

Moving PLastics and mACHine iNdustry towards Circularity Plan-C

Summary of the identified challenges and opportunities in the machine producer industry

This publication was developed as part of the Plan-C project, which promotes circular transformation in the plastics and machinery sectors across the Danube Region. The project fosters collaboration between producers and manufacturers to co-create reusable, remanufacturable products and machines. Linked to the Transnational Action Plan, it offers practical steps and innovative solutions for turning waste into value and supporting sustainable, cross-border industrial development.

The primary challenges and needs for the plastics machinery sector in the Danube Region include the lack of robust waste management and recycling infrastructure, insufficient integration between industry players, and the need for significant investment in circular economy technologies. Key needs focus on developing robust circular economy models, enhancing technological capacity for recycling secondary materials, fostering transnational collaboration, implementing eco-design principles for machinery, and leveraging digital tools like AI to improve efficiency and reduce costs.

KEY CHALLENGES

- **Inadequate Circular Infrastructure:** Many countries, particularly in the southern and eastern areas of Danube Region, lack the necessary infrastructure for waste management and the efficient processing of secondary plastic materials.
- **Environmental Concerns and Regulations:** The industry faces increasing pressure from environmental issues like plastic pollution and evolving EU Green Deal regulations, which require a transition from a linear to a circular economy model.
- **Technological & Efficiency Gaps:** Existing recycling technologies are often inefficient, prone to contamination, and energy-intensive, making large-scale implementation challenging.
- **Economic and Political Constraints:** Challenges include the high cost of bio-based raw materials, limited funding opportunities, and economic barriers that hinder investment. Moreover, there are fewer political incentives for circular practices in the machine sector compared to other industries.
- **Limited Industry Integration:** The lack of cooperation between plastics manufacturers, recyclers, and end-users, limits the effective transformation of the value chain and slows the adoption of circular principles.
- **Low Awareness of the Circular Economy:** Both machinery manufacturers and users in the plastics industry often lack awareness and understanding of circular economy concepts and their relevance to the machinery sector as a whole.



KEY NEEDS



- **Circular Economy Transformation:** The main need is to transform the entire plastics machine value chain towards circularity, focusing on reuse, maintenance, remanufacturing, and recycling of both products and equipment.
- **Technological Development and Adoption:** There is a strong need for advanced technologies, including those for efficient and high-quality recycling of secondary plastic materials, as well as energy-efficient processing solutions.
- **Eco-design for Machinery:** Manufacturers need to design machines that are robust, long-lasting, repairable and adaptable, in order to align with circular economy principles.
- **Transnational Cooperation:** Enhanced cooperation among countries in the Danube Region is essential to share best practices, knowledge, and resources, to achieve a coordinated transformation.
- **Investment and Digitalization:** Increased investment in circular economy initiatives is needed, along with the adoption of digital tools and AI to improve cost efficiency, optimize processes, and enable new circular business models.
- **Capacity Building and Awareness:** Efforts are needed to strengthen knowledge and capacity within companies to implement circular solutions, encouraging a shift in mindsets and business practices.

CHALLENGES & OPPORTUNITIES

This section compares the challenges and opportunities identified by the project partner countries across legal/policy, technical, economic, environmental and societal dimensions. It shows how different contexts shape opportunities and constraints, and where targeted action or shared learning can have the greatest impact.

By reviewing regulatory conditions, technological capacity, market factors, and societal attitudes, the analysis highlights common trends, key strengths, and potential areas for collaboration.

MACHINE INDUSTRY

LEGAL / POLICY



Challenges

- Lack of specific regulatory requirements and enforcement
- Inconsistent application and compliance with local, national, and international regulations
- Less political incentives

Opportunities

- Financial and regulatory incentives: e.g. provide tax reliefs and financial support to companies advancing the circular economy
- Establishing quality standards and certifications for recycled materials, refurbished equipments and products
- Regulatory compliance and enforcement
- Leveraging waste management regulations
- Implementation of material sourcing policy
- Incentives in public procurement for engaging in circular economy

TECHNICAL



Challenges

- Material Supply and Quality Constraints
 - Limited availability of sustainable and recycled materials
 - Inconsistent quality and supply of recycled materials
- Outdated Technology and Implementation Barriers
- Infrastructure and Logistical Gaps for End-of-Life
 - Lack of infrastructure and processes for effective waste management and recycling
 - Inadequate infrastructure for waste collection
 - Limited mechanisms for the collection, refurbishment, and recycling of used machine parts
- Quality Guarantee and Standardization Issues
 - Difficulty in providing users with quality guarantees for refurbished parts/equipment

Opportunities

- Design for circularity / Implementing Eco-design
- Materials research focusing on materials with better performance regarding longer lifetime, processability, recyclability
- Adopting Industry 4.0 and Smart Technologies to enhance energy management and process optimization
- Investing in refurbishment and recycling infrastructure
- Identifying new material sources

SOCIETAL/BEHAVIORAL



Challenges

- Lack of awareness and understanding of circular economy
- Resistance to change
- Limited market acceptance
- Human capital deficiencies / skill shortages
- Low consumer participation: low consumer awareness and participation in take-back programs

Opportunities

- Educational program & employee training to raise awareness
- Changing mindset of (machine) user and producer
- Collaboration and partnerships with local recycling facilities and circular economy networks
- Enhancing transparency in the supply chain

ECONOMIC



Challenges

- High costs of transition to circular economy
- High initial costs for upgrading to energy-saving machinery and processes
- Lack of financial support and incentives
- Market price sensitivity and cost competitiveness
- Insufficient / limited market demand

Opportunities

- Adopting circular business models (leasing, service-based offerings, circular supply chains, product as a service,...)
- Cost savings and financial efficiency (Refurbished parts are typically cheaper than new ones.)
- Emergence of new markets
- Access to funding and incentives
- Developing domestic production

ENVIRONMENTAL



Challenges

- Energy inefficiency and renewable integration
- High energy consumption and greenhouse gas emissions
- Insufficient involvement of renewable energy sources
- Challenges in technological fluid and auxiliary management
- Lack of infrastructure and processes for effective waste management and recycling
- Limited availability of sustainable and recycled materials for machine production

Opportunities

- Resource efficiency and management
 - Improvement of water management, waste prevention strategy
- Emphasis on environmental aspects and machine life
- Adopt renewable energy
- Extension of machine lifecycles through repair, refurbishment, recycling
- Supply chain resilience: to be less reliant on international suppliers
- Material sustainability: increasing share of recycled materials

CONCLUSION

While each country faces unique challenges in their transition towards a circular economy, there are significant similarities in the needs that can be leveraged across the region. Common needs include advancing technological capabilities, implementing supportive policies, enhancing public awareness, and fostering cross-sectoral collaboration. Addressing these challenges while capitalizing on shared needs can accelerate progress towards a more sustainable and circular economy across the Danube Region, benefiting both the environment and economic competitiveness.

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