:** To address environmental concerns, the focus is on **rationalizing the manufacturing process**, defining the **required ratio of recycled content**, and implementing **Design for Recycling (D4R)** principles.
- **Labor Shortage:** To tackle the lack of experts, proposed measures include **dual education programs**, enhanced employee **motivation**, and strategic **recruitment** of new talent.

B. Manufacturing Process

- **Raw Material Quality:** Challenges with low-quality materials should be solved through stricter **legislative standards** and **supplier diversification**.
- **Expertise Gaps:** Addressing the lack of technical knowledge via continuous **training** and **dual education**.
- **Logistics & Tech Parameters:** Focus on **optimisation/rationalization** and transitioning to **bio-based and eco-friendly sources**.

C. End of Life (EOL)

- **Legislation:** The primary need is for greater **clarity and simplicity** in legal frameworks.

- **Product Collection:** To improve EOL collection rates, we suggest **consumer education**, targeted **advertising**, and **incentive programs** (e.g., competitions).
- **Innovation Speed:** Leveraging **Artificial Intelligence (AI)** to accelerate the implementation of new solutions.

2. MACHINE PRODUCERS

A. Machine Construction

- **Competitiveness:** Key measures include **legislative support**, fostering **internal improvements (innovations)**, and better **marketing/information sharing**. Furthermore, a shift toward **functional construction and design** is essential.
- **Knowledge Transfer:** Strengthening the sector through the **support of technical education**.

B. Design

- **Resource Constraints:** To manage raw material dependency, the focus is on **developing technologies that are less resource-intensive**.

C. Recycling

- **Technical & Financial Feasibility:** Reducing high recycling costs through **R&D (Research & Development)**, **automation**, and direct **financial/motivational support** for recycling activities.
- **Social Attitude:** Improving public perception by increasing **awareness regarding the benefits and utility of recycling**.

Which measures were deemed the most feasible?

The findings from the Holistic Workshop highlight a clear distinction between measures that are immediately actionable and those that, while useful, face significant barriers to implementation.

Common Key Challenges (Plastics & Machinery)

Both sectors identified two primary obstacles that require collective action:

1. EU Legislation: Addressed by active participation in the inter-departmental review process for European legislative proposals.
2. Human Resources: Addressed by supporting dual education at secondary schools, involving students in practical corporate tasks, and providing lifelong learning for technical staff and designers.

1. Plastic Processors (Converters)

Highest Feasibility & Utility:

- Dual education and on-the-job training: The most feasible measure.
- Process rationalization: High implementation potential.
- Energy efficiency: Reducing energy consumption in the manufacturing process.
- Modernisation: Updating technologies and material usage.

Lowest Feasibility:

- Transitioning to bio-based and eco-friendly sources.
- Simplifying End-of-Life (EOL) legislation.
- Subsidies for applied research and implementation of universal product design.

TOP URGENT Priorities:

1. Specialist Shortage: Tackled via dual education, specialist recruitment, and designer motivation.
2. Logistics & Tech Parameters: Solved through optimisation and the gradual introduction of bio-based materials.
3. Legislative Clarity: Urgent need for simpler and clearer EOL regulations.

2. Machine Producers

Highest Feasibility & Utility:

- Functional Engineering & Design: Perfect alignment of feasibility and usefulness.
- Technical Education: Including specialised training for machine operators.
- Recycling Awareness: Promoting the benefits of recycling to the industry and public.

Lowest Feasibility:

- Developing resource-light technologies.
- Stimulating state/government demand.

TOP URGENT Priorities:

- Competitiveness: Addressed through legislative measures, improved procedures, marketing, and functional design solutions.
- Raw Material Resources: Development of technologies with lower material requirements.
- Qualified Personnel: Focused training for technicians and machine operators.

Is there anything that could be tackled immediately? Which measures need conditions that are not currently present in economy/technology?
Define short-term, mid-term and long-term actions.

The transition to a circular economy presents several challenges, ranging from material quality and environmental impact to legislative hurdles and financial demands. Based on the workshop discussions, we have categorized the necessary measures into short, mid, and long-term actions.

1. Immediate Actions (Short-term)

These measures can be implemented using current resources and do not require significant changes to the economic or technological landscape.

