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SECONDARY RAW MATERIALS IN THE CIRCULAR ECONOMY

A MULTI-PERSPECTIVE STUDY

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Introduction

Secondary raw materials represent a fundamental element of the circular economy, where recycling technologies facilitate the efficient reintegration of materials into the production process. This has the effect of reducing reliance on primary resources, which are often non-renewable. According to the Organisation for Economic Co-operation and Development (OECD, 2019), two of the five business models associated with the circular economy are directly linked to secondary raw materials. These models advocate for the use of renewable materials and sustainably sourced biological resources, thereby converting end-of-life products into secondary raw materials. Consequently, it is crucial to analyse secondary raw material markets at both the European Union (EU) and national levels.

The EU Circular Economy Action Plan, updated in 2020, emphasises the significance of secondary raw materials, including aluminium, paper, cardboard, wood, glass, plastic, textiles, construction waste and bio-waste, in the production of primary products. The European Environment Agency's Report No. 12/2022, entitled "Investigating Europe's Secondary Raw Material Markets," provides a comprehensive examination of the eight principal secondary raw material markets (zu Castell-Rudenhausen et al., 2022). This document is of particular significance for Lithuania and other countries that joined the EU in 2004, as the updated Action Plan (European Commission, 2020b) calls for concentrated efforts in sectors with high resource consumption and potential for circularity. Specific recommendations are put forth for industries including plastics, textiles, e-waste, food, water and nutrients, packaging, batteries, vehicles, buildings, and construction, with the aim of enhancing Europe's sustainability and competitiveness.

The trade in waste and secondary raw materials is of significant importance, encompassing environmental protection, social justice, and economic sustainability. Proper regulation is essential to ensure effective waste management, reduce environmental pollution, and promote sustainable recycling practices.

The European Union's commitment to a sustainable circular economy posits that waste can be viewed as a resource rather than as mere garbage. This requires a comprehensive approach to the development of legislation and policy, which

must incorporate clear definitions of the circular economy, consideration of equity issues, and robust waste management oversight, particularly in relation to waste trade. It is of the utmost importance to conduct further research into the legal, economic, and management-related aspects in order to ensure the effective implementation of the principles of the circular economy.

Steenmans and Lesniewska (2023a,b) identify four key areas for future circular economy development: systematic legislation and policy development, the delineation of clear boundaries for the circular economy, the consideration of social justice aspects, and the conduct of impact assessments. The EU is also updating legal frameworks for waste trade regulation with the objective of ensuring sustainable waste management and preventing illegal waste trade, thereby supporting the circular economy's growth.

The main objective of this monograph is to explore the theoretical and practical aspects of transforming secondary raw material markets within the circular economy framework. The following four detailed objectives have been selected for further in-depth examination:

1) To explore the theoretical, methodological and practical issues associated with the sustainable management of secondary raw materials.
2) To discuss the conceptual aspects of secondary raw material markets.
3) To investigate the good practices employed in the development of secondary raw material markets.
4) To identify the legal aspects of trade in waste and secondary raw materials.

In line with the detailed objectives of this monograph, the basis and source of its content are the selected, published scientific studies, legal documents and EU reports on secondary raw material markets, including circular economy and sustainable development conceptual frameworks and practices. These have been identified in domestic and foreign literature and subjected to critical analysis and evaluation from the perspective of the monograph's adopted objective. This comprehensive analysis comprises a narrative review of existing literature and an examination of legal acts and national court practices in selected countries (case studies).

The study is structured into four distinct sections. The opening chapter, entitled "Sustainable Management of Secondary Raw Materials," initiates the discussion by examining the fundamental assumptions underlying the concept of sustainable management of secondary raw materials. Subsequently, it addresses models for sustainable management, the opportunities and challenges faced by businesses processing secondary raw materials, as well as other critical issues related to this

topic. It includes illustrative examples and case studies that demonstrate the advantages of particular methods and processes in the selected countries.

Chapter 2, entitled "Conceptual Aspects of the Secondary Raw Material Market," investigates the conceptual aspects of the secondary raw material market, commencing with an examination of its underlying phenomenon and significance within the circular economy. This chapter identifies the key indicators used in the Circular Economy Monitoring System to represent the utilisation of secondary raw materials. Subsequently, the chapter examines the current state and potential future development scenarios of secondary raw material markets in the EU, identifying both growth opportunities and potential challenges. Furthermore, the chapter addresses the significant barriers to market development, including regulatory, economic, and technological obstacles, which will be addressed in subsequent chapters of the study.

Chapter 3, entitled "Analysis of Good Practices in Developing the Secondary Raw Material Markets," presents an analysis of effective practices in the development of secondary raw material markets, with a particular focus on illustrative examples from Belgium, the Netherlands, and Estonia. The chapter examines the ways in which these countries have advanced their secondary raw material markets through innovative strategies and policies. Furthermore, it considers the role of secondary raw material trading platforms in facilitating market development, highlighting their impact on enhancing market efficiency and connectivity. The case studies and platforms presented offer valuable insights and models for fostering robust secondary raw material markets.

The final chapter, Chapter 4 entitled "Legal Aspects of Trade in Waste and Secondary Raw Materials," examines the legal aspects of trade in waste and secondary raw materials, beginning with an overview of international regulations governing this trade. It then looks at the specifics of national regulations, highlighting differences and similarities in how different countries deal with trade in raw and secondary materials. In addition, the chapter analyses national court practice in waste management, providing insights into legal precedents and their implications for sustainable waste and resource management in Lithuania. These legal frameworks and judicial practices are crucial for ensuring effective regulation and promoting a sustainable circular economy.

The book is primarily intended for students and academics engaged in the study of circular economy, environmental law professionals, and industry leaders seeking to comprehend and capitalise on secondary raw material markets. Furthermore, non-governmental organisations (NGOs) and advocacy groups engaged in sustainability and environmental protection initiatives may also find the

book a valuable resource for advancing their work. Additionally, the book will be of interest to practitioners and policy-makers, offering valuable insights into sustainable practices, legal frameworks, and regulatory challenges. The book will also be of interest to secondary audiences, including environmental consultants, industry stakeholders, NGOs, and educators, who will find its in-depth analysis and practical examples from the selected countries beneficial.

The present monograph was prepared by an international team of researchers engaged in the project entitled "Towards the Circular Economy Transformation: An assessment of the secondary raw material markets from legal, economic, and management perspectives." The individual contributions of the authors to the book are as follows: Chapter 1 (Marek Szarucki), Chapter 2 (Ligita Gasparėnienė and Rita Remeikienė), Chapter 3 (Rita Remeikienė and Ligita Gasparėnienė), and Chapter 4 (Snieguolė Matulienė). The research was conducted with the support of an internal grant from the Mykolas Romeris University Foundation for the Promotion of Research Activities, specifically the "Funding of Joint Projects of Groups of Scientists and Researchers with a Foreign Scientist" programme, in 2023. The publication was financed through a subsidy granted to the Krakow University of Economics.

Chapter 1

Sustainable Management of Secondary Raw Materials

1.1. Essence of managing secondary raw materials sustainably

According to the report by the OECD (2022), "only 9% of plastic waste is recycled (15% is collected for recycling but 40% of that is disposed of as residues). Another 19% is incinerated, 50% ends up in landfill and 22% evades waste management systems and goes into uncontrolled dumpsites, is burned in open pits or ends up in terrestrial or aquatic environments, especially in poorer countries." Managing waste presents one of society's most significant challenges. However, waste management has been an integral part of human communities since ancient times. Recycling, although termed in the 20th century, has been practiced since early civilisations, exemplifying humanity's ability to find value in discarded items. The aphorism "one man's rubbish may be another's treasure" encapsulates this sentiment. Waste management has evolved alongside human communities, population growth, and the development of commerce. In the late 20th and early 21st centuries, changes in consumption and production patterns, influenced by increased global connectivity in finance, trade, and travel, have further transformed waste management dynamics (Letcher & Vallero, 2019). The practical implementation of certain measures related to the concept of sustainable development not only aims at reducing environmental degradation, but also focuses on regenerating its health (Dobre-Baron, et al., 2021). This stems from our shared responsibility to ensure the foundations of sustainable development for future generations. These future strategic orientations aim to mitigate waste production and facilitate efficient waste management by transitioning away from the linear "take-make-consume-throw" model towards the holistic 4R approach ("reduce-reuse-recycle-redesign").

Given the global scarcity of natural resources, the primary challenge for producers lies in maximising efficiency while increasingly incorporating secondary raw materials. This shift should result in enhanced environmental performance throughout the lifecycle of products, fostering demand for products and production

technologies with superior sustainability attributes, and empowering consumers to make informed choices. Therefore, secondary raw materials and their management will be conceptualised within the broader framework of waste management.

There is no universally accepted definition of waste. However, the EU Waste Framework Directive (European Parliament and the Council, 2008, Art. 3) provides a commonly used definition: "any substance or object which the holder discards or intends or is required to discard." This definition has remained unchanged for over three decades and applies to all waste, regardless of whether it is destined for disposal or recovery operations. Since its initial publication in 1975, the Waste Framework Directive has undergone several revisions, resulting in Directive 2008/98/EC on waste in November 2008, with subsequent amendments. These revisions have established fundamental concepts and definitions concerning waste management, including definitions of "waste," "recycling," and "recovery." The revised Waste Framework Directive has clarified the definition of "waste" by issuing specific articles that formally introduce the concepts of "by-products" and "end-of-waste." The introduction of a definition of by-products in Article 5 of the Waste Framework Directive acknowledges the situations in which materials may fall outside the definition of waste. This change aims to recognise that many materials can have value and potential uses beyond being classified as waste.

"By-products" are materials that are reused or repurposed before entering the waste stream. They denote the point at which an item categorised as "waste" ceases to be such and consider the transitions into a secondary raw material, as outlined in the end-of-waste criteria. The distinction between waste and by-products is detailed in the revised Waste Framework Directive.

The updated Waste Framework Directive places a heightened focus on waste prevention. Consequently, the waste hierarchy – comprising prevention, preparing for reuse, recycling, recovery, and disposal – is positioned at the core of the EU waste management policies (see Figure 1).

In the presented waste hierarchy, consisting of five levels, different actions are recommended (Osmani & Villoria-Saez, 2019, p. 367). At the prevention level, which is the most desirable, the following recommendations should be followed: using less material in design and manufacture; keeping products for longer; reusing products; using less hazardous materials. Preparing for the reuse level suggests checking, cleaning, repairing, refurbishing whole items or spare parts. The next two levels refer to the secondary raw material creation. The recycling level assumes the transformation of waste into a novel substance or product, including composting, provided that it adheres to the requisite quality standards. The level of other recovery is related to the following recommendations: anaerobic digestion, incineration

Figure 1. The EU waste hierarchy

Source: own elaboration based on European Parliament and the Council, 2008.

with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste; some backfilling operations. The disposal level, considered the least desirable option, involves landfill and incineration without energy recovery. The presented waste hierarchy is closely related to the zero-waste concept coined by Paul Palmer (2004) in 1970s in the USA. The concept presents a robust methodology for mitigating solid waste challenges (Zaman, 2015). The primary objective is to transform the resource supply chain from its current outdated model, thereby promoting the reuse and recycling of entire products and by-product materials. Thus, in the context of the EU waste management policies, it is crucial to take a deeper look at the management of secondary raw materials.

According to the Waste Framework Directive (2008), "recycling" refers to any recovery operation whereby waste materials are transformed into products, materials, or substances, whether for their original purpose or otherwise. This encompasses the reprocessing of organic materials but excludes energy recovery or the transformation of materials into fuels or for backfilling operations.

The provided definition underscores that only waste materials can undergo recycling. The classification of waste is not determined by its chemical, physical, or mechanical properties, nor by its composition or lifespan as a product. Instead,

as stipulated by the Waste Framework Directive, waste is defined by the action of discarding or the intent or requirement to discard by a holder.

The recycling process concludes at a specific point where a **secondary raw material**[1] is generated. At this stage, it ceases to be categorised as waste, thus becoming indistinguishable from a primary raw material and eligible for trade akin to any other commodity. Subsequently, products incorporating secondary raw materials (SRMs) can ultimately become waste, which initiates another cycle of potential recycling. Secondary raw materials encompass scraps generated during the processing of raw materials or materials obtained through the recovery and recycling of waste. SRMs originating from production process residues are typically reclaimed directly within the factories. Consequently, the cycle unfolds directly within production spaces. Another method of acquiring these SRMs involves the recovery and/or recycling of waste, a process occurring downstream from the selling and consumption phases of products. Certain materials, such as ferrous metals, have a long history of recovery and remelting. Conversely, the recovery of materials like glass, paper, and plastics as secondary raw materials is a more recent development. Separate collection methods for these materials facilitate the transformation of waste from a problem to a valuable resource.

It is worth mentioning that SRMs lack a precise legal definition at the European Union level. Technically, SRMs can be understood as materials capable of being recycled and reintegrated into the economy as fresh raw materials. These materials are commonly derived either from production waste or from End-of-Life (EoL) products, which are sent to recycling facilities upon reaching the end of their usable lifespan. In the framework of a circular economy, SRMs hold the same status as primary raw materials sourced from traditional extractive resources. This allows SRMs to be traded and transported similarly, thereby enhancing the security of supply chains.

Organic products can also be considered as part of the secondary raw material markets. Recent scientific research has demonstrated the potential to derive renewable energy from organic waste, thus contributing to economic growth and enhanced living standards through the utilisation of large biomass (Taghizadeh-Alisaraei, et al., 2017; Çelik & Demirer, 2015). This has spurred considerable investment in the bio-energetics sector. Additionally, the emerging field of nutri-

[1] The term "secondary" denotes the materials "created as a result of transformations" or "obtained for the second time," which aligns closely with the concept of secondary raw materials. These materials encompass items and waste that can be repurposed for various applications through processing. The production of secondary raw materials occurs through recovery processes.

energetics, which focuses on converting agro-food waste into nutraceutical and parapharmaceutical products boasting therapeutic properties, is experiencing notable growth. Recognising certain wastes as Secondary Raw Materials has led to the identification of natural bioactive molecules, known for their beneficial properties, paving the way for the development of sustainable, environmentally friendly products (Baaka, et al., 2017; Vella, et al., 2018). The review conducted by Scarano, et al. (2022) revealed that primary sectors utilising SRM predominantly include the chemical, pharmaceutical, food, and nutraceutical industries. Furthermore, it was observed that discarded parts collectively account for 50% of all fruit families.

Recycling is a foundational element of a circular economy, enabling resources and materials to be reused, reintroduced into the economy, and repurposed. What was previously deemed as waste can transform into valuable resources. To fully harness the potential of these secondary raw materials, it is important to dismantle existing barriers hindering their commercialisation, enhance waste management practices, and uphold stringent quality standards. By addressing these challenges, the industrial sector can maximise the utilisation of secondary raw materials and play a pivotal role in ensuring their safe and sustainable provision (Dobre-Baron, et al., 2021).

According to the European Environment Agency Report (zu Castell-Rudenhausen et al., 2022), secondary raw material markets are vital in advancing the circular economy within the EU. These markets have the potential to ensure both the timely circulation of good-quality recycled materials in the European economy and to minimise the need to extract natural resources. The EU waste policy concentrates on the following eight materials that constitute the SRM markets: aluminium, paper and cardboard, wood, glass, plastics, textiles, construction and demolition aggregate waste, and biowaste. Effective and efficient handling of the SRM is challenging and requires appropriate decision-making to achieve the EU waste policy objectives. In other words, it needs adopting various theoretical concepts, methodological approaches, methods, and tools of management sciences at both strategic and operational levels. Implementing suitable management approaches for second raw materials will enhance their efficiency and effectiveness, thereby contributing to the EU waste policy's goal of improving recycling, both qualitatively and quantitatively. The European Environment Agency (zu Castell-Rudenhausen et al., 2022) has established eight criteria for defining well-functioning SRM markets, which are as follows:

- substantial market share, encompassing both secondary and primary material markets;
- pricing reflecting the demand-supply dynamics;

- international or extensive transactional scope;
- economic viability independent of policy support;
- strong industrial recycling capacity;
- accessible market information;
- effective product standardisation.

What does it mean to sustainably manage the secondary raw materials? To answer this question, it is important to look back at the times, when a decade ago in the year 2015 the United Nations General Assembly approved the "2030 Agenda," outlining 17 universal goals (Sustainable Development Goals, SDGs) aimed at promoting sustainable development. Half of these goals specifically target environmental issues and emphasise the importance of preserving natural resources. Within the objectives of this Agenda, it becomes evident that a crucial step towards achieving a circular economy is the reduction of food waste. Furthermore, businesses are encouraged to mitigate food losses throughout the production chain and broaden their offerings while minimising the consumption of raw materials.

The essence of sustainable management of secondary raw materials lies in a conscientious effort to optimise their use and recycling processes, thus aiming at minimising resource losses and environmental impacts. It is a holistic approach which encompasses responsible sourcing, processing, and end-of-life management of secondary raw materials. Efficient utilisation and recycling are deemed essential not only for securing a stable supply of critical raw materials, but also for diminishing adverse environmental and human health effects (Nuss et al., 2022).

Sustainable management practices contribute significantly to reducing the dependency on primary raw materials, thereby conserving natural resources. The European Green Deal emphasises the importance of the responsible material sourcing in achieving low-carbon goals and acknowledging that the efficient use and recycling of secondary raw materials are integral components of transitioning towards sustainability. Furthermore, the essence of sustainable management extends beyond environmental considerations. By embracing circular economy principles and fostering resource efficiency, this approach seeks to create a regenerative system where waste recovery plays a pivotal role (European Commission, 2021c). It is not merely an ecological imperative, but also an economic and social strategy, which generates employment opportunities and supports local communities. Nevertheless, it is worth noting that the growing interest in the circular economy, evidenced by the intensification of public discourse, may result in the concept becoming less clearly defined, which could in turn lead to inefficiencies in the implementation of circular economy-based solutions (Mirzyńska et al., 2021).

