Interreg Danube Region

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Plan-C

Key factors and cornerstones

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Document Content

Introduction

The summary of key factors and cornerstones is elaborated in the form of tables based on data collected by individual project partners during the preparation of the Regional Reports, the basis for the Transnational mapping of status quo in machine industry. The identified challenges and opportunities are processed through frequency and content analysis by thematic category (Table 1-10):

- Generic level
- Material sourcing for plastic processing machine production
- Processing technologies including energy savings
- Technological waste management
- Collection of used machine parts and their reintegration/refurbishment/recycling

A summary of the key challenges and fundamental issues to be addressed in machine design is provided in Tables 11 and 12.

Further evidence to support these conclusions can be found in the document Transnational mapping of status quo in machine industry, which summarises the facts provided by representatives of the different regions participating in the project.

Table 1 Challenges – Generic level

Austria	Cost regarding the introduction of circular economy as a business model	Less political incentives in this field compared to others	Demand	
Bosnia and Herzegovina	Lack of awareness and understanding of circular economy principles among industry stakeholders			
Czech Republic	Lack of awareness of the circular economy on the side of both machine manufacturers and users (plastics industry) in relation to machine manufacturers/industry	Plastics processors focus only on the reprocessing of plastic waste rather than on the sustainability of the production facility (low demand for innovative solutions)	High cost of transition to circular economy (business model)	
Germany	High Costs	Skill Shortages	Resistance to Change	
Hungary	No plastic			
Moldova				
Romania	Dependence on imported machines and technology for plastic processing	Limited adoption and integration of circular technologies	Lack of awareness of the benefits and practices associated with the circular economy	
Serbia	Lack of awareness and education about the importance of the process of circular transformation in the machine industry	Lack of financial tools and instruments to encourage circular innovation in the machinery sector	Inconsistency of legal expectations and application of regulations in practice	There is often insufficient market demand for products made from recycled materials or designed for longevity; consumers and clients may prefer cheaper, non-circular options, and there may be limited incentives for businesses to develop and market circular products
Slovakia	Innovation solutions in the field of new products within the circular economy			
Summary	Lack of financial tools and instruments to encourage circular innovation in the machinery sector	Lack of awareness of the circular economy on the side of both machine manufacturers and users (plastics industry) in relation to machine manufacturers/industry	Less political incentives in this field compared to others	There is often insufficient market demand for products made from recycled materials or designed for longevity; consumers and clients may prefer cheaper, non-circular options, and there may be limited incentives for businesses to develop and market circular products

Table 2 Opportunities – Generic level

Austria	New markets are evolving	Investor relations	Marketing opportunities	Ecological aspects	
Bosnia and Herzegovina	Educational initiatives and capacity-building programs				
Czech Republic	Raising awareness among employees of machine building and plastics processing companies of the need to promote sustainable machinery (emphasis on environmental aspects and machine life)	Reliefs (e.g. tax) for companies verifiably involved in the circular economy and vice versa	Suppression of a consumerist mindset in companies	EMS/EMAS implementation and monitoring of compliance	Ecodesign
Germany	Policy Support	Collaboration			
Hungary	CNC				
Moldova					
Romania	Developing domestic production of machines and equipment	Promote financial support and incentives	Enhance knowledge and training	Facilitate access to circular technologies	
Serbia	The introduction and implementation of various educational programs, formal and informal, as well as the implementation of employee training in relevant companies, with the aim of raising awareness and examining the possibilities for accelerated transformation	Introduction of greater benefits (and other mechanisms) to help companies that accept the process of circular transition	Controlled application of the law in practice, including the system of penalties		
Slovakia	Strengthening of some non-community groups and communities, which would supervise plastic pollution in nature				
Summary	The introduction and implementation of various educational programs, formal and informal, as well as the implementation of employee training in relevant companies, with the aim of raising awareness and examining the possibilities for accelerated transformation	Promote financial support and incentives	Introduction of greater benefits (and other mechanisms) to help companies that accept the process of circular transition	Marketing opportunities	Ecodesign, Suppression of a consumerist mindset in companies