- For PLASTIC PROCESSORS:
  - **In-house Training:** Bringing external trainers directly into companies to upskill current staff.
  - **University Partnerships:** Strengthening ties with academic institutions for knowledge exchange.
  - **Education Outreach:** Popularization lectures at schools to promote **dual education**.
  - **Recruitment:** Launching active campaigns for new talent acquisition.

- For MACHINE PRODUCERS:
  - **Process Optimisation:** Immediate focus on refining current workflows.

- **Public Relations & Marketing:** Increasing awareness among both the general public and professional sectors.
- **Skill Development:** Immediate technical training for operators and technicians.

2. Measures Requiring Currently Unavailable Conditions (Mid to Long-term)
Some measures are currently stalled due to missing legislative, economic, or technological frameworks.

- **Legislative Barriers:**
  - **EU Representation:** A stronger, more active presence of Slovak representatives in EU legislative processes is required.
  - **Employment Laws:** There is a critical need to relax legislative requirements for hiring foreign experts to mirror the flexibility seen in countries like Germany.
  - **Adult Education Act:** This legislation is currently not active in practice, hindering systematic lifelong learning.
- **Deposit-Refund Systems:** The legislative framework for collection systems needs substantial restructuring before it can be effectively scaled.
- **Economic & Tech Constraints:** High financial costs for **R&D** and the significant investment required for **low-emission/bio-based materials** remain prohibitive for many players.

Constructing a Pathway to move forward
→ assign measures to their appropriate track sections (sorted by importance)

	Short-term (0–1 Year)	Mid-term (2–5 Years)	Long-term (5+ Years)
Human Capital	External **in-house training** & specialised **recruitment**.	Full integration of **Dual Education** & university partnerships.	Implementation of the **Adult Education Act** & lifelong learning systems.
Design & Technology	Process **optimisation** & functional engineering.	**Modernisation** of technologies & materials.	R&D into **resource-light** & universal product design.
Legislation	Active participation in **EU legislative** reviews.	Relaxation of hiring laws for **foreign experts**.	New legislative framework for **EOL & Deposit-Refund systems.**

Sustainability	**Energy efficiency** audits & quick-win reductions.	Scaling up Design for Recycling (**D4R**).	Full transition to **bio-based** and eco-friendly raw materials.
Market & Society	Marketing campaigns & **public awareness** of recycling.	Increasing **functional competitiveness** on the market.	Stimulating **State Demand** for circular products/machinery.

Strategy development for the circular transformation of the entire value chain on a holistic level

Deliverable D.3.2.3 - RECORD SHEET

ICMPP & CLUSTERO (ROMANIA)

SORINTEX (R. MOLDOVA)

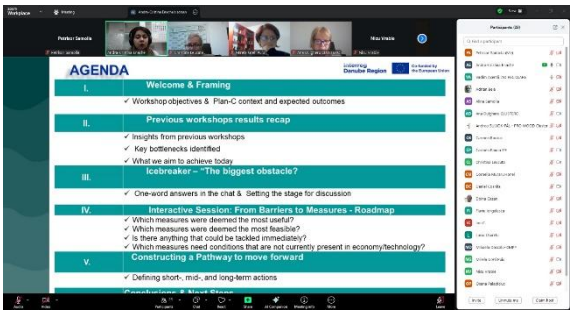
All interregional groups are responsible for evaluating and completing this check list, which contains individual parameters that should be evaluated and recorded during workshop D.3.2.2. In some cases, short statements are sufficient; in other cases, please provide an evaluation comment, upload files, photo documentation, etc.