In essence, the sustainable management of secondary raw materials is a linchpin for transitioning to a circular economy, where materials are utilised judiciously, and this contributes to the overall sustainability and resilience of our production and consumption systems (Migała-Warchoł et al., 2023). This overarching perspective lays the foundation for a comprehensive exploration of the models, challenges, opportunities, and exemplary practices in the subsequent sections of this chapter.

1.2. Models of sustainable management of secondary raw materials

While many waste management models prioritise economic and environmental factors, social aspects are often overlooked. For a waste management system to be truly sustainable, it must be environmentally effective, economically feasible, and socially acceptable. Nilsson-Djerf and McDougall (2000) emphasise that for a waste management system to succeed, it must be embraced by the population it serves.

This sentiment is echoed by Petts (2000), who argues that the most effective management of municipal solid waste must align with local environmental, economic, and social priorities. Moreover, it requires a departure from the traditional top-down approaches, where experts design solutions independently of public input, towards a more inclusive process which engages the public before critical decisions are made.

In the global quest for a more sustainable and environmentally conscious future, the effective management of secondary raw materials has emerged as a critical imperative. As societies struggle with the challenges of resource depletion, environmental degradation, and waste accumulation, the adoption of the models for sustainable management of secondary raw materials becomes a crucial necessity. This section examines various frameworks, strategies, and initiatives which are aimed at optimising the utilisation, recycling, and recovery of secondary raw materials to mitigate the environmental impact and promote the principles of a circular economy. Several models and approaches to waste management have been developed, each focusing on different aspects and objectives. These models contribute to the efficient and sustainable handling of waste materials. Table 1 presents the selected waste management models proposed by different authors and arranged in ascending order by the year of publication.

Table 1. Selected approaches and models of waste management

Author(s)	Model	Description
SUSHIL, 1993	Application of Physical System Theory and Goal Programming to Waste Management in National Planning	The system model of the economy has been integrated into a multi-objective goal programming model to address waste management goals within a specific planning period. This model considers various factors, including resource structure, standard of living, sustained economic growth, waste recycling, and environmental quality. It enables the determination of the optimal quantity of waste to be generated across different sectors and facilitates the assessment of optimal waste recycling efforts. Additionally, it assists in determining the most suitable technologies to be employed in various sectors.
Huang & Baetz, 1995	Grey Quadratic-Programming Model for Waste Flow Allocation	This modelling approach allocates waste flow within a municipal solid waste management system, addressing uncertainty.
Hicks et al., 2004	Generic Functional Model for Waste Management	This model defines and classifies waste from various perspectives and presents a functional model for waste material and flow, thus aiming at reducing disposal costs and creating value through recycling.
Rawabdeh, 2005	Model of waste assessment in a jobbing shop environment	This model serves as guidelines for identifying waste problems and opportunities for waste elimination in job shop environments.
Wiel, et al., 2012	Reverse Logistics for Waste Reduction	This model of four reverse logistics concepts enables an analysis of waste management practices in industry. It provides practical strategies for practitioners to develop and employ waste management strategies that reduce waste in cradle-to-cradle-oriented firms. It offers a useful analytical frame of reference for further research in the same and in different empirical settings.
Srivastava & Nema, 2012	Fuzzy Parametric Programming Model for Integrated Solid Waste Management	This model addresses uncertainty in waste quantity and the capacity of waste management facilities, aiding in multi-objective integrated solid waste management.
Mykhaylovych & Oleksandrivna, 2013	Stage Model of Waste Management Development	This theoretical model provides a structured approach to the development of waste management systems and outlines different stages of evolution.
Elsaid & Aghezzaf, 2015	A framework for an integrated waste management system	This framework offers a holistic view of waste management and emphasises the development of a comprehensive waste management system.

Topić & Biedermann, 2015	Integrated Solid Waste Management Model	This model focuses on planning integrated and sustainable solid waste management systems at the regional and municipal levels.
Brauweiler, et al., 2017	Model of economic and legal mechanisms of waste management	This model outlines the economic and legal mechanisms of waste management using a systemic approach. The authors explore the contemporary methods of waste management, focusing on updated practices. Through an analysis of legal norms, the model identifies the avenues for enhancing the main directions of the waste management system.
Trapp & Kanbach, 2021	Industrial Symbiosis	Relates to the concept of industrial symbiosis in agro-park clusters. This model involves the exchange and utilisation of by-products between companies within a cluster, capturing environmental and economic value. The agro-park cluster incorporates a biogas plant which transforms by-products into high-value inputs such as electricity.
Santa-Maria et al., 2022	Circular Business Model Innovation	The process of CBMI is a specific type of sustainable business model innovation. Moreover, the CBMI process can be understood as "innovating the BM (i.e., updating the elements of an existing business model, or establishing a new organisation and associated business model) to embed, implement, and capitalise on CE practices"
Pluskal et al., 2022	Optimal Location and Operation Model for Waste-to-Energy Plants	This model focuses on optimising the location and operation of waste-to-energy plants, considering future waste composition uncertainties.
Hosseinalizadeh et. al., 2022	System Dynamics-Optimisation Approach for Energy Production from Municipal Solid Waste	This hybrid model studies waste management systems, specifically focusing on energy production from municipal solid waste. The framework can be applied to all decision-making models that can add an advantage to system dynamics models. Moreover, the system dynamics model exemplifies that raising awareness, increasing Feed-in-Tariff, and investing in waste-to-energy technologies positively affect the waste management system.

Source: own elaboration based on the sources in the table.

To sum up, the models and frameworks presented in the literature (see Table 1) cover a wide range of waste management topics, from theoretical approaches to practical applications. Over the years, researchers have focused on developing comprehensive frameworks which address the specific challenges such as uncer-

tainty, optimisation, and integration of waste management systems. These models offer valuable insights and tools for policymakers, practitioners, and researchers to enhance waste management practices, improve resource efficiency, and mitigate environmental impacts. By continuing to build upon these foundational works and integrating emerging technologies and methodologies, the field of waste management can further advance towards sustainable and efficient solutions for handling waste in various sectors and contexts. These models and approaches collectively contribute to the understanding and improvement of waste management systems by addressing various dimensions of waste handling, sustainability, cost-efficiency, and environmental impact. They provide valuable insights and tools that can be employed to facilitate the sustainable management of secondary raw materials. By integrating these models and approaches into waste management practices, stakeholders can work towards more sustainable and efficient solutions for handling waste and promoting the circular economy.

A very interesting and valuable approach to managing secondary raw materials in a sustainable matter is reverse logistics. Reverse logistics focuses on the material stream of products that no longer fulfil their intended function at each stage of the supply chain lifecycle. This concept aligns with the approach of Rogers and Tibben-Lembke (2001), who categorised products with consideration of their origin (an end user or a supply chain partner). Additionally, three types of returns based on the product origin and the reason for occurrence were identified: manufacturing, distribution, and customer returns (de Brito & Dekker, 2004). The paper adopts the latter approach to returns, as outlined in Table 2. Furthermore, the authors assert that along with the material flow, there is always an associated information flow; for instance, companies are obligated to report the activities related to waste management (Kosacka-Olejnik & Werner-Lewandowska, 2018).

Reverse logistics notes that both products and packaging may undergo various processes. Given the lack of a standardised approach among researchers, Kosacka-Olejnik and Werner-Lewandowska (2018) compiled a summary of the RL information by utilising a SIPOC diagram. The authors analysed the key aspects of reverse logistics, encompassing internal and external suppliers, various input types corresponding to a supplier type, RL processes, expected outputs which depend on recovery/reprocessing options, and RL activity customers (both internal and external). Up to now, RL has primarily been discussed within the context of recovery options (reuse, remanufacturing, recycling, etc.) offered to customers. However, Kosacka-Olejnik and Werner-Lewandowska (2018) additionally examine all the types of material flows provided by internal and external suppliers and present the process structure of RL. The authors advocate for considering each

Table 2. SIPOC diagram for reverse logistics

Suppliers (S)	Input (I)	Process (P)	Output (O)	Customers (C)
Internal: organisation (e.g. quality control, production, warehouse) External: partners in the supply chain (e.g. distributor, retailer) End user (final customer)	Quality-control returns By-products Excess inventory Product recalls B2B commercial returns (e.g. wrong /damage deliverables, unsold products) Packaging Unwanted product (fully value) Warranty returns Service returns (e.g. repairs, spare parts) End-of-use returns (e.g. leasing product) End-of-life returns	Collection Evaluation Storage Recovery Redistribution Integration	Usable product (directly/ reprocessed) Usable material (directly/ reprocessed) Useable packaging Energy Waste of landfill	Internal: other department, employee External: partner in the supply chain (distributor, retailer) End user, company from other supply chain

Source: Kosacka-Olejnik & Werner-Lewandowska, 2018, p. 115.

process through the lens of the Plan–Do–Check–Act (PDCA) cycle, recognised as one of the most common and straightforward management approaches for process control and continuous improvement.

Effective reverse logistics entails implementing the systems which comprise geographically proximate nodes and recycling centres. The establishment of monitoring and reporting systems, coupled with the development of reverse logistics networks, is crucial for effective waste management and recycling.

Optimising the management of secondary raw materials involves incorporating practices that go beyond simple waste management and embrace the idea of the circular economy. This perspective seeks to close the life cycle of materials, promote the circulation of resources, and reduce the generation of non-reusable waste as much as possible.

1.3. Challenges of sustainable management of secondary raw materials

Sustainable management of secondary resources, essential for mitigating environmental degradation and fostering circular models, encounters many challenges spanning technical, economic, cultural, and organisational areas. Challenges are met at different levels: country, sector, company, and product. Addressing these challenges is vital for advancing towards circular and sustainable models.

The lack of social acceptance presents a significant challenge to sustainability initiatives aimed at managing recycled goods. Cultural attitudes towards waste and recycling greatly influence individual behaviour and societal norms (Phulwani, et al., 2020). In some societies, environmental concerns may take a backseat, with recycling viewed as inconvenient or unimportant. Crociata et al. (2015) emphasise the profound impact of cultural norms and values on waste management practices. When recycling is not deeply ingrained in cultural values, the efforts to promote sustainable behaviour may face resistance (Minelgaitė & Liobikienė, 2019). Moreover, the entrenched recycling habits and consumption patterns can be challenging to change, particularly when rooted in long-standing cultural practices.

The recycling of complex chemicals poses a multifaceted challenge due to their intricate molecular structures, diverse compositions, and potential hazards. Unlike simpler materials, these chemicals complicate identification, separation, and recycling processes. Contamination issues stemming from intentional or unintentional mixing during manufacturing or use processes exacerbate recycling challenges. Furthermore, the toxicity and hazardous properties of some complex chemicals pose environmental and human health risks, thus necessitating meticulous handling and treatment. Lack of standardised recycling methods, coupled with high energy requirements for certain processes and economic viability concerns, adds to the complexity. Addressing these challenges requires interdisciplinary approaches, technological advancements, and stringent regulatory frameworks to ensure environmental sustainability and human safety (Lange, 2009).

The collection and sorting processes present significant challenges to the long-term management of secondary raw materials. Inefficient collection systems, especially in recycling programmes, can lead to low material recovery rates. These inefficiencies stem from flaws in the design or execution of collection initiatives and diminish the overall effectiveness of recycling efforts. Additionally, sorting and separating materials pose challenges, with contamination from mixed materials being a prevalent issue. This contamination lowers the quality of recycled goods, diminishes their utility and market value. Addressing these challenges

requires improvements in the collection infrastructure, technology, and public awareness to enhance the recycling system efficiency (Cimpan et al., 2015).

It is worth mentioning, that the management of secondary raw materials faces multifaceted challenges across various stages of collection, distribution, and processing. These challenges stem from the diverse nature of waste materials, contamination issues, technological limitations, financial constraints, and regulatory gaps (Pires et al., 2019). Thus, they differ from country to country.

One significant challenge arises from the heterogeneous composition of waste materials, which complicates the collection and sorting processes. The absence of standardised waste management systems further exacerbates these challenges, making it difficult to implement efficient processes. Contamination and mixing of waste streams present additional hurdles, thus compromising the quality of recovered secondary raw materials and reducing their overall value and efficacy. Outdated or inadequate technologies hinder the efficiency of material recovery and necessitate the investments in modern technology, which often come with significant costs. Operational expenses associated with sustainable management, ranging from collection to recycling, pose financial barriers, particularly for smaller entities or regions with limited resources. Moreover, a lack of awareness regarding the importance of sustainable resource management leads to improper waste disposal practices and underscores the need for public education and awareness campaigns (Pires et al., 2019).

Community engagement in recycling and waste recovery programmes varies, with factors such as motivation and perceived insignificance affecting citizen participation levels (Knickmeyer, 2020). Ambiguities in regulations and policies surrounding the management of secondary resource hinder the establishment of sustainable practices, while misaligned incentives fail to encourage companies to embrace sustainability measures. Commercialising secondary raw materials may face challenges due to the market fragmentation and concerns regarding quality and standards. To address these challenges, the collaborative efforts involving governments, businesses, communities, and society at large are essential. This includes the implementation of innovative technologies, advancements in environmental research, policy revisions, and the development of incentives to achieve sustainable management of secondary resources, which will ultimately lead to enhanced resource management. Below are provided two country-specific examples of the challenges in the Netherlands and Poland.

The barriers and challenges faced in the transition to a Circular Economy vary depending on the stakeholders involved. According to a recent survey conducted by the *Versnellingshuis*, which serves to provide the insights to stakeholders en-

gaged in the circular economy transition, the companies active in this transition encounter several obstacles in the Netherlands. The publication "Rode Draden 2022," submitted to the parliament in February 2022, outlines eight main barriers identified by these companies:

1. Policies, laws, and regulations.
2. Coordination of the transition efforts.
3. Balancing price and value, particularly regarding the assessment of environmentally harmful effects.
4. Establishing clear direction for the transition, including defining operational targets.
5. Creating a market for circular products and services.
6. Securing financing for circular initiatives.
7. Facilitating trade in secondary products, materials, and raw materials.
8. Managing the cost of labour associated with circular practices.

In Poland, these barriers seem to be slightly different, and are mostly related to legal and organisational factors. According to Styś, et al. (2016), the major challenges stem from:

1. Ambiguities in defining organisational roles within the waste management system, including stakeholder competencies.
2. Uncertainty regarding waste ownership, transfer, and disposal, which impedes cost optimisation and limits municipal revenue from secondary raw material trading.
3. Institutional arrangements leading to market consolidation and local monopolies in municipal waste collection, influenced by public tender practices.
4. Institutional biases favouring activities that contradict waste management hierarchies, such as the prominence of incineration plants and regulated operations of Regional Municipal Waste Processing Installations.
5. Barriers hindering technological, business, social, and organisational innovation and obstructing synergies between waste management and other sectors.
6. Inadequate social campaigns contributing to low ecological awareness among the populace.

Technological barriers significantly contribute to the low level of selective waste collection in Poland. Recycling plastic waste incurs higher costs compared to glass, cardboard, or metal packaging recycling, which results in non-competitive prices for secondary plastics against primary raw materials. This challenge is

prevalent not only in Poland, but also across the EU, with recycled plastics satisfying only 6% of the total demand for plastics (Baran, 2021). The recycling sector requires substantial technological advancements to enhance profitability, as current economic losses from single-use plastic packaging alone amount to approximately 95% of their material value, estimated between EUR 70 and 105 billion annually. This issue underscores the magnitude of improper plastic waste management and leads to significant economic costs and irreversible environmental damage (Baran, 2021). The implementation of a mandatory deposit for plastic, metal, and glass containers starting from 1 January 2025 will necessitate a shift in habits of the population in Poland. Individuals will need to allocate space at home for storing bottles or cans before returning them to the shop.

Summarising, it can be stated that the implementation of the circular model requires an integrated effort and cooperation between various stakeholders. For successful management of secondary raw materials and promotion of their use, it is necessary to harmonise technological, economic, cultural, and organisational aspects. Public acceptance and cultural habits are principal factors in determining the effectiveness of recycling. Therefore, changing cultural norms and promoting public education are necessary to shape sustainable behaviour and attitudes towards waste and its recycling.

Technological innovation is vital to improving the efficiency of waste collection, sorting, and recycling. The investment in modern technologies can help overcome existing operational barriers and ensure higher quality of secondary raw materials. To implement the effective recycling procedures, it is necessary to harmonise waste management practices and standards. In addition, the development of the economic and legal incentives to encourage companies and consumers to participate in the circular economy is also crucial. Policy makers should aim at creating an enabling environment for circular economy models by reviewing the existing legal regulations and setting clear sustainability targets.

1.4. Opportunities for sustainable management of secondary raw materials

The sustainable management of secondary raw materials addresses the challenges linked to natural resource extraction and waste generation, which presents a multifaceted array of opportunities across various domains. Rooted in the circular economy principles, these opportunities not only strengthen environmental well-being, but also yield economic and social dividends. There are numerous opportunities which advance environmental conservation, resource efficiency, and eco-

nomic development. Utilising secondary raw materials, obtained from recycled or reclaimed sources, offers a multitude of benefits and prospects for sustainable practices.

According to Owen and Chiras (1995), sustainable management of secondary raw materials plays a pivotal role in conserving finite natural resources and safeguarding ecosystems. Prioritising recycling and reuse tends to reduce dependence on scarce resources, thereby easing pressure on ecosystems and biodiversity. This conservation approach helps mitigate environmental impacts associated with resource extraction, such as habitat disruption and deforestation. It also minimises the need for extensive mining or logging, thus mitigating soil degradation and preserving crucial biodiversity hotspots.