Table 3 Challenges – Material sourcing for plastic processing machine production

Austria	Regulations	Safety aspects		
Bosnia and Herzegovina	Limited availability of sustainable and recycled materials for machine production			
Czech Republic	High quality materials with a long service life	If possible, recycled (at least partially) and recyclable materials	Resource scarcity must always be kept in mind	
Germany	Cost Competitiveness	Supplier Engagement		
Hungary	No sourcing			
Moldova	There are NO regulations that would require recycled plastics to be used as raw material in the production process			
Romania	Limited access to capital for plastic processing firms (particularly SMEs)	Limited use of recycled materials due to concerns about quality and availability.		
Serbia	Limited availability of high-quality recycled materials	High cost of sustainable materials	Lack of incentives for using recycled materials	Inconsistent quality and supply of recycled materials
Slovakia	Requirements of mainly automotive companies for recycled products, but with properties that these recycled products can sometimes achieve only under the assumption of a higher input price			
Summary	Limited availability of sustainable and recycled materials for machine production	High cost of sustainable materials	Supplier Engagement	Safety aspects
	Inconsistent quality and supply of recycled materials	Lack of incentives for using recycled materials		

Table 4 Opportunities – Material sourcing for plastic processing machine production

Austria	Access to new material sources	Local suppliers		
Bosnia and Herzegovina	Investment in research and development, identifying alternative materials and sustainable sourcing methods			
Czech Republic	Identification of new sources of materials	Materials research - materials with better performance with regard to longer lifetime, processability (energy intensity, environmental aspect), recyclability, etc.		
Germany	Innovation in Materials	Circular Economy		
Hungary	Grants			
Moldova	Regulation that would require recycled plastics to be used as feedstock for plastics production			
Romania	Facilitate access to funding and investment	Leverage circular economy networks	Design for circularity (design resource-efficient and sustainable materials technologies)	Enhance transparency in the supply chain (sustainability of sourced materials)
Serbia	Establish partnerships with local recycling facilities to ensure a steady supply of high-quality recycled materials	Implement financial incentives, such as subsidies or tax breaks, for using sustainable materials	Develop quality standards and certification systems for recycled materials	Promote research into alternative, sustainable materials
Slovakia	Creating a strategy and policy in the field of plastic waste recycling (reasonable solutions to the advantages of certain types of recycling and their use)			
Summary	Materials research - materials with better performance with regard to longer lifetime, processability recyclability, etc.	Investment in research and development, identifying alternative materials and sustainable sourcing methods	Establish partnerships with local recycling facilities to ensure a steady supply of high-quality recycled materials	Identification of new sources of materials
	Design for circularity (design resource-efficient and sustainable materials technologies)	Implement financial incentives, such as subsidies or tax breaks, for using sustainable materials		Develop quality standards and certification systems for recycled materials

Table 5 Challenges – Processing technologies including energy savings

Austria	Innovations are missing			
Bosnia and Herzegovina	Outdated and inefficient technologies leading to high energy consumption and waste generation			
Czech Republic	Inefficient use of energy	Insufficient involvement of renewable energy sources	Closed-loop of cooling water, including the possibility of waste heat recovery	Process fluids, lubricants and other technological auxiliaries with lower environmental impact
Germany	Technology Adaption	R&D Investment		
Hungary	Renewable energy sources			
Moldova	Machine industry is practically based on imports. Most often are imported second-hand machines.			
Romania	High energy consumption and greenhouse gas emissions	High initial costs for upgrading to energy-saving machinery and processes	Technical barriers to implementation	
Serbia	Outdated machinery and equipment	High energy consumption due to inefficient processes	Limited investment in energy-efficient technologies	Lack of technical expertise in energy-saving methods
Slovakia	Insufficient offer of recycling technologies, it is usually necessary to focus on the development of special lines or single-purpose machines			
Summary	Inefficient use of energy	Outdated and inefficient technologies leading to high energy consumption and waste generation	High initial costs for upgrading to energy-saving machinery and processes, Limited investment	Closed-loop of cooling water, including the possibility of waste heat recovery
	Insufficient involvement of renewable energy sources	Technical barriers to implementation		Process fluids, lubricants and other technological auxiliaries with lower environmental impact