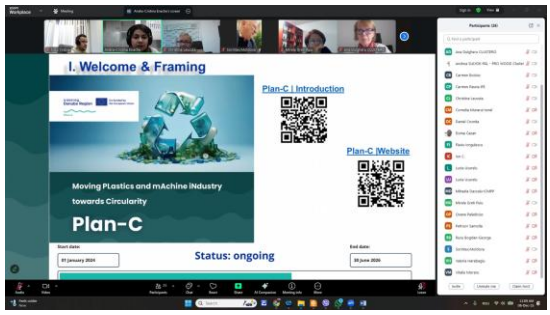
Involved Partners:	ICMPP & CLUSTERO (ROMANIA) SORINTEX (R. MOLDOVA)
Participants:	26 participants from: Organizers : • ICMPP (RO) • SORINTEX (MD) • CLUSTERO (RO) 3 SMEs : • DATSA TEXTIL (RO) • SC EDERA SRL (RO) • RELIANS CORP SRL (RO) 1 Large Enterprise: • UNICREDIT S.P.A (RO) 5 Higher education and research organizations • INMA Bucharest – National Institute for Research and Development of Machines and Installations for Agriculture and the Food Industry (RO) • Institute for Economic Forecasting – Romanian Academy (RO) • "Alexandru Ioan Cuza" University of Iași – Faculty of Computer Science (RO) • "Alexandru Ioan Cuza" University of Iași – Faculty of Chemistry (RO) • "Grigore T. Popa" University of Medicine and Pharmacy Iași (RO) 1 Local public authority • Iași City Hall (RO)
Date of proceeding:	08.12.2025
Place of proceeding:	Online

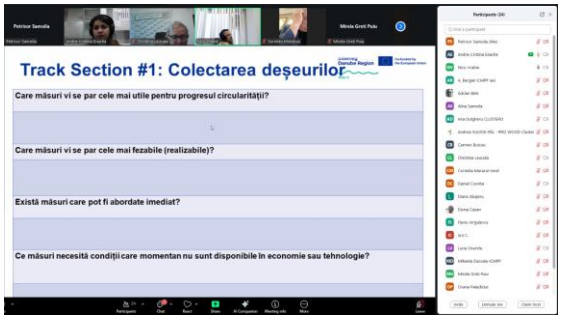
Input from Workshop topic:
Participants discussed the main track sections and hurdles identified in previous workshops and explored practical measures to overcome them. Building on earlier workshop results, the group collaboratively prioritised solutions and outlined initial steps for a shared circularity roadmap.
Short description of the workshop, possible images, photos, etc.:

The workshop was an interactive and collaborative session aimed at advancing the circularity roadmap for the plastics value chain within the Plan-C project. Building on insights and barriers identified in previous workshops, participants reviewed key findings and worked together to transform existing challenges into concrete, implementable measures.
The agenda included:

- ✓ A short introduction to the workshop objectives.
- ✓ A recap of results from previous workshops.
- ✓ An icebreaker exercise to identify the most relevant perceived obstacles.
- ✓ An interactive session where participants prioritised measures based on their potential impact and feasibility.







The group then structured these measures into short-, medium-, and long-term actions, forming the basis of a preliminary pathway for the transnational circularity roadmap.

A Pathway to move forward

	Short-term	Mid-term	Long-term
1. Colectare deșeuri	Campanii de conștientizare; puncte locale; inițiative comunitare	Extindere sisteme separate; centre dedicate; pilot take-back	Infrastructură națională; legislație; tehnologii inteligente
2. Sortare deșeuri	Sortare comunitară; ghid separare textile	Depozite locale; identificare plastic; standardizare	Facilități automate/AI; trasabilitate completă
3. Reintegrare reciclate	Testare mică (izolații, construcții)	Lanțuri stabile; colaborări industriale și cercetare	Adoptare largă; lanțuri circulare integrate
4. Design pentru circularitate	- Conștientizare; ghiduri; design simplificat	Design pentru dezasamblare; materiale alternative; instruire	Standard industrial și național; integrare totală materiale sustenabile
5. (Re)utilizare/ Educație & Guvernanță	Educație circulară; promovare reutilizare; scheme simple	Extindere reutilizare; rețele reparații; colaborare inter-industrială și inter-ministerială; pilot curricula	Reformă curricula națională; ecosisteme pe termen lung; stimulente și reglementări

The workshop concluded with a summary of outcomes and a briefing on how the contributions will be integrated into upcoming Plan-C deliverables.