Embracing secondary raw materials promotes a circular economy, fostering a harmonious balance between human activities and the delicate ecosystems which support life on our planet. This approach aligns with global efforts to promote responsible resource utilisation and address the ongoing loss of biodiversity.

Engaging in sustainable management of secondary raw materials presents a powerful strategy for minimising harmful environmental impacts. Conventional processes involved in extracting, processing, and transporting virgin raw materials contribute significantly to pollution, habitat destruction, and carbon emissions. Opting for secondary raw materials substantially mitigates these adverse effects, fostering a more environmentally responsible approach.

By diverting materials from landfills and reducing the demand for resource-intensive extraction, production-associated carbon footprint is diminished. This shift aligns with global sustainability goals, addresses climate concerns, and mitigates the ecological harm linked to the traditional raw material procurement. Embracing secondary raw materials emerges as a practical and impactful measure to harmonise industrial activities with environmental preservation (Klemeš, et al., 2010).

In the context of saving energy and reducing emissions, the research on Shanghai's waste management by Dong et al. (2018) highlights the significant benefits associated with recycling secondary raw materials. In 2016, Shanghai's waste recycling system achieved remarkable results, thus contributing to an energy-saving effect of 8.7 million tonnes of coal equivalent (Mtce) and a CO_2 reduction of 16.81 million tonnes. Waste steel and nonferrous metal recycling emerged as key contributors, jointly accounting for approximately 86% of energy savings and 93% of CO_2 reduction. Interestingly, the recycling of waste steel showed a notably higher CO_2 reduction effect compared to nonferrous metal recycling, which emphasises the importance of specific recycling processes in achieving substantial environmental benefits. These findings underscore the potential for significant

energy savings and emission reductions through increased recycling rates and the implementation of advanced technologies in waste management systems. They provide the valuable insights for sustainable waste practices, particularly in rapidly developing regions like China (Xiao et al., 2020).

The promotion of circular economy practices stands out as a prominent avenue in sustainable management, where waste is repurposed into materials crucial for crafting new products. This approach not only reduces reliance on new raw materials, but also creates employment opportunities in waste management, recycling, and product manufacturing sectors. Furthermore, sustainable management serves as a driver for product design innovation, compelling manufacturers to embrace sustainable design principles. This results in the creation of products which are easily disassembled, recyclable, and reusable, and leads to advancements in materials engineering and industrial design.

In ecological contexts, sustainable management offers avenues for mitigating negative impacts, particularly through environmental protection and climate change mitigation. By reducing the need for new raw material extraction and associated emissions, it contributes to environmental preservation and climate action efforts. Moreover, technological advancements play a crucial role in sustainable management by propelling the development and adoption of efficient waste processing technologies. Enhanced recycling methods and energy recovery systems, coupled with digital tools like artificial intelligence and data analytics, further amplify waste management efficiency (Huang & Koroteev, 2021; Noman et al., 2022).

Economically, sustainable management fosters the emergence of new markets and sectors, particularly in secondary raw materials (zu Castell-Rudenhausen, 2022). Robust markets for such materials drive economic growth and incentivise sustainable business practices. This economic dynamism is complemented by the enhancement of corporate reputations and fulfilment of social responsibility imperatives within the business realm. Businesses embracing sustainability enjoy heightened customer loyalty and competitive advantages in sustainability-conscious markets, while also demonstrating alignment with international corporate social responsibility norms. Lastly, sustainable management fosters global cooperation by facilitating knowledge exchange, best practice sharing, and technology transfer among nations and regions, thus nurturing international solidarity in addressing the overarching environmental challenges on a global scale.

Summarising, it can be stated that sustainable management of secondary raw materials is an important strategy which can help solve the problems related to the extraction of natural resources and the generation of waste, while opening up a wide range of opportunities in different fields. Based on the principles of the cir-

cular economy, these opportunities not only enhance environmental protection, but also provide economic and social dividends in key areas such as:

1. *Environmental protection and preservation of natural resources.* The use of secondary raw materials reduces dependence on limited natural resources, thereby reducing pressure on ecosystems and biodiversity. This helps reduce environmental destruction associated with resource extraction, such as habitat destruction and deforestation.
2. *Energy efficiency and reduction of greenhouse gas emissions.* Recycling of secondary raw materials allows saving energy and reducing CO_2 emissions, as shown by the studies conducted in the Shanghai waste management system.
3. *Economy and markets.* Sustainable management promotes the emergence of new markets and sectors, such as the market for secondary raw materials, stimulates economic growth and the introduction of sustainable business practices.
4. *Innovation and industrial design.* The use of secondary raw materials promotes product design innovation, which enables manufacturing of the products that are easily disassembled, recycled, and reused.
5. *International cooperation.* Sustainable management fosters global cooperation by facilitating knowledge exchange, best practice sharing, and technology transfer among nations and regions, thus nurturing international solidarity in addressing the overarching environmental challenges on a global scale.

1.5. Good practices of sustainable management of secondary raw materials

Numerous compelling examples in the discourse on sustainable management practices for secondary raw materials underline the gradual adoption of eco-friendly methodologies and demonstrate a dedication to both environmental issues and economic feasibility. One notable example lies in the initiative to harness natural molecules from by-products of marine food chains (Lucarini et al., 2020). The authors emphasise the significance of converting waste from fish processing into high-value products for human nutrition. The sustainable management of the marine food chain aims at recovering and valorising secondary raw materials from the fisheries industry, with a focus on producing natural molecules, like omega-3 fatty acids, for new products in human nutrition. The case study emphasises treating food waste to reuse bioactive molecules and transform discards into

high-value products, while also prioritising environmentally friendly protocols for raw material processing. This approach promotes diet sustainability and environmental protection, limits waste release, prevents potentially polluting chemicals, and fosters the development of new value chains and economic opportunities in local communities (Lucarini et al., 2020).

Expanding on the achievements of pioneering methods, like sustainable food waste management, the textile sector exemplifies responsible resource stewardship. According to a study by Dobre-Baron et al. (2021), innovations in textiles highlight a dedication to sustainability, particularly in adopting circular production models. Noteworthy is the commitment of the H&M Group, which prioritises utilising recycled fibres and production waste to craft new materials. A key advancement is the implementation of groundbreaking technologies, like the Green Machine, introduced in November 2020, capable of efficiently separating and recycling cotton and polyester blends at a large scale, thereby reducing the dependence on finite natural resources.

Numerous examples of good practices of sustainable secondary raw resources management could be found in different parts of the world. Table 3 presents some examples from the selected countries.

Table 3. Good practices of sustainable management of secondary raw materials in the selected countries

Country	Good practices	Company
Switzerland	In Switzerland, an efficient collection and recycling system has been implemented. Citizens actively participate in waste sorting, and local authorities have established advanced infrastructures for the management of recyclable materials. This approach has led to high recycling rates and recovery of secondary raw materials.	Müller Recycling AG
Japan	Japan is leading the way in developing advanced recycling technologies. Examples include the recovery of precious metals from discarded electronic products and the transformation of plastic waste into useful fuels or chemicals. These innovations not only mitigate waste generation, but also foster new avenues for business.	Mitsubishi Material, Mitsui Chemicals, Sekisui Chemicals, JFE Engineering
Germany	Germany's implementation of a successful deposit and return system for beverage containers is exemplary. Under this system, consumers pay a deposit, which they receive back upon returning empty containers. This approach has significantly elevated recycling rates and fostered the reuse of secondary raw materials, notably plastic and glass containers.	TOMRA

Country	Good practices	Company
Sweden	Sweden has pioneered waste incineration systems with energy recovery. These installations play a dual role in waste management by not only diminishing the volume of waste destined for landfill, but also harnessing thermal energy for district heating and electricity generation. This approach significantly contributes to the ongoing shift towards more sustainable energy sources.	Stockholm Exergi AB
Lithuania	Lithuania demonstrates exemplary initiatives in altering consumption patterns and consumer behaviour, exemplified by innovative platforms serving as online marketplace facilitating the exchange of clothes and other pre-owned goods. Additionally, the country boasts 75 sharing points, which provide various repair services for used items. Noteworthy among these is Textile, a Lithuanian circular fashion platform, which offers a comprehensive array of services, including buying, selling, donating, repairing, renewing, and remodelling used clothing.	Vinted, Mainukai, Dėkui, TikoTiks, Dalinkimės, Daiktų kiemas
Netherlands	The Netherlands fosters collaboration among companies by facilitating the exchange of products and waste. This agreement aims at decreasing waste generation and enhancing resource efficiency by promoting the reuse of materials across various industrial sectors.	Reblend
Poland	Poland has implemented various initiatives to advance the circular economy. Some initiatives encompass support programmes for research and development in recycling technologies, while others are aimed at encouraging businesses to embrace sustainable practices. Additionally, the country has instituted an industrial symbiosis programme to foster collaboration among companies, facilitate the reuse of by-products, and reduce waste.	Mazowsze Dairy Cooperative in Chorzele, Polski Koncern Naftowy ORLEN S.A.

Source: own study.

Each year, *Müller Recycling AG* undertakes the sorting and recycling of 20,000 tonnes of bottles, which represents over half of Switzerland's plastic bottle waste. Out of the 23,500 tonnes of plastic bottles processed annually by *Müller Recycling*, 20,000 tonnes are integrated into a closed-loop recycling system. This system ensures that plastic bottles undergo continuous recycling cycles, with substances perpetually infused to facilitate the creation of new bottles. Thomas Müller, the third generation of his family to manage the company, explains that this process enables bottles to be recycled up to six times, which confirms the sustainability and resource efficiency inherent in PET recycling. Unlike other packaging materials, PET has reaped the benefits of a paradigm shift towards recycling attitudes that commenced approximately three decades ago. Müller highlights, "Thanks to

innovative advancements, we now produce recycled PET of such exceptional purity and quality that it is virtually indistinguishable from newly manufactured PET." (House of Switzerland, 2022). The Swiss landscape is covered with more than 56,000 PET collection points, facilitating the recycling of approximately 200 million bottles annually, which equates to a staggering 6,950 tonnes of PET diverted from the waste stream.

Japan is renowned for its pioneering waste management techniques, cutting-edge technologies, and unwavering dedication to environmental sustainability. Within this landscape, numerous Japanese plastic recycling enterprises have emerged as frontrunners which make substantial strides in advancing the circular economy and sustainable waste management practices. From a European standpoint, standout companies including *Mitsubishi Material*, *Mitsui Chemicals*, *Sekisui Chemicals*, *JFE Engineering*, *MATEC Inc.*, *Daiei Kankyo Group*, *Taka Pla*, and *Planic* embody the essence of innovation, technological prowess, and environmental stewardship within the Japanese plastic recycling sector.

In comparison to Europe, Japan's plastics recycling market remains relatively modest, accounting for 8.24 million tonnes of plastic waste in 2021. While Japan boasts an impressive recycling rate of 82%, it is crucial to acknowledge that 57% of this figure involves thermal methods such as incineration with energy recovery. The remaining 25% undergoes transformation into other products or is returned to raw materials. Interestingly, a substantial 70% of non-recycled plastic is exported abroad for recycling, which results in an effective recycling rate of less than 10%. Looking forward to 2035, projections indicate a significant expansion in the domestic market for recycled plastics and materials, which is expected to soar to 504 billion yen (3,238.878 million Euro). Specifically, the market for recycled plastics alone is forecasted to reach 355.3 billion yen (2,283.157 million Euro), i.e. two times more than its current size (Fobker, 2023).

Germany is home to the world's most extensive and efficient deposit return scheme, achieving an unparalleled 98% return rate on eligible single-use drink containers. This remarkable success is attributed to the scheme's substantial deposit value and widespread network of convenient return locations. Germany implements deposit systems for both refillable and one-way containers. Initially, German law mandated that beverage producers and retailers sell at least 72% of beverages in refillable containers, known as a "reuse quota." However, as this quota had not been achieved, a one-way Deposit Return System (DRS) was introduced. To prevent the dominance of one-way containers over refillable, policymakers established a high deposit value. Additionally, producers were given the flexibility to set an even higher deposit value if desired (TOMRA, 2024).

Stockholm Exergi stands as the primary energy provider for all residents of Stockholm. Currently serving over 800,000 Stockholmers and more than 400 public establishments, *Stockholm Exergi* offers district heating, cooling, and electricity services (*Stockholm Exergi*, 2023). Covering 90% of Stockholm County with district heating, the company ensures that 90% of the energy supplied is renewable or recycled, with plans to achieve 100% by 2030. Utilising residual heat and generating energy from biofuels and non-recyclable waste, *Stockholm Exergi* plays a crucial role in sustainable energy production. The company's operations are broadly divided into three functions: production, distribution (market), and fuel supply, with the distribution network serving as the core component. Through these networks, *Stockholm Exergi* serves as a central hub for waste management and energy supply infrastructure in Stockholm. In 2021, *Sörab* and *Stockholm Exergi* unveiled Sweden's first automated pre-treatment facility for recyclable materials extracted from residual waste (Avfall Sverige, 2022). This innovative method targets the identification and segregation of materials erroneously disposed of in general waste bins, which allows for their subsequent recycling. Nonetheless, it remains crucial to emphasise source separation to ensure cleaner material streams. Pre-treatment for energy recovery serves as an adjunct measure when intending to curtail the volume of plastic directed towards incineration, among other objectives.

In addition to its good practices related to the change in consumption patterns and consumer behaviour positively influencing secondary resources management (see Table 3), Lithuania exemplifies effective waste reduction and heightened recycling efforts, notably through its deposit refund system for single-use beverage packaging. This system ensures a significant return rate of pure, high-quality secondary raw materials. Furthermore, the country aims to significantly reduce waste sent to landfills by 2030, with a target of lowering landfilled waste to just 5% of the total waste volume. Complementary measures include the implementation of new regulations governing reuse, recycling, and recovery, as well as the enforcement of product and waste management standards. Additionally, restrictions have been imposed on the placement of products containing hazardous substances on the market, which further promotes waste management practices and environmental sustainability (European Environment Agency, 2022a; 2023a).

The Netherlands demonstrates proactive measures in achieving the goals of the circular economy, particularly in the textile industry. The government's textile policy programme outlines clear targets for the sector's value chain, aiming for a fully circular economy by 2050 (European Environment Agency, 2022c). To reduce the ecological footprint, emphasis is placed on sustainable design and production, including the use of recycled materials. By 2025, the goal is to incorporate an average

of 25% recycled and sustainable materials in new textile products, with the introduction of Extended Producer Responsibility (EPR) for textiles to promote circular design and production. Initiatives like the *Denim Deal* highlight successful collaboration within the industry, which highlights the potential for large-scale circular practices among frontrunners. A good example is the company *Reblend*, which specialises in repurposing textiles unsuitable for wearing by utilising an eco-friendly process that eschews water and additional chemicals to produce textiles with improved ecological footprints. According to Anita de Wit, co-founder of *Reblend*: "We use mainly textiles that are no longer suitable for wearing (70%) and utilise them in a smart process without the use of water or additional chemicals, which yields yarn and textiles with a considerably better ecological footprint!" (Ministries of Infrastructure and Water Management, and Economic Affairs and Climate, 2016). Despite pioneering in recycled textile production in the Netherlands, their small-scale operations limit their output compared to larger manufacturers. Challenges persist, particularly in navigating government procurement procedures, yet *Reblend* continues to derive value from alternative aspects of their operations.

In assessing Poland's transition to a Circular Economy (CE), the findings from the 2020 publication by the Polish Academy of Sciences suggest a gradual and deliberate pace. While some may perceive this pace as slow, the Academy argues that it is deliberate and preferable, aimed at avoiding abrupt shifts and excessive constraints (European Environment Agency, 2022c). Figure 2 shows that Poland lags behind many EU countries in terms of resource productivity. The Ministry of Economic Development and Technology in Poland offers three catalogues featuring good practices in the Circular Economy (CE). These catalogues cover: 1) the agri-food sector, focusing on waste and byproducts management, along with support mechanisms for CE implementation, 2) chemistry, highlighting resource-product relationships, CE-aligned products, and effective natural resource management examples, and 3) buildings and construction, showcasing eco-innovative solutions, Green Public Procurement (GPP), and a directory of companies supporting the CE.

In 2022, Poland collected 2,132,000 tonnes of post-consumer waste, with 920,000 tonnes from separate collection and 1,212,000 tonnes from mixed waste. The recycling rate was 21.2%, lower than the European average. Separate collection proved significantly more effective for recycling, with 45.3% of waste managed compared to only 2.9% for mixed waste. Energy recovery accounted for 35.2% of waste, while 43.6% went to landfill. Despite being below the European average, Poland is demonstrating an upward trend in recycling, with a notable 8.7% increase since 2018, according to expert Anna Kozera-Szalkowska (Teraz Srodowisko, 2024).

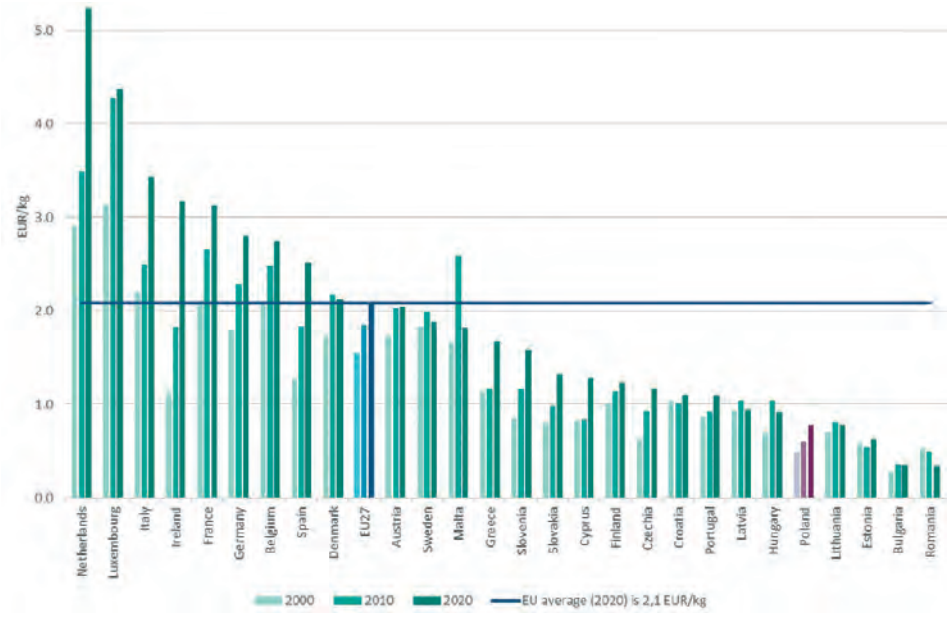

Figure 2. Resource productivity (gross domestic product/domestic material consumption), EU27, 2000, 2010 and 2020, EUR per kg

Source: European Environment Agency, 2022c, p. 4.