Table 6 Opportunities – Processing technologies including energy savings

Austria	Possibility of saving money in the long run	Better image for all stakeholders (investors/customers… especially regarding ESG)		
Bosnia and Herzegovina	Adoption of energy-efficient technologies and process optimization			
Czech Republic	Renewable energy and improved energy management	Selection of technological auxiliaries based on green chemistry principles (including R&D)	Improvement of water management	Integrating of Industry 4.0
Germany	Government Incentives	Technological Advancements		
Hungary	EU fundings			
Moldova	Focus on importing/manufacturing high-quality, durable machines that have longer operational lifespans, reducing the frequency of replacement, increasing energy savings and the generation of waste			
Romania	Adopt energy-saving technologies	Promote renewable energy integration	Use of smart manufacturing and IoT to enhance energy management and process optimization	
Serbia	Invest in modern, energy-efficient machinery and equipment	Provide financial support for energy audits and upgrades	Train workforce in energy-saving practices and technologies	Encourage the adoption of Industry 4.0 technologies for better process optimization and energy management
Slovakia	Support through large manufacturers better properties of plastic products with the aim of longer sustainability			
Summary	Encourage the adoption of Industry 4.0 technologies for better process optimization, use of smart manufacturing and IoT	Adoption of energy-efficient technologies and process optimization	Provide financial support for energy audits and upgrades	Improvement of water management
		Renewable energy and improved energy management	Invest in modern, energy-efficient machinery and equipment	Selection of technological auxiliaries based on green chemistry principles (including R&D)

Table 7 Challenges – Technological waste management

Austria	Design of the different components	Lack of infrastructure		
Bosnia and Herzegovina	Lack of infrastructure and processes for effective waste management and recycling			
Czech Republic	Collection and subsequent recycling of technological waste	Collection and consequent recycling of process auxiliaries (lubricants, coolants, etc.) or proper disposal with low environmental impact	Prevention of leakages of operating fluids and technological auxiliaries	
Germany	Waste Management Systems	Recycling Infrastructure	Regulatory Hurdles	Economic Viability
Hungary	MOHU			
Moldova	There is no national plastic waste collection network. Only some large economic agents collect plastic packaging, and some city halls have plastic waste collection bins – mainly city halls near the capital Chisinau.			
Romania	Lack of regulations specific for technological waste management	Limited availability of advanced technological waste management		
Serbia	Inadequate infrastructure for waste collection and recycling	Lack of regulatory frameworks and enforcement	Limited knowledge of best practices in waste management	High costs associated with waste processing
Slovakia	Innovation solutions in the field of new products within the circular economy require high costs for product development and testing			
Summary	Lack of infrastructure and processes for effective waste management and recycling	Waste Management Systems – limited knowledge and availability	Lack of regulations specific for technological waste management	Collection and consequent recycling of process auxiliaries (lubricants, coolants, etc.) or proper disposal with low environmental impact Prevention of leakages of operating fluids and technological auxiliaries

Table 8 Opportunities – Technological waste management

Austria	Design for Recycling	Saving materials and eventually costs	EPR	
Bosnia and Herzegovina	Development of advanced recycling technologies	Improvement of waste management systems		
Czech Republic	Use of a waste prevention strategy	Promoting research into the recyclability and recycling of process waste and technological auxiliaries	Monitoring compliance with legislative requirements	
Germany	Innovative Solutions	Industry Collaboration		
Hungary	Export			
Moldova	Development of a vast plastic waste collection network			
Romania	Designing equipment that is easy to disassemble, maintain, and recycle	Increasing the share of recycled materials	Partnerships with waste management companies	Adopting circular business models and innovative waste processing technologies
Serbia	Develop and modernize infrastructure for waste collection and recycling	Implement clear and enforceable regulations to support waste management	Educate businesses on best practices and benefits of proper waste management	Provide subsidies or incentives for companies that invest in waste processing technologies
Slovakia	Discount in the framework of public procurement - directory of manufacturers within the circular economy, as well as their products			
Summary	Designing equipment that is easy to disassemble, maintain, and recycle	Develop and modernize infrastructure for waste collection and recycling	EPR Adopting circular business models and innovative waste processing technologies	Promoting research into the recyclability and recycling of process waste and technological auxiliaries
	Provide subsidies or incentives for companies that invest in waste processing technologies	Implement clear and enforceable regulations to support waste management	Discount in the framework of public procurement - directory of manufacturers within the circular economy, as well as their products	Educate businesses on best practices and benefits of proper waste management