Deriving a Roadmap from the Workshop results:

Which sectors of a product's lifespan were most important? Which area should be focused on?
Based on the group discussion, the most relevant areas for improving circularity in the plastics value chain were: • Waste collection • Waste sorting • Reintegration of recycled materials • Design for circularity • Reuse and repurposing of plastics and textiles These focus areas reflect persistent systemic gaps in Romania and the Republic of Moldova, particularly limited efficient collection systems, insufficient sorting capacity, and limited circular design practices.
Which measures were deemed the most useful?
Participants identified the following measures as having the highest potential impact: • Improving national and local waste collection systems, including specialised collection points (e.g., textile bins, dedicated plastic centers). • Developing infrastructure for pre-sorting and identifying plastic types to increase recycling quality. • Introducing legislation to limit the production and use of non-recyclable plastics and promote biodegradable alternatives. • Implementing circular economy education programs from kindergarten to post-secondary levels. • Promoting reuse of textiles (e.g., for insulation or construction materials). • Strengthening cooperation between ministries, municipalities, industry, and research institutions. • Providing incentives for recyclers and businesses implementing circular solutions. • Conducting SWOT analyses for industries with significant plastic use to identify barriers and opportunities.
Which measures were deemed the most feasible?
These measures are considered feasible with existing resources, infrastructure, and technology: • Awareness campaigns and educational programs. • Introducing textile and plastic collection points at local level. • Strengthening collaboration between public authorities, schools, businesses, and research institutions. • Developing guidelines for sorting and separating textile fractions. • Initiating pilot programs for textile reuse and small-scale demonstration activities
Is there anything that could be tackled immediately? Which measures need conditions that are not currently present in economy/technology? Define short-term, mid-term and long-term actions.
Immediate/ Short-term Actions (can be tackled now): • Launch awareness and education campaigns on circular economy and proper waste separation. • Set up localized collection bins for plastics and textiles. • Implement basic sorting improvements at community level (schools, companies, neighborhoods). • Initiate small-scale cooperation projects between recyclers and research institutes.

- Share good practices across regions and sectors.

Mid- to Long-term Actions (require conditions not yet present in economy or technology):

- Legislative changes to limit non-recyclable plastics and enforce producer responsibility.
- Establish large-scale sorting and recycling facilities capable of handling complex plastic and textile streams.
- National-level integration of circular economy curriculum (requiring Ministry of Education approval).
- Economic incentives and subsidy frameworks for recyclers (requiring policy action).
- Development and adoption of biodegradable alternatives at industrial scale.
- Mapping plastic-intensive industries and conducting sector-specific SWOT analyses.

Constructing a Pathway to move forward **→ assign measures to their appropriate track sections (sorted by importance)**			
	Short-term	**Mid-term**	**Long-term**
Section 1: Waste Collection	Awareness campaigns for population; setting up local collection points, including textile bins; small-scale community collection initiatives	Expanding separate collection systems; improving logistics; establishing dedicated collection centers for sorted plastics and textiles; pilot schemes for take-back by producers	National integrated collection infrastructure; legislation to enforce producer responsibility; smart collection technologies
Section 2: Waste Sorting	Basic sorting at community/municipal level; guidance for separating textile fractions (e.g., polyester mixes)	Development of local sorting depots; identifying plastic types for efficient recycling; standardization of sorting methods	Large-scale, automated/ AI-driven sorting facilities with advanced identification technologies; full material traceability;
Section 3: Reintegration of Recycled Materials	Small-scale testing of recycled plastics and textiles in secondary applications (e.g., insulation, construction)	Creating stable supply chains for recycled materials; industrial collaborations; cooperation with industry and research institutions	Industry-wide adoption of recycled materials; circular supply chains fully integrated into production
Section 4: Design for Circularity	Awareness for producers; initial guidelines; encouraging mono-material or simplified product designs; basic design-for-reuse guidance	Design for disassembly and modularity; evaluation of material alternatives (biodegradable or non-plastic materials); sectorial SWOT analyses; industry training	Industry-wide circular design standards and regulations; national design standards; full integration of sustainable materials in production
Section 5: Use & Reuse	Circular economy education campaigns;	Scaling reuse systems; repair and refurbishment	National curriculum reforms; long-term

/ Education & Governance	promoting reuse behaviors; simple take-back schemes for products and textiles	networks; cross-industry collaboration; inter-ministerial coordination; pilot curricula	reuse ecosystems embedded in market and legislation; incentives for recyclers; regulatory frameworks enforced by authorities