To sum up the above section, good practices in sustainable management of secondary raw materials are being implemented across various countries and sectors. Examples include deposit refund systems for single-use beverage packaging, such as those observed in Germany and Lithuania, which ensure high return rates of pure secondary raw materials. Waste incineration systems with energy recovery, as seen in Sweden and the Netherlands, not only reduce landfill waste, but also contribute to renewable energy production. Industrial symbiosis programmes, like those established in the Netherlands, facilitate cooperation between companies to reuse by-products and reduce waste. In the plastic industry, countries like Poland are setting targets for the use of sustainable and recycled materials, supported by policies such as EPR for plastic products. These initiatives collectively aim to reduce waste generation, improve resource efficiency, and foster a transition to a more sustainable economy. Learning from good practices may bring benefits in developing new and proved models to manage secondary raw materials in an efficient way.

Chapter 2

Conceptual Aspects of the Secondary Raw Material Market

2.1. Phenomenon of the secondary raw material market

Secondary raw materials refer to directly recyclable waste and recycled materials derived from waste (Parliament of the Republic of Lithuania, 1998b). Glossary "Secondary Materials" (Busch Systems, 2016) states that secondary materials are the materials which have been previously utilised, recycled, and then reintroduced into the manufacturing process. This practice reduces dependence on extracting fresh raw resources, like paper, aluminium, and plastic. Utilising secondary materials is beneficial for the sustainable management of resources and helps to preserve them for extended durations. Secondary raw material is a material which, after undergoing a recovery process, is used as an input in new production cycles.

The significance of raw material markets is unchanged since these markets provide the essential materials for industrial production, infrastructure development, and the overall economic growth. The effective and sustainable use of raw materials and their efficient trade are important for maintaining the stability of the economy and ensuring the harmonious use of natural resources. Before defining the secondary raw material market, we will discuss its functions, participants, and processes. The raw material market acts as a trade intermediary, where manufacturers, suppliers, traders, and processors are involved in the supply chain, and transmit raw materials to each other, sometimes through several intermediaries, until they reach a final consumer. The dynamics of the raw materials are determined by many factors, including the interaction of supply and demand, international trade, price variability, market trends, political solutions, economic conditions, etc., which may affect the supply chain participants, their financial results, and market stability.

Unlike the traditional commodity markets, the secondary raw material market has no standardised criteria that identify a well-functioning or competitive market. Given the criteria for market definition, such as: (a) traded (exchanged)

homogeneous assets, (b) constant presence of buyers (sellers) who intend to buy or sell, and (c) public availability of the information on the prices of raw and other materials, it can be stated that the secondary raw material market is represented by criterion (b) only, i.e. constant presence of buyers (sellers) who intend to buy or sell secondary raw materials. The information on the prices of raw and other materials for sale is not publicly available; also the market has many segments, which is why the assets are not homogenous.

As discussed in the first section of the book, the definition of *the secondary raw material market* is associated with the word "processing." "Processing" refers to any recovery operation, during which waste is recycled to products or materials regardless of whether they are intended to be used for initial or other purposes (European Parliament and the Council, 2008). Waste recycling is a waste consumption activity when the materials constituting waste are recycled to products or materials of the same or other purpose. This activity covers recycling of organic materials, but does not include recycling for energy producing and recycling into the materials which are intended to be used as a fuel or filler (Parliament of the Republic of Lithuania, 1998b). The key features of the secondary raw material market are as follows (Kirchherr et al., 2017):

1. *Legal aspects of ownership rights.* If a material is raw or is a waste that does not have a legal owner, it is an obstacle to the formation of an effective relationship between a seller and a buyer. Waste ownership issues require constant monitoring to prevent legal problems that may hinder the development of newly formed markets, especially if waste is collected and managed by public authorities.
2. *Compliance with regulation.* All parties involved in processing secondary raw materials must comply with applicable environmental, waste, chemical material processing regulations, as well as emission standards and industrial permit issue procedures.
3. *Freedom of business and contracts.* Horizontal and vertical integration in recycling circuits can pose a risk of market monopolisation. It is necessary to ensure the freedom of business and contract establishment to ensure a healthy level of competition.
4. *Market pricing.* Market prices must be flexible and reflect real economic conditions to properly regulate the balance of the supply and demand for secondary raw materials.
5. *Competition.* Healthy competition is necessary to ensure the effective use of resources and promotion of innovation in the sector of secondary raw materials.

6. *Profit as an economic signal*. Profits and losses provide valuable feedback on the condition of the secondary raw material market and help companies adequately respond to changing demand for raw materials.

The secondary raw material market in the European Union and other countries is characterised by large circulation: the volume of recycled materials is impressive here. Although estimation of the market size is complicated due to limited access to statistics, the *Eurostat* database provides some information. For instance, the volumes of trading plastic, paper, cardboard, and glass waste exceeded 2.8 billion tonnes in 2020 (European Environment Agency, 2021b).

The secondary raw material market must be analysed as a value-generating chain consisting of the following stages (European Environment Agency, 2022g) (see Figure 3):

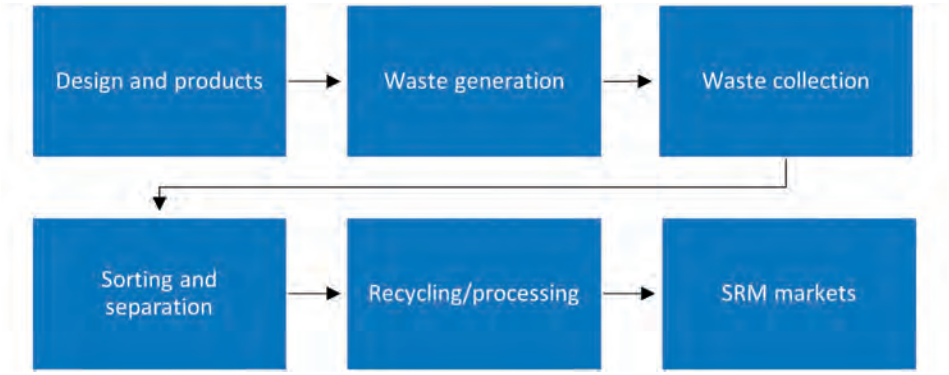

Figure 3. Value chain of secondary raw materials

Source: European Environment Agency, 2022g, p. 35.

- Design and products – it is important to select materials and recycle them;
- Waste generation – waste sorting on site;
- Waste collection – collection systems;
- Sorting and separation – quality of the raw material;
- Recycling/processing – production of secondary raw materials;
- Secondary raw material markets – use in production and market demand.

The value chain of secondary raw materials includes two main stages, which, although not directly related to the waste value chain, significantly affect its efficiency:

– Product design and manufacturing. This stage covers the management of post-consumer waste, consisting of discarded or end-of-life products that are made of various materials. If products are designed to be easily recycled,

the recovery of individual materials from end-of-life products becomes more efficient.

– Final demand. The use of secondary raw materials depends on continuous and sufficient demand. The materials and components used in the production process must come from secondary sources. The supply and demand must be balanced so that secondary raw materials are effectively integrated into the production process.

Summarising, it can be stated that secondary raw materials play a significant role in the sustainable development strategy helping to reduce the dependence on natural resources and contributing to the efficiency of waste recycling. Secondary raw materials are the materials obtained from the recycling and recovery of used products. They include plastics, paper, glass, metals and other materials that are returned to the production cycle. The materials, extracted from previously used products, help to maintain the balance of resources, such as paper, aluminium, and plastics. The secondary raw material market is complex and different from the traditional raw material market. It lacks the standardised criteria, and the materials traded are not homogeneous. The secondary raw material market operates as a value chain where particular factors, starting with design and ending with product development and the final demand, are significant. Product design should facilitate post-consumer waste recycling, while the final demand should ensure that secondary raw materials are effectively used for new product manufacturing.

To assess the situation with the use of secondary raw materials in the country and understand how they contribute to the circular economy, it is relevant to examine the indicators which represent the use of secondary raw materials and their significance in the circular economy monitoring system.

2.2. Indicators representing the use of secondary raw materials in the Circular Economy Monitoring System

The circular economy is a model for production and consumption that seeks to maintain the value of products, materials and resources for as long as possible by implementing various strategies in all phases of a product life cycle (European Commission, 2023b). Magennis and Heaney's (2018) study focuses on the transition from a linear to a circular economy and indicates the following elements of a circular economy: design-to-circularity, sharing, reuse, repair, redistribution, re-production, and recycling. The circular economy, in contrast to the traditional linear economy, which is based on the principle of "take, make, use and throw away," seeks to keep resources in operation as long as possible, thus maximising

their value. At the end of a product's useful life, materials or products are collected and recycled. The study "The Review of the Recyclable Raw Materials Market" by the Innovation Agency (2023a) presents the circular economy monitoring system approved by the EC in 2018 (see Table 4).

In response to the growing expectations regarding the transformation towards the circular economy, the European Commission presented an updated version of the circular economy monitoring system in 2023 (European Commission, 2023b). The updates not only cover the most critical areas of the circular economy, but also highlight the links with climate neutrality and zero pollution goals. The new Circular Economy Monitoring System is developed to provide a comprehensive picture of the circular economy performance and assess both the direct and indirect benefits of increasing circularity. The major updates of this version include a new group of indicators, titled "Global sustainability and resilience," which covers five new indicators (Innovation Agency, 2023a): material footprint, resource productivity, consumption footprint, greenhouse gas emissions from production activities, and material dependence. The aforementioned indicators may be described as follows:

- *Material footprint* is an indicator which measures the total amount of materials (both domestic and imported) used for domestic consumption and production. For instance, Lithuanian material footprint was 23 tonnes of raw materials per capita, whereas the EU average was 14 tonnes per capita in 2020. The high Lithuanian material footprint is related to the country's dependence on imported energy sources and primary raw materials, as well as the structure of the economy, which is dominated by the industrial and construction sectors, intensive material users.
- *Resource productivity* is an indicator which describes what part of the gross domestic product (GDP) is created from each kilogram of resources used. A higher rate of resource productivity means that the economy creates higher value added from each unit of resources. It also indicates the more efficient economic growth which is less dependent on resource consumption. The updates of the Circular Economy Monitoring System include the comparison of this indicator with the base data of 2000.
- *Consumption footprint* is an indicator calculated on the basis of a life cycle analysis. It reflects the environmental impact of consumption. The indicator is compared to the capabilities of the entire planet; it covers 16 impact categories and considers five primary areas of consumption: food, mobility, housing, household goods, and appliances. This indicator is broader than the footprint of raw materials, as it reflects the impact of population consumption on the environment.

- *Greenhouse gas emissions from production activities* is an indicator which measures the amounts of greenhouse gases emitted during goods/services production/provision processes. It reflects the potential of the circular economy to reduce the effects of climate change, but it does not consider the emissions generated by households. Greenhouse emissions from production activities vary greatly in the EU Member States, which can be explained by the differences in economy structures, the use of renewable and non-renewable energy sources, technological innovation and its energy efficiency, as well as sustainability levels. For example, the well-developed transport and logistics sector, where alternative fuels are not widely used, is one of the major causes of GHG emissions in Lithuania.
- *Material dependence* indicator measures the share of imported materials in the total structure of the materials used in the country. A high rate of this indicator shows that a country is highly dependent on imported materials, which may lead to a higher risk of disruptions in global value chains.

Table 4. Indicators in the Circular Economy Monitoring System

No.	Indicator, unit of measurement	Relevance	EU examples
Production and consumption			
1.	Material consumption, tonnes per capita	Circular economy should help to address the supply risks of raw materials, especially critical raw materials	Raw Materials Initiative, Resource Efficiency Plan
2.	Green public procurement*, percent of GDP	Public procurement accounts for a large share of consumption and can promote the circular economy	Public procurement strategy, EU support schemes and voluntary criteria for green public procurement
3a-c	Waste generation, kilograms per capita	Generation of waste is minimised in the circular economy	Waste Framework Directive; Directive on specific waste streams; Plastic strategy
4.	Food waste*, kilograms per capita	Food waste has a negative impact on the environment, climate and economy	General Food Law; Waste System Directive; various initiatives (e.g. Food Loss and Food Waste Platform)
Waste management			
5a-b	General recycling rates, percent	Growing recycling volumes are part of the transition to the circular economy	Waste Framework Directive

6a-f	Specific waste stream recycling rate, percent	This reflects the progress in recycling major waste streams	Waste Framework Directive; Landfill Directive; Directive on specific waste streams
Secondary raw materials			
7a-b	Share of recycled materials in the demand for raw materials, percent	In the circular economy, secondary raw materials are mostly used for manufacturing new products	Waste Framework Directive; Ecodesign Directive; EU Ecolabel; REACH; Interface between Chemicals, Products and Waste Policy; Plastic Strategy; quality standards for secondary raw materials.
8.	Trade in recyclable raw materials, thousand tonnes	Trade in recyclable raw materials reflects the importance of domestic and global markets in the circular economy	Internal market policy; Waste Shipment Regulation; Trade policy
9a-c	Private investment (percent of GDP at current prices), jobs (percent of total employment) and value added (percent of GDP at current prices)	This reflects the contribution of the circular economy to job creation and growth	European Investment Plan; structural and investment funds; InnovFin; circular economy financial support platform; Financial Sustainability Strategy; Green Employment Initiative; New Skills Agenda for Europe; internal market policy
10.	Patents, number	Circular economy-related innovative technologies promote the EU competitiveness on a global scale	Participation in *Horizon* and other EC programmes promotes the investment in innovative technologies related to the circular economy.

*Indicator is under development.
Source: Innovation Agency, 2023a, p. 13.

Summarising, it can be stated that the analysis of the secondary raw material market is based on waste management metrics, including general recycling rates and recycling rates estimated for specific waste streams, as well as the use of recycled materials which covers the share of recycled materials in the overall demand for raw materials, trade in recyclable materials, investment in relevant technologies, workplaces, value added, and patents. The estimation and analysis of these indicators for individual industries and individual waste categories can provide a comprehensive picture of different aspects of the secondary raw material market, help to forecast future trends, and promote the use of secondary raw materials.

2.3. Secondary raw material markets and their future development scenarios in the EU

Secondary raw material markets cover many materials, such as metal, paper, wood, plastic, construction and demolition waste, and biomaterials. Each of these markets has its own specific operational characteristics, different historical and current contexts, different degree of the material cycle completion, and distinct business and economic importance. While some markets have been operating stably and contribute significantly to the circular economy, others are still facing the challenges that hinder their further development. This remains relevant even with strict waste and recycling policies at both the EU and national levels.

For the reasons explicated above, the European Environment Agency (EEA) (zu Castell-Rudenhausen et al., 2022) established the criteria which allow to assess whether a secondary raw material market is functioning well (the assessment criteria are provided in Annex 1):

- **Market size and growth**:
  - High shares of supply and demand with respect to total market size;
  - Enough stable or increasing supply and demand;
  - Open international trade and high tradability;
  - High industrial capacity (factories, equipment) based on secondary material inputs.
- **Role of policy drivers in market development**:
  - Non-policy-driven supply and demand;
  - Inclusion in compliance schemes for packaging waste or Extended Producer Responsibility (EPR) schemes;
  - No competition from energy use.
- **Prices**:
  - Reference international or national prices;
  - "Organised markets" for trading (e.g. forwards, futures, options);
  - Sufficient information available to both demand and supply actors.
- **Technical specification and barriers**:
  - Standardised product specifications;
  - Absence of regulatory barriers to using secondary raw materials as inputs in manufacturing.

The report by the EEA (zu Castell-Rudenhausen et al., 2022) suggests that glass, aluminium, paper and cardboard markets in the EU are well-functioning. Meanwhile, textiles, wood, construction and demolition, bio-waste, and plastic markets are rated as underdeveloped or poorly functioning. The best developed secondary

raw material markets in the EU are aluminium, paper and cardboard, and glass markets. We will briefly review the situation of the well-functioning markets.

For instance, aluminium recycling rates in the EU are among the highest compared to other materials, with more than 90% of aluminium from the automotive and construction sectors and 75% of aluminium cans being recycled in the EU (European Environment Agency, 2022d). According to the "European Aluminium" (2020) and Innovation Agency (2023a), aluminium recycling could also reduce supply insecurity resulting from the EU's dependence on imports. Aluminium has high circularity and is an easily recyclable material: it can be separated and reused many times without losing its technical properties. Although aluminium production is energy intensive, recycling of aluminium scrap saves a significant amount of energy. Nevertheless, there are two tendencies which negatively affect the aluminium recycling business:

- the export of aluminium products from Europe, which leads to a loss of resources;
- the impact of cheap imports, which make European investment in recycling uneconomical.

Aluminium recycling accounts for 36% of the aluminium metal supply in Europe. However, higher recycling rates must be achieved since the demand for recycled aluminium is increasing. The recycling rate is expected to increase to 40%-76% between 2019 and 2050, particularly due to the use of aluminium in electric cars (*European Aluminium*, 2020).