Table 9 Challenges – Collection of used machine parts and their reintegration/refurbishment/recycling

Austria	Commitment of all stakeholders	Mindset of the customers that old can be good as new	Mindset of the producers, that it is possible to make money with used products	
Bosnia and Herzegovina	Limited mechanisms for the collection, refurbishment, and recycling of used machine parts.			
Czech Republic	Production of robust, long-life equipment, enabling repair and replacement of parts, ecodesign	To increase users' (plastics industry) confidence in refurbished equipment, to show users that not only new machines can be powerful and of high quality	Create a system of take-back of parts/production equipment	Provide users with quality guarantees for refurbished parts/equipment
Germany	Logistics	Refurbishment Capacity	Economic Incentives	Standardization
Hungary	Legalization			
Moldova	Compliance with local, national, and international regulations regarding waste handling, hazardous materials, and recycling.	Limited demand for refurbished or recycled parts, particularly if they are perceived as inferior to new parts.		
Romania	Limited collection of industrial used machine parts	Difficulties in the effective collection and transportation of technological waste	Limited market acceptance for refurbished or recycled machine parts	
Serbia	Lack of systems for collecting and sorting used machine parts	Limited facilities for refurbishment and recycling	Low consumer awareness and participation in take-back programs	
Slovakia	Insufficient offer of recycling technologies, it is usually necessary to focus on the development of special lines or single-purpose machines			
Summary	Limited mechanisms for the collection, refurbishment, and recycling of used machine parts.	To increase users' (plastics industry) confidence in refurbished equipment, to show users that not only new machines can be powerful and of high quality	Mindset of the producers, that it is possible to make money with used products Commitment of all stakeholders	Provide users with quality guarantees for refurbished parts/equipment

Table 10 Opportunities – Collection of used machine parts and their reintegration/refurbishment/recycling

Austria	Less reliant on international suppliers for rare materials	New customers through models like renting (product as a service)			
Bosnia and Herzegovina	Establishment of take-back schemes, refurbishment centres, and partnerships with recycling facilities				
Czech Republic	Raise awareness of machine users (plastics industry) about the possibility of refurbishing and remanufacturing equipment, as well as the possible take-back of parts/equipment = change the mindset of users		Create a system for the take-back of equipment/parts supported by a standard/legislation	Guarantee the quality of refurbished equipment/parts based on a standard	
Germany	Circular Business Models	Public-Private Partnerships			
Hungary	New markets				
Moldova	Refurbished parts are typically cheaper than new ones, providing cost-effective solutions for customers needing replacements. This can be particularly appealing in industries where equipment maintenance and repair are significant expenses				
Romania	Extension product lifecycles	Encouraging repair, refurbishment and recycling	Ensuring the quality and functionality of refurbished parts	Development of new business models focused on leasing, service-based offerings, and circular supply chains	Developing recycling infrastructure
Serbia	Establish a nationwide system for collecting and sorting used machine parts	Invest in refurbishment and recycling facilities	Launch awareness campaigns to promote take-back programs	Provide financial incentives for companies that refurbish or recycle used parts	Develop standards for refurbished products to ensure quality and reliability
Slovakia	Focus on the training of experts in the field of eco-design, and the implementation of solutions in practice				
Summary	Raise awareness of machine users (plastics industry) about the possibility of refurbishing and remanufacturing equipment, as well as the possible take-back of parts/equipment = change the mindset of users	Create a system for the take-back of equipment/parts supported by a standard/legislation	Guarantee the quality of refurbished equipment/parts based on a standard	Provide financial incentives for companies that refurbish or recycle used parts Invest in refurbishment and recycling facilities	Focus on the training of experts in the field of eco-design, and the implementation of solutions in practice, Extension product lifecycles