The estimations by the "Material Economics" (2018) suggest that the demand for aluminium will increase from 250 to 450 kg per person by 2050. Their report proposes that the demand for aluminium can be met through recycling, and the stock of recycled aluminium could reduce the need for the primary aluminium production (zu Castell-Rudenhausen et al., 2022). The key aspects of the Lithuanian situation are as follows:

- Lithuania recycles 73.8% of aluminium.
- If a new calculation methodology, which considers factory losses and assumes aluminium losses to be the same as other metals, is applied, the aluminium recycling rate will drop to 63.5%. This will be 13.5% below the EU's 2025 target. The major difference between the old and new calculation methodologies is that the new methodology does not include recycled waste packaging into the amount of sorted packaging waste.
- Although the new methodology is already applied in Lithuania, aluminium recycling rate increased by 16% in 2021 compared to 2020.

The market for recycled paper pulp is considered to be well-functioning since the secondary paper and cardboard markets have been developing for a long time. The EU-27 produced 42.9 million tonnes of paper and cardboard waste in 2018 (Eurostat, 2021a). Vast majority of this waste (74%) was packaging waste (Eurostat, 2021b). Although paper and cardboard are always recyclable, the number of recycling cycles is limited, and the recycling process becomes more complex when paper and cardboard are combined with other materials. The elements which are difficult to separate from the fibrous material degrade the pulp quality and lead to fibre collection, sorting and recycling losses. In compliance with the European legislation, paper must be collected separately from municipal waste with a view to meeting the recycling targets indicated in the Waste Framework Directive. The 2020 Packaging and Packaging Waste Directive sets a 60% recycling target for paper and cardboard packaging. To increase the volumes of recycling, the following percentages are set: 75% by 2025, and 85% by 2030. To increase their recycling levels, most EU Member States have developed the Extended Producer Responsibility (EPR) schemes for packaging, which has become mandatory by 2024. Currently, almost 50% of the materials used for paper production are secondary. 24% of all generated paper and cardboard waste is exported to non-EU countries, 38% is traded between the EU Member States, and the remaining 38% is processed domestically. This shows that the market for paper and cardboard waste is significant and open (European Environment Agency, 2022d; Innovation Agency, 2023a).

Two important factors related to the maturity of secondary raw material markets are the market size and the quality of the materials. Recycled paper accounts for almost 50% of the material in the paper industry. The recycled paper market is also driving the trend to replace single-use plastics with more environmentally friendly alternatives, including recycled paper and fibre packaging solutions (Emerging Alternatives for Single-use plastics in Packaging, 2019).

The EU-27 countries produced 16.4 million tonnes of glass waste, or 37 kg per inhabitant, in 2019 (Eurostat, 2021a). Of this amount, 32.5 kg per inhabitant was packaging waste (Eurostat, 2021b). In the same year, 76% of glass packaging was recycled in the EU-27 (Eurostat, 2021b). According to the Glass Packing Institute (2021), glass is a unique material because it does not degrade and can be melted down an unlimited number of times without losing quality. FEVE, the European Container Glass Federation (2021), indicates that recycled glass can replace up to 95% of raw materials in the glass manufacturing process, and the largest share of the glass waste is used to make new bottles and jars. In addition, glass waste can be reused without the melting process.

One of the limitations for glass recycling is that packaging glass cannot be mixed with other types of glass, such as window glass, ovenware and crystal since

the latter types of glass undergo different manufacturing processes. European legislation requires glass to be collected separately. The Packaging and Packaging Waste Directive set a 60% recycling target for glass packaging waste in 2008. This target will increase to 70% by 2025, and to 75% by 2030. To increase their volumes of glass recycling, most EU Member States have developed the Extended Producer Responsibility (EPR) schemes for packaging, which has become mandatory by 2024. Most EU Member States already have deposit refund schemes for glass bottles.

Less developed secondary raw material markets are the EU markets for construction and packaging wood, plastic, compost, construction and demolition waste, and textile.

Construction and packaging wood. The construction sector generated about 8.6 million tonnes of harmless wood waste in 2018 (Eurostat, 2021a). About a third of this wood waste is currently recycled, but recycling rates vary between the Member States. The rest of the waste is disposed in landfills or incinerated. Wood waste is widely used for particle board production in central and southern Europe, but Finnish and Swedish industries rely on higher quality sawmill waste stocks.

Wood quality may deteriorate under certain conditions, so wood waste may not be suitable for recycling or reuse. Also, preparing wood with nails and paint for recycling is a labour-intensive price. Wooden structures (e.g. beams) and interior elements (e.g. doors, window frames, etc.) are currently being reused, albeit on a small scale.

According to the Waste Framework Directive, 70% of non-hazardous construction and demolition (C&D) waste by weight must be reused or recycled by 2020. The Directive also requires the EU Member States to promote selective demolition to facilitate high-quality recycling and ensure that a C&D waste sorting system has been developed (at least for wood, mineral fractions, metal, glass, plastic and plaster).

The use of recycled wood as a raw material presents some challenges, such as the logistics involved in collection and transportation, and the need to sort the wood. More than twenty years ago Germany used wood waste as an energy source in incineration plants or simply disposed it in landfills. However, the German government has recognised that safe disposal is not sufficient, and resources must be recycled. Waste prevention must be given the highest priority. Following this principle, an environmental policy, which established the prerequisites for efficient and environmentally safe waste prevention and recycling at the production stage, has been implemented (Garcia & Hora, 2017). 34% of wood waste was used in the wood industry for the production of partial panels in Germany in 2013-2014 (Meinlschmidt et al., 2016). The UK's rate was 53%, while Italy achieved

95%. The assessment of the secondary wood market in terms of the criteria of a well-functioning market is provided in Table 5.

Table 5. Assessment of the secondary wood market in terms of the criteria of a well-functioning market

Category	Criterion of a well-functioning market	Assessment of the secondary wood market
Market size and growth	High shares of supply and demand	Low shares of supply and demand
	Sufficiently stable/increasing supply and demand	Not stable
	Open international trade and high tradability	Mostly domestic markets
	High industrial capacity based on secondary material inputs	For particle board production only
Policy drivers in market development	Non-policy-driven supply and demand	Separate waste collection requirements and recycling targets are set in the Waste Framework Directive
	Application of Extended Producer Responsibility and/or Compliance schemes	Most Member States have the Extended Producer Responsibility schemes
	No competition from energy use	Recycling strongly competes with energy recovery
Prices	Reference prices	No reference prices
	Organised markets for trading; derivatives (e.g. futures)	No organised markets for trading and derivatives
	Sufficient information available to supply and demand actors	Lack of reliable information
Technical specification and barriers	Standardised product specifications	Standards to support trading of solid recovered fuels have been developed; no standardised product specifications
	No regulatory barriers to using secondary raw materials as inputs in manufacturing	An EoW concept has been developed in some Member States; no EU-wide EoW criteria

Source: own elaboration, based on the assessment by the EEA (zu Castell-Rudenhausen et al., 2022).

Table 5 indicates that the secondary market of wood derived from construction and packaging waste is poorly-functioning primarily due to the low shares and instability of supply and demand. The market is not open, not organised, trading takes place only in domestic markets, there is no trade in derivatives. Markets do not provide any reference prices, supply and demand agents are lacking the reliable information.

Secondary material inputs are effectively used for particle board production only. The supply and demand are the EU waste management policy driven, and recycling strongly competes with energy recovery. Standards for classifying wood waste as fuel have been developed to support trading of solid recovered fuels (SRFs), but there are no standardised product specifications. Some states (e.g. Austria, Italy) have developed an end-of-waste (EoW) concept for secondary raw material market for wood, but there are no EoW-wide criteria for wood. The positive factor is adoption of the Extended Producer Responsibility schemes in many EU Member States, but the entirety of the factors shows that the market is still in its infancy.

Plastics. The data by the "Material Economics" (2018) and the European Commission (2022a) propose that the EU generates nearly 45 million tonnes of plastic waste per year, which is 50 percent more than 25-30 million tonnes reported officially. Most of the demand for plastic is generated by the packaging sector, followed by building and construction, automotive and electronics sectors (Plastics Europe, 2019). The textile sector also requires a large amount of plastic, but there are no reliable statistics on what this amount is (zu Castell-Rudenhausen et al., 2022).

The average recycling rate for plastic packaging waste in the EU-27 and the UK was 42 percent in 2018 (Eurostat, 2018), though collection and recycling rates vary for different polymer types and applications. Given that the real amounts of plastic waste can be twice as high as officially declared, there is no reliable data on what amounts of plastic waste are actually recycled.

Packaging waste and technical plastic waste are used for producing mixed plastics, recycled monopolymer flakes, regranulates and regrinds, monomers, and pyrolysis oil (zu Castell-Rudenhausen et al., 2022). Nevertheless, the production of high-quality secondary plastics is hampered by (Material Economics, 2018; ETC/WMGE, 2019a; EEA, 2021b):

- product complexity (plastic waste contains different polymers and additives);
- different degrees of recyclability (some polymers cannot be recycled in the same waste stream);
- hazardous materials (additives, colourants, plasticisers, stabilisers);
- low traceability of the chemical content;
- contamination (e.g. plastics can be contaminated by food waste or chemical substances);
- downcycling (the recycled content is of lower quality than an original product and is used in lower value products);
- price (the costs of sorting and processing raise the price of products made from secondary plastics);

– degradation (polymer length is degraded during recycling);
– very limited options of mechanical recycling for thermoset polymers.

In general, the demand for recycled plastic is increasing. The drivers behind this increase are compliance with the targets set in the EU Single-Use Plastic Directive (EU, 2019a), transition to the circular economy, development of the sustainable industry, and environmental responsibility of customers (zu Castell-Rudenhausen et al., 2022). The assessment of the secondary plastic market in terms of the criteria of a well-functioning market is provided in Table 6.

Table 6. Assessment of the secondary plastic market in terms of the criteria of a well-functioning market

Category	Criterion of a well-functioning market	Assessment of the secondary plastic market
Market size and growth	High shares of supply and demand	Large supply of plastic waste in general, but high demand for recycled PET only
	Sufficiently stable/increasing supply and demand	Recycling targets, transition to the circular economy, development of the sustainable industry, and environmental responsibility of customers are increasing the supply; the use of recycled plastic is still very low
	Open international trade and high tradability	International trading of PET
	High industrial capacity based on secondary material inputs	Advanced technologies are under development; the recycled content from PET is not downcycled
Policy drivers in market development	Non-policy-driven supply and demand	Separate waste collection requirements and recycling targets are set in the Waste Framework Directive
	Application of Extended Producer Responsibility and/or Compliance schemes	Most Member States have the Extended Producer Responsibility schemes
	No competition from energy use	Competition with use for energy recovery, but source-separated plastic waste is rarely incinerated.
Prices	Reference prices	Only for certain polymers
	Organised markets for trading; derivatives (e.g. futures)	Trading platforms for PET
	Sufficient information available to supply and demand actors	For PET only

Technical specification and barriers	Standardised product specifications	Standards for using primary polymers; unclear standards for plastic waste
	No regulatory barriers to using secondary raw materials as inputs in manufacturing	Lack of EoW criteria

Source: own elaboration, based on the assessment by the EEA (zu Castell-Rudenhausen et al., 2022).

Table 6 shows that the secondary plastic market is not well balanced: the general supply of plastic waste is large, but it is of inadequate quality. Only the demand for recycled PET is much higher than the supply, and it is difficult for manufacturers to find recycled plastic of sufficient quality. PET from EPR schemes and deposit-return schemes (PET bottles) is a highly sought-after raw material in different sectors (e.g. the food sector, the textile sector), which creates competition for recyclable plastic not only in domestic, but also in international markets ("Plasticker," 2022). The price of recycled plastic may vary from 90% of the price of virgin material to a negative value (mainly due to contamination, material degradation, hazardous content, and the links between virgin resin prices and the highly volatile price of oil); thus, recycling is not always economically competitive (Kosior and Mitchell, 2020; Pohjakallio, 2020). Nevertheless, recycled content is not downcycled, i.e. it is used for products of similar value. The lack of the EU-wide EoW criteria is a barrier to good functioning of the secondary plastic marker since it raises the degree of ambiguity (Ljungkvist Nordin et al., 2019). The development of EoW criteria is intended for 2022 and 2023 (European Commission, 2022b).

Compost. In 2018, the EU produced 87 million tonnes of biowaste, which includes separately collected biowaste and biowaste collected with mixed (residual) waste (Eurostat, 2021a). In compliance with the EU regulations, municipal biowaste is selected separately because it is a prerequisite for recycling. The Waste Framework Directive stipulates that the share of municipal waste, including biowaste, prepared for reuse and recycling should increase to a minimum of 55 percent of the total by weight by 2025.

Composting and anaerobic digestion are the most commonly used treatment methods for separately collected biowaste. The final products are compost, which can be used as fertiliser, soil improvers and growing medium ingredients, or digestate, which can be used as organic fertiliser or soil improver. When implementing the EU Fertilising Products Regulation (EU, 2019b), the purpose is to create a policy framework that would promote the use of organic fertilisers and soil improvers. This would help reduce the EU's dependence on the import of mineral fertilisers

and would serve the development of the circular economy. Currently, some EU Member States have already introduced compost quality management schemes, but it is noticeable that the secondary fertilisers and soil improvers do not reach the quality of mineral fertilisers, and the markets for compost from biowaste are very local. The report by the ECN (European Compost Network, 2023) indicates that the EU generates somewhat between 118 and 138 million tonnes of bio-waste, but only about 40 percent is effectively recycled into high-quality compost and digestate. The estimations for 2022 (European Compost Network, 2023) confirmed that less than 40 million tonnes of municipal biowaste were processed into high-quality compost and digestate in 2022, which means that only 17 percent of separately collected municipal solid waste is organically recycled. For reaching the recycling target of 65 percent by 2035, further incentives need to be applied to divert organic waste from landfills and direct it towards the European fertiliser market.

The statistics of the countries (Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Switzerland), which have the quantified information about the use of compost produced from biowaste, show that the main market where compost produced from biowaste is used is agriculture and horticulture. The second market is landscaping and green areas. Belgium, Ireland and the Netherlands have relatively large growing media markets. Belgium and the Netherlands are developing their compost export markets (European Environment Agency, 2020).

According to the EEA (zu Castell-Rudenhausen et al., 2022), the EU market for secondary fertilisers and soil improvers produced from compost does not currently meet the criteria of a well-functioning market (see Table 7).

Table 7. Assessment of the secondary compost market in terms of the criteria of a well-functioning market

Category	Criterion of a well-functioning market	Assessment of the secondary compost market
Market size and growth	High shares of supply and demand	Low demand due to inadequate quality of biowaste; secondary fertilisers and soil improvers do not reach the quality of mineral fertilisers
	Sufficiently stable/increasing supply and demand	Demand is not stable, although slowly growing
	Open international trade and high tradability	Trade mainly takes place in local markets; lack of international trade
	High industrial capacity based on secondary material inputs	Difficult to assess since only a limited number of countries have data available

Policy drivers in market development	Non-policy-driven supply and demand	High political intervention; many requirements are set in the Waste Framework Directive
	Application of Extended Producer Responsibility and/or Compliance schemes	Not relevant, the initial stage only
	No competition from energy use	Partly; biowaste is rarely incinerated
Prices	Reference prices	No reference prices at either domestic or international level
	Organised markets for trading; derivatives (e.g. futures)	No
	Sufficient information available to supply and demand actors	Lack of reliable information
Technical specification and barriers	Standardised product specifications	Yes; application of the European Compost Network Quality Assurance Scheme (ECN-QAS)
	No regulatory barriers to using secondary raw materials as inputs in manufacturing	No data available

Source: own elaboration, based on the assessment by the EEA (zu Castell-Rudenhausen et al., 2022).

The assessment in Table 7 indicates that the current secondary compost market in the EU is not well-functioning. The market only fits the criterion of product standardisation (by applying the European Compost Network Quality Assurance Scheme (ECN-QAS)). It also partly fits the criterion of no competition from energy use. However, unstable demand, high political intervention, and the lack of reference prices do not allow this market to function effectively.

Construction and demolition waste. Construction and demolition waste accounts for more than a third of all waste generated in the EU. It contains different materials, for instance, concrete, bricks, wood, glass, metals, and plastic (European Commission, 2024). However, the most economically valuable fractions make up only a small part of all construction and demolition waste. These are mainly metals, plastics, and glass (European Commission, 2018). Other waste can contain small amounts of hazardous materials, such as solvents and asbestos, which can pose environmental risks and impede recycling (European Commission, 2024). The mineral fraction of construction and demolition waste can be utilised by producing aggregates which, in their turn, can be used for manufacturing bricks, floor and roof tiles, ceramics, and concrete.

The EU-27 statistics show that 207 million tonnes of construction and demolition waste were recycled in 2018. The applications include road sub-bases, sand production, ready-mix concrete, concrete blocks, cement, ceramics and bricks, and low-cost adsorbent for wastewater treatment, an SRM in clinker production (ETC/WMGE, 2020; Reis et al., 2021).

It is noteworthy that technologies for separation, recovery and recycling of construction and demolition waste are available, they are well-established and generally inexpensive (European Commission, 2023a). Thus, the low current level of recycling (which varies greatly across the EU, ranging from 10 to 90 percent (European Commission, 2023a)) is more associated with market inefficiencies (Embureau, 2022). The criteria which show why the secondary market of the aggregates derived from construction and demolition waste is not well-functioning are provided in Table 8.

Table 8. Assessment of the secondary market of the aggregates derived from construction and demolition waste in terms of the criteria of a well-functioning market

Category	Criterion of a well-functioning market	Assessment of the secondary aggregates market
Market size and growth	High shares of supply and demand	High supply but unstable demand
	Sufficiently stable/increasing supply and demand	Stable supply; demand depends on the quality of aggregates
	Open international trade and high tradability	Trade mainly takes place in local markets; heavy weight of waste; high transportation costs; low price
	High industrial capacity based on secondary material inputs	Difficult to assess since only a limited number of countries have data available
Policy drivers in market development	Non-policy-driven supply and demand	High political intervention; requirements for collecting and recycling construction waste are set in the Waste Framework Directive
	Application of Extended Producer Responsibility and/or Compliance schemes	Not relevant, the initial stage only
	No competition from energy use	Not relevant

Prices	Reference prices	No reference prices
	Organised markets for trading; derivatives (e.g. futures)	Local markets only
	Sufficient information available to supply and demand actors	No information available
Technical specification and barriers	Standardised product specifications	Developed standards of quality
	No regulatory barriers to using secondary raw materials as inputs in manufacturing	Unclear regulation; case-specific permits

Source: own elaboration, based on the assessment by the EEA (zu Castell-Rudenhausen et al., 2022).

The supply of the aggregates produced from construction and demolition waste is comparatively stable and secure, but of inadequate quality, which leads to unstable demand. Production of crushed concrete waste requires selective demolition and treatment, which raises costs. The introduction of material passports to provide the characteristics of materials and components, as intended, will also increase costs. The high relative weight of construction and demolition waste requires the infrastructure which would allow transporting good-quality recycled materials in a cost-efficient way.

The price of the aggregates derived from construction and demolition waste varies across Europe. It is comparatively low and depends on the quality. The final price can also be affected by transportation costs.

Production of the aggregates from construction and demolition waste must comply with the specific regulations within the EU. These regulations are aimed at limiting the risk of hazardous substances present in the environment. They are as follows: 1) the regulations for the use of waste aggregates with limits on total content and/or leaching of pollutants; 2) the national EoW criteria (Velzeboer & Zomeren, 2017). Application of specific requirements means significant political intervention, i.e. the supply and demand are highly dependent on the political instruments practiced. The market only fits the criterion of the developed standards of quality.

With consideration of the factors discussed above, it can be concluded that construction and demolishing waste is available for recycling in large quantities, the technologies to convert the waste into recycled aggregates are mature, but the quality criteria, lack of reference prices, and pollutant limit values in the environmental regulations within the EU limit the effective functioning of this market.

Textile. Textiles make up a significant part of general waste with nearly five million of tones discarded each year, which makes around 12 kg per person in the EU. The textile industry is one of the largest polluters after food, housing and mobility (Bolitho, 2023).

Unsorted textiles are often classified as general waste and are incinerated or landfilled. Sorted textiles (textile is required to be separately collected by 2025, in accordance with the European legislation) can be reused, recycled or disposed, depending on its quality (European Environment Agency, 2022g). According to the Eurostat data (2021a), the EU-27 produced nearly 2.17 million tonnes of textile waste in 2018. Reusable textile is mainly sold to foreign markets, whereas non-reusable textile waste is downcycled (for instance, by producing rags, upholstery or insulation filling) or incinerated. Only about 1 percent of textile waste is recycled into new textiles (clothes) and enters the market for new products (European Environment Agency, 2019).

The textile-to-textile recycling is complicated by the lack of effective technologies for separating fibre and ensuring fibre quality. Both currently used technologies – mechanical and chemical recycling – have their limitations. One of the main barriers to high-quality textile recycling is a mix of diverse materials, fibres and dyes. For instance, a chemical recycling process can turn the nylon waste back into raw caprolactam (a substance that is normally made from crude oil), but the same cannot be said about other substances, i.e. a textile product is simply not made for being recycled at the end (Bolitho, 2023).

The EU Member States commonly import textile waste from other member states, while the main export direction of textile waste is non-EU member states (53 percent of all textile waste), which indicates that the market for textile waste is comparatively open (zu Castell-Rudenhausen et al., 2022). Nevertheless, the market does not meet the criteria to be considered a well-functioning market (see Table 9).

Table 9. Assessment of the secondary market of textile in terms of the criteria of a well-functioning market

Category	Criterion of a well-functioning market	Assessment of the secondary textile market
Market size and growth	High shares of supply and demand	Inadequate quality of waste leads to poor quality of recycled textiles, which leads to low demand
	Sufficiently stable/increasing supply and demand	Demand is low
	Open international trade and high tradability	Open international trade; significant trade volumes

	High industrial capacity based on secondary material inputs	Due to technological challenges, textile-to-textile recycling is limited
Policy drivers in market development	Non-policy-driven supply and demand	Obligations to the Member States are provided in the Waste Framework Directive; the EU recycling targets are to be introduced
	Application of Extended Producer Responsibility and/or Compliance schemes	Only a few Member States have Extended Producer Responsibility and/or Compliance schemes
	No competition from energy use	Requires a significant share of energy recovery
Prices	Reference prices	No reference prices
	Organised markets for trading; derivatives (e.g. futures)	No organised markets
	Sufficient information available to supply and demand actors	No information available
Technical specification and barriers	Standardised product specifications	No united product standards within the EU
	No regulatory barriers to using secondary raw materials as inputs in manufacturing	No information available

Source: own elaboration, based on the assessment by the EEA (zu Castell-Rudenhausen et al., 2022).

Table 9 indicates that the market of textile waste meets only the criteria of open international trade and high tradability, and no competition from energy use. However, textile recycling is limited due to technological challenges, the share of SRM is relatively small as well as the industrial capacity for producing SRM. The supply and demand are not stable, the compliance schemes are hardly applied. All these factors make the textile waste market poorly functioning.

The EEA (zu Castell-Rudenhausen et al., 2022) assessment of the secondary raw material markets is based on the method of expert evaluation (a qualitative evaluation) since there is a lack of information and data to conduct a quantitative evaluation. Following the EEA's (zu Castell-Rudenhausen et al., 2022) methodology for assessing the functionality of the secondary raw material markets, the researchers assessed the Lithuanian secondary raw material market. The results are presented in the study titled "The need and recommendations for the

development of the Lithuanian secondary raw material market," conducted by the Innovation Agency (Project No. 01.2.1-LVPA-V-842 -01-0004) (Innovation Agency, 2023b).

Summarising, it can be stated that the aluminium, paper and cardboard, and glass markets are well-functioning secondary raw material markets in the EU; they meet all the criteria proposed by the EEA (zu Castell-Rudenhausen et al., 2022) and have been functioning for a period of time. These markets are significant and less dependent on the policy framework aimed at regulating the supply of materials. In general, the EU secondary raw material markets have competitive prices.

Less developed secondary raw material markets (mainly for plastics, bio-waste (compost), construction and demolition waste, and textiles) are characterised by unstable and insufficient supply compared to alternatives in the primary raw material market, weak demand, low technical standards, and high dependence on regulations. In other words, the development of these markets to a great extent depends on the ability of regulators to promote supply (for example, through recycling targets) and demand (for example, through the requirements for the use of recycled content). The secondary raw material markets which produce low-cost recyclables (e.g. compost or recyclable construction and waste) are difficult to develop into large markets simply because the transportation costs cannot be covered by the prices at which these recycled materials are traded on the secondary market.

The size of the market and the quality of the materials in terms of industrial use are the two major factors that characterise the growth of a well-functioning secondary raw material market. Each market, including the secondary raw material market, faces various development barriers, which are described in the following subsection.

2.4. Barriers to the development of the secondary raw material markets in the EU

Sustainable waste management is one of the major pillars when implementing the principles of the circular economy. Actually, it means designing out and minimising waste in production processes and converting waste into new secondary materials (Ohana Consultancy, 2021). Although many companies and industries across the EU have been implementing innovations to convert waste into secondary raw materials, they are facing significant challenges and regulatory barriers. Literature analysis (Moors et al., 2005; Wilts, 2016; Interreg Europe, 2018; Masi et al., 2018; Grafstrom & Aasma, 2021; Kovac & Vandenberghe, 2020; Ohana Con-

sultancy, 2021; European Environment Agency, 2022g; zu Castell-Rudenhausen et al., 2022; the European Economic and Social Committee, 2023) allowed to divide the major barriers to the development of the secondary raw material markets into six groups:

1. **Regulatory barriers (including the lack of regulation and overregulation):** although environmental and waste management policies stimulate the emergence of new secondary raw material markets and promote the growth of mature markets, these markets are subject to many specific regulations and rules, including some non-environmental regulations. The lack of regulation or its weak enforcement is an obstacle to the development of the secondary raw material market. Current regulatory systems do not sufficiently promote the use of recycled materials (obstacle of a regulatory nature) (Ohana Consultancy, 2021). The EU still needs a clear definition of waste, comprehensible criteria for classifying waste, re-classifying end-of-life products, and a framework for recognising waste as a secondary raw material. The European Economic and Social Committee (2023) called upon the European Commission to ensure a comprehensive approach with coordinated EU policies to provide regulatory certainty for investments in exploration, extraction, processing, refining and recycling of raw materials.
   Nevertheless, overregulation is also detrimental. According to Kovac and Vandenberghe (2020), over-regulation can impede implementation of sustainable practices, distort the operation of the market, undermine productivity, diminish growth and social wealth and, consequently, sustainability. Thus, it is important that regulation incentivises a circular model rather than focuses on sanctions for not meeting particular criteria or standards. Lawmakers must follow the principles of efficiency and wealth maximisation. Strict regulation is suggested merely in cases of market failures.
2. **Technical barriers (including inefficient technologies, product design, and the poor quality of secondary raw materials):** the absence of effective technologies or poor access to these technologies (starting from waste collection, waste processing and ending with the use of secondary raw materials in production) can become a barrier to the development of the secondary raw material markets. Currently used technologies are often not adapted to the use of secondary raw materials (technological barriers) (Ohana Consultancy, 2021). Even if particular technologies exist, they have not been scaled and commercialised. Thus, it is important that the conditions for technology scale up are created at the EU level, which would help to increase recycling efficiency and cost-effectiveness (Ohana Consultancy, 2021).

Product design is another technical barrier to the development of the circular economy. As noted by Ohana Consultancy (2021), most products are not designed for circularity, and producers do not prioritise circularity in a product design. As a result, a substantial part of products are disposed of after their first life cycle. To improve the situation, products must be designed so that they can be easily repaired or disassembled, which would facilitate their reuse and recycling.

Quality control is also critical. In the absence of quality control at various stages of the value chain (waste collection, traceability of pollutants, standardisation of secondary raw materials, etc.), secondary raw materials which are not competitive in terms of quality compared to primary raw materials can be supplied for production. In addition, a complex problem related to the management of the secondary raw material market is the lack of reliable, comprehensive and relevant information regularly provided to shareholders. Access to the information would allow shareholders not only to make rational decisions, but also to better monitor market changes. Meanwhile, stakeholders in the primary raw material market can easily obtain the information about availability of raw materials, their price, quality, traceability, trade platforms, etc.

3. **Industry capacity barriers (including investment needs):** although authorities are increasingly supporting the recycling of waste supply and the availability of secondary raw material markets, some parts of the value chain may be lacking the recycling capacity. For instance, the lack of plastic recycling capacities makes it difficult to manage the large volumes of plastic waste generated by many different end-users.

   To conduct production sustainably, producers often need to modify their production processes, which requires building the additional infrastructure and expanding capacity. When combining different types of technologies, the need for identification, sorting and pre-treatment of feedstock before treatment arises. Chemical, thermal and biological technologies used in processing waste, unlike mechanical technologies, require significant investment not only in implementation (installation of new machinery, retooling machines, building new logistics facilities, etc.), but also in controlling the process conditions. In addition, it is difficult to combine automated and digital solutions. New processes and technologies can be hardly compatible with the current production system and conflict with earlier investment (Moors et al., 2005). When making significant investments, guarantees are needed that the critical mass of material will be processed

with innovative technologies in the future, and uninterrupted supply will be ensured to prevent downtime.

Finally, when implementing thermal technologies, a minimum feedstock for processing is required, which means that only a limited number of plants can be developed.

4. **Economic barriers (including prices, costs, supply frictions, information, etc.):** some secondary raw material markets are not cost competitive compared to the virgin raw material markets. This is the case even when waste is sold at negative prices since the barriers described above (see points 1, 2 and 3) can increase costs for industrial producers. It is often cheaper for producers to buy virgin raw materials than reuse recycled materials. In addition, designing innovative recycling systems is costly, as well as R&D activities for developing and testing new recycling methods and technologies. Since innovative technologies are newly implemented, they are not yet producing economies of scale.

   Producers of packaging and consumer goods that are potential users of secondary raw materials do not rely on the capability of the secondary raw material market to ensure a continuous and stable supply of homogenous materials. Thus, the market share of secondary raw materials remains much lower in comparison to the market share of virgin raw materials,

   In other cases, stakeholders are far from having complete information about the functioning of the secondary raw material markets, and the lack of information can become a major obstacle to the development of economically beneficial competitiveness, even in presence of both the demand and a decent quality supply.
5. **Competition from energy recovery from waste.** This problem is caused by the fact that competition from energy uses the same waste feedstock. Some markets for secondary raw materials, especially those related to the bioeconomy, generate a high demand for waste feedstock. This competition takes place even despite the violation of the waste hierarchy and the greater economic benefits that waste recycling could bring. For example, waste incineration requires significantly less investment compared to recycling. Incineration plants have a steady supply of waste, so it is difficult for waste processors to compete with waste incineration plants. Wilts (2016) provides an example when the Swedish and German waste recycling sectors faced serious financial problems due to overcapacity of their waste incineration markets.
6. **Low public awareness.** To promote the use of secondary raw materials, regional and local authorities should develop waste management concept

and form an attitude to sustainable environmental management in educational institutions, neighbourhoods, introduce the public to the concepts of the circular economy and industrial symbiosis.

The study "Green Transformation of Lithuanian Industry 2050" (Innovation Agency, 2023b) highlights the major circular economy related challenges faced by Lithuanian industry:

- interdependence of agents within the product value chain can limit the potential to transform production processes;
- wider industrial symbiosis and material recycling and reuse solutions are not seen by industrial companies as economically efficient or sufficiently developed technologically;
- the scale of demand and supply of secondary raw materials, even in technologically developed industrial sectors, is significantly different; thus, material recycling and reuse solutions are rejected by companies as economically unprofitable.

The first challenge is related to the fact that circular economy solutions in different industries, including production of food and beverages, are highly dependent on market demand and functionality of the value chain. On the one hand, it is an opportunity to reduce greenhouse gas emissions. However, at the same time, the ability to make circularity decisions is highly dependent on the factors which may only partially be controlled by business companies. The interdependence of value chains makes the implementation of circular economy solutions a considerable challenge. Industrial processes are usually highly tied to suppliers, and it is difficult to change suppliers, especially when the production scale is large. Thus, problems are not only caused by the need for initial investment in technology, but also by the need to find new suppliers when the list of suppliers in the market is limited.

The second challenge is related to economic competitiveness and the unavailability of the necessary technologies. When examining the potential of industrial symbiosis, it can be noted that manufacturing companies see the potential of supplying by-products and/or materials, remaining after their production processes, to other sectors, but the solutions that would allow the purchase or use of processed raw materials are rarely developed.

The third problem is that the scale of supply and demand for secondary raw materials varies significantly within industry. The unevenness of supply and demand causes doubts as to whether a particular sector or company will have a sufficient scale of material supply and demand. Thus, circular economy solutions are rejected as risky and economically unprofitable.

Bruneckienė et al. (2021), researchers representing Kaunas University of Technology, conducted the study titled "Challenges and Opportunities of the Circular Economy in Lithuania," where they analyse the threats and opportunities experienced by Lithuanian companies and stakeholders when pursuing the circular economy objectives and transforming production processes at the EU and national level. The research revealed that the major challenges in the area of raw materials are **the lack of secondary raw materials** in the absence of a unified and competitive market, and **low demand for secondary raw materials**. Secondary raw materials are often more **expensive** than virgin ones. **Substantial amounts of industrial waste are lost**. Manufacturing companies in Lithuania are focused on increasing production efficiency, not on ensuring the circularity of the entire value chain. Some industrial enterprises work for foreign companies and have limited powers to make decisions concerning circularity innovations. In many manufacturing companies, the methods of the linear economy are established, so the circular economy is seen as a threat, a challenge or a vague area. It should also be noted that Lithuania **does not have a ranking** (C2B; B2B; B2C; C2C) **of its item repurposing and reuse market.**

Summarising, it can be stated that the major barriers to the development of the secondary raw material markets in the EU are the absence of a legal framework for recognising waste as a secondary raw material, the lack of comprehensible criteria for classifying waste and re-classifying end-of-life products, over-regulation of industrial practices which impedes implementation of sustainable processes and undermines productivity (regulatory barriers), inefficiency of recycling technologies, circularity unfriendly product design, and the poor quality of secondary raw materials (technical barriers), industry capacity barriers and the need for significant investment which may conflict with earlier investment, poor price and cost competitiveness of secondary raw materials compared to virgin raw materials, supply frictions, the lack of complete information about the functioning of the secondary raw material markets (economic barriers), competition from energy recovery from waste, and low public awareness of the benefits of circular economy and industrial symbiosis.

The development of the use of secondary raw materials in Lithuania is impeded by the absence of a unified and competitive market, low demand for secondary raw materials and their high prices, dependency on foreign business partners when making circularity decisions, and deep establishment of the methods of the linear economy.

Chapter 3

Analysis of Good Practices in Developing the Secondary Raw Material Markets

3.1. Development of the secondary raw material markets in Belgium, the Netherlands and Estonia

The good practices of Belgium, the Netherlands and Estonia in the field of recycling secondary raw materials are inspiring when looking at their Circularity Indices: the circularity index estimated for Belgium in 2021 was 20.5, for the Netherlands – 33.8, and for Estonia – 15.1 (Strata, 2022).