Conclusion

Table 11 Summary of identified challenges

Generic level	Lack of financial tools and instruments to encourage circular innovation in the machinery sector	Lack of awareness of the circular economy on the side of both machine manufacturers and users (plastics industry) in relation to machine manufacturers/industry	Less political incentives in this field compared to others	There is often insufficient market demand for products made from recycled materials or designed for longevity; consumers and clients may prefer cheaper, non-circular options, and there may be limited incentives for businesses to develop and market circular products
Material sourcing for plastic processing machine production	Limited availability of sustainable and recycled materials for machine production	High cost of sustainable materials	Supplier Engagement	Safety aspects
	Inconsistent quality and supply of recycled materials	Lack of incentives for using recycled materials		
Processing technologies including energy savings	Inefficient use of energy	Outdated and inefficient technologies leading to high energy consumption and waste generation	High initial costs for upgrading to energy-saving machinery and processes, Limited investment	Closed-loop of cooling water, including the possibility of waste heat recovery
	Insufficient involvement of renewable energy sources	Technical barriers to implementation		Process fluids, lubricants and other technological auxiliaries with lower environmental impact
Technological waste management	Lack of infrastructure and processes for effective waste management and recycling	Waste Management Systems – limited knowledge and availability	Lack of regulations specific for technological waste management	Collection and consequent recycling of process auxiliaries (lubricants, coolants, etc.) or proper disposal with low environmental impact
				Prevention of leakages of operating fluids and technological auxiliaries
Collection of used machine parts and their reintegration/ refurbishment/ recycling	Limited mechanisms for the collection, refurbishment, and recycling of used machine parts.	To increase users' (plastics industry) confidence in refurbished equipment, to show users that not only new machines can be powerful and of high quality	Mindset of the producers, that it is possible to make money with used products	Provide users with quality guarantees for refurbished parts/equipment
			Commitment of all stakeholders	

Table 12 Summary of identified opportunities

Generic level	The introduction and implementation of various educational programs, formal and informal, as well as the implementation of employee training in relevant companies, with the aim of raising awareness and examining the possibilities for accelerated transformation		Introduction of greater benefits (and other mechanisms) to help companies that accept the process of circular transition	Promote financial support and incentives Marketing opportunities
Material sourcing for plastic processing machine production	Materials research - materials with better performance with regard to longer lifetime, processability recyclability, etc.	Investment in research and development, identifying alternative materials and sustainable sourcing methods	Establish partnerships with local recycling facilities to ensure a steady supply of high-quality recycled materials	Identification of new sources of materials
	Design for circularity (design resource-efficient and sustainable materials technologies)	Implement financial incentives, such as subsidies or tax breaks, for using sustainable materials		Develop quality standards and certification systems for recycled materials
Processing technologies including energy savings	Encourage the adoption of Industry 4.0 technologies for better process optimization, use of smart manufacturing and IoT	Adoption of energy-efficient technologies and process optimization	Provide financial support for energy audits and upgrades	Improvement of water management
		Renewable energy and improved energy management	Invest in modern, energy-efficient machinery and equipment	Selection of technological auxiliaries based on green chemistry principles (including R&D)
Technological waste management	Designing equipment that is easy to disassemble, maintain, and recycle	Develop and modernize infrastructure for waste collection and recycling	EPR Adopting circular business models and innovative waste processing technologies	Promoting research into the recyclability and recycling of process waste and technological auxiliaries
	Provide subsidies or incentives for companies that invest in waste processing technologies	Implement clear and enforceable regulations to support waste management	Discount in the framework of public procurement - directory of manufacturers within the circular economy, as well as their products	Educate businesses on best practices and benefits of proper waste management
Collection of used machine parts and their reintegration/ refurbishment/ recycling	Raise awareness of machine users (plastics industry) about the possibility of refurbishing and remanufacturing equipment, as well as the possible take-back of parts/equipment = change the mindset of users	Create a system for the take-back of equipment/parts supported by a standard/legislation	Guarantee the quality of refurbished equipment/parts based on a standard	Provide financial incentives for companies that refurbish or recycle used parts
			Focus on the training of experts in the field of eco-design, and the implementation of solutions in practice, Extension product lifecycles	Invest in refurbishment and recycling facilities