Belgium recycled 79.2% of all its waste in 2020, which is well above the EU average of 53%. Belgian government is continuously improving the country's waste management system. Municipalities are responsible for collecting and managing household waste. They often cooperate with each other through public associations to ensure effectiveness. Some types of waste (e.g. plastics) are collected from people's homes, others need to be taken to recycling container parks and collection points. A combination of drum sieves, infrared machines, and AI separates the different types of sorted waste, presses it into large bales which then travel to recycling plants (Nauriyal, 2024). A landfill ban is applicable in the entire country (the three regions). Moreover, the tax system (landfill tax and incineration tax) makes landfill the least favourable option and favours separate collection of waste. Nevertheless, the country has a high level of incineration which reached a stable plateau around 43% in 2020 and previous years (European Environment Agency, 2022f).

The Netherlands is a leader in recycling in Europe, having diverted more than half of the country's municipal solid waste to recycling. A landfill ban covers numerous materials, and a disposal tax incentivises recycling. The National Waste Management Plan (NWMP) introduced a new target for the collection of household waste in 2020. At least 75 % should be separately collected, with a maximum of 100 kg residual household waste generated per person per year (ETC/WMGE, 2021). The latter target corresponds to around 20 % municipal waste generated. The country has a high level of incineration, which has been slowly decreasing the past years and stood at 41.8 % in 2020 (European Environment Agency, 2022b,d).

In Estonia, the circular economy is perceived as a tool which not only allows achieving environmental goals, but also generates opportunities for job creation and stimulates innovation. Over the past 10 years, Tallinn has demonstrated considerable progress in the field of sustainable waste management and received the European Green Capital award in 2023 (OECD Library, 2024). Estonia generates around 500 thousand tonnes of municipal waste annually. It has a rather stable total recycling rate of just below 30%. Although, according to the Ministry of the Environment of Estonia (2021), the extraction of recyclables is not the strategic focus of the country, and Estonia is trying to raise its efficiency of separate collection and reduction of the generation of mixed municipal waste, the country is able to extract 7,193 tonnes of recyclables annually from mixed/residual municipal waste for recycling, of which around 60 % is plastics (European Environment Agency, 2022e).

Next, we will examine how the use of secondary raw materials is promoted in Belgium, the Netherlands and Estonia in terms of regulation measures, the extended producer responsibility, the creation and organisation of the systems for collecting secondary raw materials, implementation of the "Pay As You Throw (PAYT)" principle, imposition of landfill taxes, public education about waste recycling, and project financing for business enterprises.

Regulation measures. The impact study on "How to stimulate secondary raw material markets" by Interreg Europe (2018) suggests that the regulation measures which promote the use of secondary raw materials are waste management decisions and plans at the national and regional levels. When making decisions at the national and regional levels, it is necessary to prepare detailed federal and regional/local waste management plans. Waste management planning is the cornerstone of any national, regional or municipal waste management policy. Waste management plans allow: a) assessing the current situation to identify strengths and weaknesses, b) setting qualitative and quantitative waste management objectives (including recycling objectives), c) formulating appropriate strategies to achieve objectives, d) selecting implementation measures, and e) creating monitoring and assessment schemes to track progress.

Belgium is divided into regions (Flanders, Brussels, Wallonia). The regions themselves are responsible for organising waste management. In 2017, Belgium reached and exceeded the EU goal: by 2020, it was preparing and recycling 56 per cent of paper, metal, plastic, and glass in its municipal waste. Wallonia reused, recycled and recovered 96 percent of its industrial waste in 2015.

The responsibility for managing and processing industrial waste rests with the private sector. About 20 million tonnes of (primary) industrial waste is generated in Flanders; one third of this waste is construction and demolition waste. 15% of indus-

trial waste in Flanders is landfilled or incinerated. The remaining 85% is recycled, composted, and reused. About 3 million tonnes of industrial waste is generated in Brussels. 12.5% of industrial waste is landfilled, 9.5% is incinerated, the remaining 78% is recycled, composted, and reused (Sustainable Development, 2019).

Management plans for the main waste streams (see Table 10) were approved in 2010. Due to the large scale of waste recycling and composting, Belgium successfully achieved the EU 2020 objectives, one of which was to start recycling household waste.

Table 10. Fulfilment of the EU 2020 recycling objectives in the main regions in Belgium

Waste stream	2010	2020	After 2020	Progress
EU objective				
Paper, metal, plastic, glass in household waste: preparation for reuse and recycling		50%		Achieved in 2017 In Brussels – 43% In Flanders – 64% In Wallonia – 43% In Belgium – 56 %
Municipal waste: preparation for reuse and recycling			2025: 55% 2030: 60% 2035: 65%	Based on the revised calculation methods and the 2017 data, the goals have not yet been achieved
Brussels: Capital Region				
Reduction of household waste per capita compared to 2017			2023: 5% 2030: 20%	No data
Recycling rate of all household waste		50%		2017: 43%
Reuse of household waste per capita			2023: 3 kg per capita 2030: 6 kg per capita	The 2023 goal was achieved in 2018
Flanders				
Maximum generation of municipal waste			2022: 502 kg per capita	Achieved in 2018 (468.5 kg per capita)
Maximum generation of residual municipal waste	150 kg per capita (2007)		2022: 138 kg per capita Differentiated by municipalities 2030: 100 kg per capita	The 2007 goal was achieved in 2018 (146 kg per capita) In 2018, approximately one third of the municipalities fulfilled the objectives set for 2022

Municipal waste recycling			2022: 7 kg per capita	5.4 kg per capita (2018)
Wallonia				
Separate collection of municipal waste	65%			The 2008 objective was achieved in 2015: 70 percent
Municipal waste collection, recycling and reuse	54%			No data
Maximum generation of municipal and similar waste per capita (excluding inert, bulky and yard waste)	292 kg per year			The objective was achieved in 2010 – 278 kg per capita
Maximum generation of municipal and similar waste per capita (excluding inert, bulky and yard waste)	445 kg per year		2025: 501 kg per year	The 2010 objective was not achieved – the 2018 rate was 518 kg per capita
Reuse, recycling and regeneration of industrial waste	85%			The objective achieved in 2015: 96 percent
Municipal waste going to landfill	6%			The objective achieved in 2018: 1.7 percent

Source: OECD 2021.

To promote the circular economy, the Belgian government developed the circular economy plans and targets in all three regions; the plans were linked to the country's economic development targets (see Figure 4).

The Brussels-Capital Region approved the 2016 Circular Economy Programme, which promotes the economic circularity of resources. The programme also promotes the reduce of food waste and recovery of unsold food. It stimulates farming in the city of Brussels to reduce the distance of food from farms to consumers. The region's and waste management plan (2018) supports the transition to the circular economy and includes the related objectives. For instance, the plan stipulates that the volumes of repaired and reused electrical and electronic devices should increase by 50 percent in 2023 compared to 2017 (OECD, 2021).

Flanders approved the region's Vision 2050. The Vision considers the circular economy to be one of the seven transition priorities. Flanders Energy and Climate

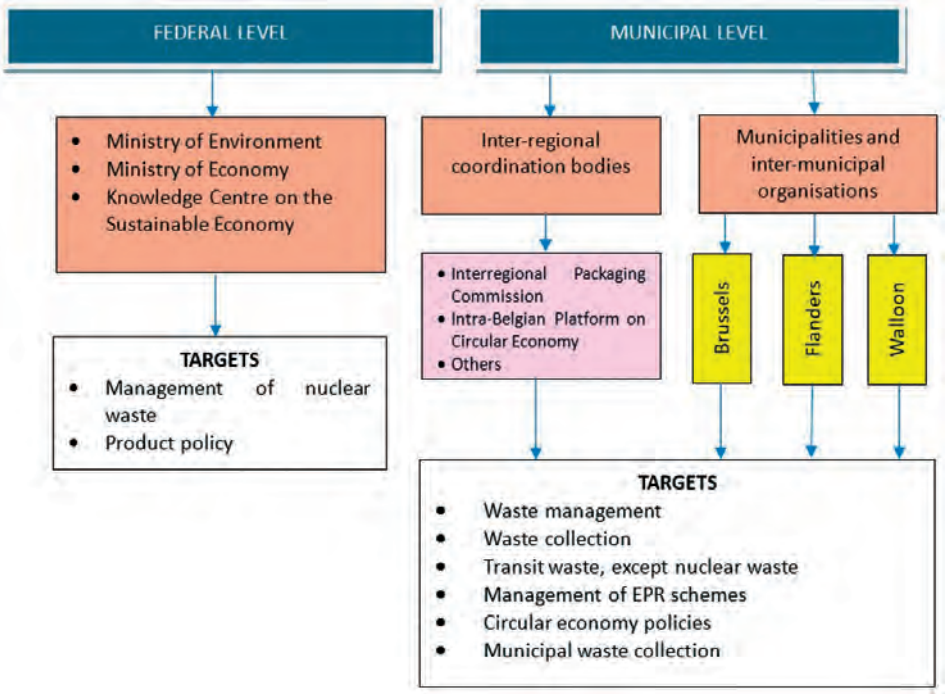

Figure 4. Distribution of the responsibilities and functions for waste management in the circular economy at national, regional and local levels in Belgium

Source: OECD 2021.

Plan 2021-2030 links the climate and circular economy objectives and aims to reduce the GHG footprint by 30% by 2030 (OECD, 2021).

Wallonia's third regional waste and resource plan 2018 links the circular economy to higher waste recycling volumes in the region and considers new public procurement initiatives (OECD, 2021).

At the national level, the Belgian Ministries of Environment and Economy approved the Circular Economy Action Plan, which covers 21 measures focused on product and consumer protection policies. The federal government, not the regions, has competence in these areas, but the Plan has been coordinated with the three Belgian regions.

Established in 2018, the Belgian Internal Circular Economy Platform brings together officials from regional authorities and the federal government twice a year to exchange information and coordinate joint actions. The platform was established because the division of competences at different levels had been identified as an obstacle to the circular economy (OECD Working Party on Urban Policy, 2019).

Three Belgian regions also have their waste information systems, collect data from waste operators, and share information between municipal organisations,

producer responsibility organisations, and other sources. The regions are accountable to the government which aims to ensure the harmonisation of data collection methods, as well as regional cooperation mechanisms. The Inter-regional Packaging Commission (IRPC) is responsible for reporting on the generation and treatment of packaging waste. The Brussels Environment Agency, Public Waste Agency of Flanders (OVAM), and the Walloon Regional Department have jointly developed *BeWeee*, a joint reporting platform for waste management professionals and individual businesses. A joint system for monitoring reusable packaging and regular exchange of information on waste transportation has also been developed.

The Netherlands recycles 80% of its waste and is one of the leaders in Europe (ETC-CE, 2022). The Ministry of Infrastructure and Water Management is responsible for coordinating the circular economy policy. Additionally, particular ministries are responsible for the following areas related to circularity:

- Ministry of the Interior and Kingdom Relations – construction of residential and non-residential buildings;
- Ministry of Infrastructure and Water Management – construction of civil engineering;
- Ministry of Economic Affairs and Climate Policy – manufacturing industry;
- Ministry of Infrastructure and Water Management – plastic and consumer goods;
- Ministry of Agriculture, Nature and Food Quality – biomass and food.

The ministries not only closely cooperate with each other in solving the problems of circularity, but also coordinate their actions with other ministries in the areas of education, labour market, and fiscal policy.

The timeline for transition to the circular economy in the Netherlands is the period 2016-2050 (Government of the Netherlands, 2024):

- The 2050 Circular Economy Programme was approved by the government in 2016. The programme describes how the economy could be made sustainable and fully circular by 2050. The programme provides actions which ensure the use of raw materials and products/services in a smarter and more efficient way.
- The Raw Materials Agreement was signed in 2017. The Agreement was signed by 180 countries in Hague in January 2017. The Agreement sets out what should be done so that the economy of the Netherlands could function by using renewable resources. The Agreement was approved by both the government and the industry.

- The 2018 Transition Agendas were approved. The government and the signatories to the Raw Materials Agreement developed five Transition Agendas, focusing on five sectors and value chains which are important to the economy but at the same time are a significant environmental burden. The Transition Agendas were drawn up for plastics, consumer goods, manufacturing, construction, biomass, and food. The Agendas determine how the relevant sector can become circular by 2050 and what actions need to be taken.
- The 2019-2023 Circular Economy Program: Actions and Projects was introduced. The government presented the Circular Economy Programme which translates the five Transition Agendas into the actions and projects to be implemented in 2019-2023.
- The Circular Economy Programme was updated in 2021. It is aimed at reducing the use of raw materials by 50% by 2030. The first objective of the Programme is ambitious but not unattainable: the Netherlands has committed to using 50% less primary resources (minerals, metals, and fossil fuels) by 2030.
- Zero waste economy by 2050. The Netherlands aims at developing the circular economy by 2050. A zero-waste economy will be based on the use of sustainable and renewable raw materials, and the reuse of products and raw materials.

The Dutch government cooperates with other governments at a bilateral and regional level both within the United Nations, the European Union, and beyond. The government is also actively involved in multi-stakeholder platforms where the government, businesses, and international organisations work towards the objectives of the circular economy. One example is the PACE Platform for Accelerating the Circular Economy, which has more than 40 members.

Estonia's waste generation (excluding major mineral wastes) increased by 12% between 2010 and 2018. During 2006 and 2020, the generation of municipal waste per capita fluctuated between 398 and 383 kg per capita, with a net decrease. The trend stagnated shortly after the introduction of Estonia's first waste prevention programme in 2014, however continued increasing again in 2016-2018. Municipal waste generation in Estonia still remains below the European average value (517 kg per capita in 2020) (European Environment Agency, 2023b).

In 2021, the Government of Estonia adopted a decision to extend the National Waste Management Plan 2014-2020 retroactively until the final approval of a new National Waste Management Plan. This also includes Estonia's Waste Prevention Programme. The major objective of the Estonian Waste Prevention Programme is to support activities that contribute to the more efficient usage of the resources

and help to introduce the principles of a circular economy, prevent waste and emissions, and reduce the environmental impact of activities. The Programme covers the following sectors:

- construction and infrastructure,
- industry,
- retail,
- households,
- public services.

The priority waste types include food and organic waste, food and demolition waste, hazardous waste, household/municipal waste, packaging, waste electrical and electronic equipment /batteries, and industrial waste (oil shale). The quantitative targets of the Estonian Waste Management Programme are as follows (European Environment Agency, 2023b):

- relative growth of municipal waste generation compared to relative increase in GDP should remain less than 50%;
- relative growth of packaging generation should be maximally 2/3 compared to relative increase in GDP;
- construction and demolition waste recovery rate should remain > 75%;
- electronic waste collection rate should not be lower 65% of that put on the market three years earlier;
- portable batteries and accumulators waste collection rate should not be lower 45% of that put on the market three years earlier.

The quantitative targets of the Programme are monitored yearly. The implementation of the Waste Management Programme has been evaluated in connection with its extension. A new version covering 2022-2028 is currently under development.

Estonia has also approved the specific waste prevention measures in compliance with Article 9 of the Waste Framework Directive (see Table 11).

Table 11. Specific waste prevention measures approved in Estonia in compliance with Article 9 of the Waste Framework Directive

Requirement	Measures
Promotion and support of sustainable consumption models	• Public procurers use an electronic platform for public procurement which includes a built-in green public procurement (GPP) criteria for easy GPP implementation; • GPP criteria for furniture, cleaning products and services, office paper and office IT products are mandatory for the public sector from the beginning of 2022; • Circular economy white paper was published in 2022 with the aim to promote waste prevention and reuse among other things

Promotion of the design, manufacturing and use of the resource-efficient, durable, reparable, reusable and ungradable products	• The SUP Directive provisions relating to design requirements on packaging; • Innovation project on modular renovation elements for buildings (Horizon 2020); • Guidelines for packaging design were developed in 2022
Prevention of critical raw materials from becoming waste	• The system for collection and recycling of CRM containing products and materials (MTÜ EES-Ringlus and MTÜ Eesti Elektroonikaromu); • Increased recovery of batteries and WEEE; • Collected waste portable batteries and accumulators are treated outside Estonia, most of waste automotive batteries and accumulators are treated in Estonia (in AS Ecometal); • Relevant provisions for reprocessing of potential extractive waste and sidestreams are included in the wider national policy on waste or resource efficiency
Promotion of reuse and repair activities	• The packaging undertaking at the point of sale must provide information on the availability of reusable food containers and beverage cups, including the conditions under which the point of sale will accept the sale of ready-to-eat food and beverages in the end-user's or consumer's reusable food container or beverage cup; • From 01.01.24 only reusable containers and cutlery may be used for serving food and drink at public events
Availability of spare parts, instruction manuals, technical information	• Quality standards for second hand products and legal liabilities are going to be harmonised
Reduction of the generation of food waste	• The national strategy on food waste prevention was developed in 2021; • Awareness campaign in September 2022
Promotion of food donation	• An interactive guide to food donation has been produced and is available on-line[1]; • Food donation promotion is included in the new food waste prevention plan; • Guidelines for safe donation of food were announced in 2022
Reduction of the content of hazardous substances	• Based on research commissioned by the Ministry of the environment, oil shale ash was excluded from the hazardous waste list in 2019 because classifying oil shale ash as non-hazardous means greater recycling in agriculture, cement and road construction
Reduction of generation of waste	• Scientific basis for improved recycling of oil shale ash has been created and regulation changed enabling further recycling; • Further support to develop solutions for waste minimisation and recycling for oil shale waste

[2] https://www.toiduannetamine.ee/

Measures to prevent and reduce litter	• Implementation of the EU Single Use Plastics Directive; • From 01.01.24 only reusable containers and cutlery may be used for serving food and drink at public events; • The deposit-based system uses QR codes for identification of returned packages
Reduction of marine waste generation	• The City of Tallinn forbids the use of plastic cutlery and serving food and drinks in single-use plastic dishes at public events; • Estonia's marine litter plan *Mereprügi plaan*, approved by the Ministry of the Environment in 2020, sets out 100 measures to prevent marine litter

Source: European Environment Agency, 2023b.

The Extended Producer Responsibility. The Extended Producer Responsibility (EPR) is characterised by an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage. In practice, EPR means that producers take responsibility for collecting and sorting end-of-life products before their final treatment (in the ideal case – recycling). The EPR systems apply for various types of waste (paper, batteries, packaging) which can be used as secondary raw materials in industry.

The EPR organisation VALIPAC[2] is responsible for coordinating the recycling of industrial and commercial packaging in Belgium. The main functions of VALIPAC are monitoring the collection and recycling of packaging with consideration of the quantities which enter the market, collecting the relevant data, and motivating companies to collect packaging waste separately (VALIPAC, 2023).

Belgium established Extended Producer Responsibility for batteries, end-of-life vehicles, mineral oils, photovoltaic panels, packaging, tires, and electrical and electronic equipment waste. In this respect, Belgium exceeds the EU requirements since the EU requirements do not include Extended Producer Responsibility for oils or tires. Belgian producers and importers can ensure the collection and recovery of waste themselves or establish a joint non-profit association to help fulfil their obligations. Association members pay fees to fund the collection, treatment, and recycling of their waste stream, as well as related administrative duties.

The case of Dutch good practice in EPR: an example of producer/supplier responsibility

The Netherlands has the functional deposit system for small plastic bottles. To improve waste treatment, the country decided to start a deposit system for small plastic bottles and beverage cans. A 20-year long political debate finally came to

[2] VALIPAC is an accredited organisation for the extended producer responsibility applied to commercial and industrial packaging.

an end: manufacturers have been responsible for the deposit system for plastic bottles since 1 July 2021, and for the deposit system for beverage cans – since 31 December 2022. The regulations came into force due to a change to the Extended Producer Responsibility (EPR) scheme for packaging. The amended Packaging Management Decree (AMvB) came into force on 1 July 2021. The objectives to be achieved by manufacturers were expanded to include not only recycling but also reuse. In addition, packaging manufacturers have been responsible for the packaging used by other companies.

The Ministry of Infrastructure and Water Management has established Extended Producer Responsibility (EPR) for textile products in the Netherlands. Manufacturers have been responsible for textile recycling and reuse since 1 July 2023. This means that manufacturers are responsible for a proper collection system, recycling and reuse of clothing and home textiles, and financing the entire system (Government of the Netherlands, 2023).

Estonia has taken a significant step towards the Extended Producer Responsibility with the launch of the Extended Producer Responsibility System aligned with the Directives Act for packaging on 1 January 2020. Under this progressive framework, producers bear the responsibility for their products throughout their lifecycle, with a particular focus on packaging materials. Producers dealing with EPR products must undergo registration with the relevant authority to acquire a packaging registration number. They must also pay a fee which depends on the EPR for each type of material. VAT is added to the service fees in the amount of 20%. Producers must submit annual reports detailing their packaging quantities. In cases of non-compliance, the following sanctions are imposed ("Lovat," 2024):

- Failure to fulfil the obligation to take back packaging and packaging waste or violation of the take-back requirements shall be punished with a fine of up to 300 fine units;
- Violation of the requirements for keeping records of packaging and packaging waste or failure to implement a self-checking system shall be punished with a fine of up to 200 fine units;
- The delayed payment of the amounts provided for in the Contract with extended organisation responsibility, the producer undertakes to pay late interest 0.05% of the amount delayed for a day upon the request.

Creation and organisation of the systems for collecting secondary raw materials. In general, waste collection systems can be classified by: a) the type of waste sorting model (e.g. mixed waste), and b) the location of a collection system (e.g. ground bins, door-to-door, 'buried' bins). Collection/sorting of waste in contain-

ers (at selected locations throughout the area) for different-coloured recyclables (e.g. glass, paper, plastic) could be a good starting point.

Belgium uses a door-to-door collection system for recyclable materials. Garbage bags vary in colour depending on what material is to be recycled. Brown bags are used for general waste. They cost between 1 and 2 euros per bag. The price is high because it is a way to reduce waste and encourage people to recycle. Blue bags are used for plastic, metal and drink boxes, which must be clean and free of food residue. Green bags are for GFT (*Groente*, *Fruit in Tuinafval*), i.e. they are used for organic waste which will be turned into compost to fertilise fields. Depending on the collection schedule, a bag of the appropriate colour is left at the door to be collected by waste collectors. If in Lithuania, people have to throw waste to different containers, in Belgium it is collected from door to door.

By 2017, Belgium had achieved the EU 2030 targets for the recycling of glass, paper and cardboard, metal and wood packaging (see Table 12).

Table 12. Achieving Belgium's packaging recycling targets

Type of packaging waste	Belgium: National recycling rate 2017	EU target (2008)	EU target (2025)	EU target (2030)
Glass	100%	60%	70%	75%
Plastic	44.5%	22.5%	50%	55%
Paper and cardboard	92.9%	60%	75%	85%
Metal	98.5%	50%	70% – ferrous 50% – aluminium	80% – ferrous 60% – aluminium
Wood	98.3%	15%	25%	30%
Others	6.2%			
Total	83.8%	55%	65%	70%

Source: OECD 2021, p. 187.

The recycling of municipal waste plays a particularly important role in the aim of the Netherlands to achieve the goals of the circular economy by 2050. Non-recyclable waste usually goes to either incinerators or landfills. The incinerators produce electricity which is then fed back into the Dutch power grid. Both recycling and waste collection are managed at the municipal level and paid for through city taxes. This means that requirements can vary across neighbouring areas. Some municipalities provide separate recycling cans which allow house-

holds to separate materials. In Amsterdam and some other large cities recycling needs to be deposited in communal, roadside containers which are either underground or on street level, and municipalities organise their regular emptying (Lapper, 2024).

A designated paper recycling bin (often blue) is collected regularly, usually every two weeks. A designated bin (usually orange) is provided to separate plastic at home, often alongside metal and drinks cartons. Certain plastic bottles can be recycled at local supermarkets. 'On-pack' recycling labels indicate whether the packaging is recyclable or not. Some plastics (for example, cling film (saran wrap), plastic sticky tape, and bottles used for chemicals) cannot be recycled. Certain glass bottles can also be recycled at local supermarkets. Some municipalities also provide curbside collections of glass recycling. Metal waste, including drink cans, food tins, and aluminium foil, can be recycled alongside plastics (orange bin), as long as they are clean. In some cities, like Amsterdam, metals are disposed along with non-recyclable waste and then separated out by local household waste sorting centres. Local municipalities organise waste collection either weekly or fortnightly (Lapper, 2024).

Door-to-door waste collection in Estonia refers to the collection and transportation of household waste from a designated area to a designated waste disposal site or sites by a company selected through a procurement organised by a local government unit. The Waste Act obliges the local government to organise household waste transportation within its administrative territory. Household waste generated in homes is collected and transported by a waste transport company.

The goal of the organised waste transportation is primarily to supply the entire population with waste transport and thereby prevent littering of the environment. The problem of ownerless waste is believed to disappear, because residents have to pay for their waste management anyway and the hauler must also take away what is placed next to the waste container. Containers that are filled to the brim are expected to disappear, as well as the motive to take waste to other people's containers or the forest.

Organised waste transportation includes paper and cardboard, biowaste, bulky waste, and municipal solid waste. These types of waste may only be handed over to a waste hauler serving the region under contract or, in a free market situation, to a company holding a corresponding environmental protection permit. Packaging waste is not included into the organised waste transportation (Tallinn City Municipality, 2024).

Implementation of the "Pay As You Throw (PAYT)" principle. PAYT principle (or the principle "polluter pays") is applied to make waste producers finan-

cially responsible for the collection and treatment of the waste they produce. Special tariffs will apply to secondary raw materials (Eunomia, 2022).

The PAYT schemes are being used by local authorities in Belgium, the Netherlands, and Estonia to promote recycling and reduce the amount of waste collected from households. When applying PAYT schemes, part of the tax can depend on (Eunomia, 2022):

1) the size of the container selected by a household;
2) container collection frequency;
3) application of a fee for a used bag;
4) weight of waste for collection;
5) a combination of the above-mentioned points.

Belgian citizens have to pay when they dispose their waste streams collected by municipalities or when they bring waste to collection points. The major purpose is to stimulate citizens to sort their waste by making waste sorting more attractive financially. Most expensive is collection of residual waste, followed by collection of biodegradable waste (to stimulate the home composting), with lowest taxes applied to plastic bottles and flasks, metal packaging and drink cartons. The separate collection of paper and cardboard, container glass, and textile is free (Regions for Recycling, 2014).

The PAYT systems in the Netherlands are designed to incentivise citizens to separate their waste at source. 50% of the municipalities in the country use a system for PAYT, which corresponds to a population coverage of 37%. The PAYT systems are mainly applied in small, non-urban municipalities. The tariffs are mainly based on volume, frequency and/or weight of waste. Most municipalities apply a system based on volume and frequency; another frequently applied system is based on volume. Total PAYT was 50.4% for a municipality (the country has 177 municipalities) and 37.3% for households (the average number of households per municipality was 16,221) in 2021 (according to the Country Profile provided by the European Environment Agency (2022)). The cost for waste disposal tends to decrease in municipalities where a PAYT system is applied, due to less residual waste.

The Ministry of the Environment of Estonia (2021) reported that Estonian municipalities have varying PAYT systems, but none of them have a weight-based system. The most commonly used volume-based systems are the fee for separately collected fractions (kitchen waste, paper and cardboard) – EUR 0.01 per lift per container regardless of its size, and the fee calculated for residual waste on equal basis regardless the container size. The volume-based systems are, however, treated as a weak type of PAYT, and the country does not have any uniform method-

ology to determine waste management fees. The positive aspect of applying the PAYT systems is that the coverage of the systems exceeds 50% of the population.

Imposition of landfill taxes. Landfill taxes are charged to private landfill operators to help direct waste away from landfills and towards environmentally preferable disposal alternatives, such as reuse, recycling, and composting.

The Brussels region in Belgium has no landfills. Flanders established a tax of 107.87 EUR/t for combustible waste, and 59.33 EUR/t – for non-combustible waste in 2020. The average landfill tariff (before taxes) was 49 EUR/t for household and similar waste, and 40 EUR/t for industrial waste in 2018. Wallonia established a 120.52 EUR/t tariff for general waste, a 66.89 EUR/t tariff for non-combustible waste, and a 267.55 EUR/t tariff for hazardous and non-hazardous mixed waste in 2020 (Cewep, 2021).

The Netherlands is one of the countries where many municipalities have an efficient PAYT system. For this reason, the results of waste management are impressive, and the number of organisations which are involved in the PAYT system is growing. The Netherlands introduced a landfill tax in 1995, but abolished it in 2012. The tax was re-introduced in 2015. Since 2021, the waste removal tax, landfill tax, and incineration tax have been equal – 33.15 EUR/t each (Cewep, 2021).

Estonia introduced a 29.84 EUR/t tariff in 1990. Untreated waste has not been allowed since 2004, and unsorted municipal solid waste – since 2008 (Cewep, 2021). In addition, Estonia has a partial landfill ban on biodegradable waste (European Environment Agency, 2022e). The Ministry of the Environment of Estonia (2021) reports that they proposed the increase of the landfill tax, but it has remained at the same level. Nevertheless, Estonia imposes the following non-compliance fees:

- for hazardous and non-hazardous waste, landfilled quantities larger than permitted: fee is 5 times higher than the usual fee, i.e. 149.2 EUR/t;
- for hazardous and non-hazardous waste, landfilled without permit: fee is 10 times higher than the usual fee, i.e. 298.4 EUR/t.

Since July 2020, the share of biodegradable waste in municipal waste landfilled shall not exceed 20% by weight. The allowed percentage has been gradually decreasing. The stabilisation of waste containing less than 20% of biodegradable waste is still necessary (Ministry of the Environment of Estonia, 2021).

Public education about waste recycling. Practical implementation of the principles of the circular economy is impossible without the acceptance and cooperation of society. Thus, is critical to increase the persuasive power of continual public education.

In 2020, Belgium passed the law prohibiting the bottling (supplying) of drinks in single-use packages at organised events and in daily activities. At non-government events, drinks can be bottled in single-use packaging if an organiser ensures that 95% of single-use packaging is collected and recycled on-site. In 2022, the government's ban was extended to include food supply in single-use packages. Some cities and municipalities, such as Ghent, Leuven, Lochristi, Lokeren, Moerbeke, Wachtebeke, Zele, and Zelzate completely banned the supply of drinks in single-use packaging at all their events and activities. These regulations are aimed at preventing littering and promoting multiple-use systems.

Many municipalities and organisations in Flanders have introduced pilot reuse and promotion systems:

- *Tielt* – a pilot reusable takeaway system in local restaurants;
- *Mechelen* – a reuse system for take-away food which unites about 10 local restaurants;
- *Leuven* – a subsidy of up to EUR 750 for hotels, restaurants and catering establishments with a reusable coffee cup system;
- University of Brussels – implementation of a reuse system for all hot drinks and takeaways;
- *Metsense* – a social restaurant group which is developing their own system for waste and takeaway food;
- University of Antwerp – an internal waste reuse system.

Raising awareness of the circular economy remains a critical issue in the Netherlands. The Netherlands hosted the World Circular Economy and Climate Forum in April 2021. This global conference has greatly increased public awareness of the circular economy and its potential to help achieve climate goals (Government of the Netherlands, 2024). The 'Waste at School' programme targets to the reduction of waste in schools. Behavioural science knowledge is applied in practical projects. Knowledge is shared with professionals in municipalities, schools and companies through courses and online tools and knowledge products.

Waste prevention-related campaigns serve to raise consumers' awareness of the environmental impact of waste materials and offer perspectives for action by providing more sustainable alternatives. Information is provided, for example, by *Milieu Centraal* and *Voedingscentrum*, and the campaign "Iedereen doet wat" (*everyone does something*). In the programmes for littering, household waste and industrial waste, scientific behavioural knowledge is translated into practical measures for municipalities and the business community. In addition, knowledge about the circular economy is integrated into training courses at knowledge in-

stitutions, in secondary vocational education and in higher vocational education (European Environment Agency, 2023c).

Estonia's marine litter plan includes and is intended for information to and guidance of the public. During May-October summer seasons 2020 and 2021, the international sea garbage collector *Seabin* in the Tallinn Old City Harbour collected marine trash and drew attention to the litter problem. The collector was open for exploration by both children and adults. An Annual Waste Prevention Week organised by national and local authorities in 2022 focused on prevention of textile waste.

In international partnership, Tallinn University of Technology organised a wide dissemination action on raw material-related topics for school students to become raw material ambassadors to wider communities.

Several major events took place in the summer of 2022, 2021, and even earlier, with reuse requirements (e.g. *Paide Arvamusfestival*, *Tartu Autovabaduse Puiestee*, *Viljandi Folk*, etc.). Event organisers pointed out that the use of reusable packaging and reusable packaging at events has more than halved waste generation. The estimations show that more than 30,500 disposable cups and plates were avoided at the Patarei Seafood Street in Tallinn in the summer of 2021 (European Environment Agency, 2023c).

Project financing for business enterprises. The transition to the circular economy needs resources to drive the uptake of new business models and support the development of innovative technologies. Governments can support the transition to the circular economy by using specific economic instruments.

The "Be Circular" call for projects is an initiative of the Government of the Brussels-Capital Region, launched within the framework of the Brussels Regional Programme for a Circular Economy (BRPCE) to financially support self-employed people and business companies in Brussels to set up innovative projects related to the circular economy. The "Be Circular" call for projects has a budget of several million euros per year. It involves companies (start-ups or long-established, VSEs, SMEs or large companies), self-employed persons, non-profit organisations, and business partnerships. Financing is provided for any innovative approach or project that aims to create or move the core business of an applicant towards greater sustainability within a circular economy perspective and in connection with one of the priority topics. Each year, the Region indicates the type of projects it is looking for, so it can guide project leaders and enable them to contribute to regional objectives. Financial support from the Region of up to EUR 50,000, EUR 80,000 or EUR 200,000 depending on the category, with an additional 10% for social and democratic enterprises and an additional 30% for urban production projects.

Individual support is provided from coaches with technical business expertise (marketing, financing, communication, strategy and business development, human resources management, etc.) (hub.brussels, 2024).

The Village Finance grant has been provided since 2016 as part of the Brussels Regional Programme for a Circular Economy (BRPCE). It has made available a fund that aims to support around 20 Brussels companies through the provision of grants. To help start-ups and very small businesses in Brussels who want to get involved in the circular economy, the Village Finance awards EUR 5,000 in grants for entrepreneurial creation or development projects that integrate the concepts of the circular economy. This grant, which is conditional on obtaining a bank loan of at least EUR 10,000, enables project leaders to raise the capital they need to start their projects. Since 2016, the Village Finance has awarded approximately 60 grants. Around 20 projects, such as sustainable food, brewing, textiles, computer science, and even herbal medicine, have been supported each year (hub.brussels, 2024).

Another example of good practice in project financing is the Netherlands: the country provides financial support, invests in research and innovation. The largest part of the provincial support for corporate circular projects is subsidy-oriented. The support mainly covers financial support programmes, and research and innovation funding. The main source of capital in the Netherlands is the European Regional Development Fund which provides financing for regional programmes, such as *OP Zuid*, O*P Noord*, *OP Oost*, and *Kansen voor West*. The provinces allocated a total of 229 million euros per year to various regional programmes in 2014-2020, but there is no data on how much funding was allocated to circular economy projects. About 10% of funding was allocated to circular economy projects in 2018. Together, the provinces spend 107 million EUR a year on the loans provided by the joint investment funds. It is difficult to say what proportion of funds is intended for circular economy projects, but in some cases the amounts are known. For instance, 13% of the amount lent by the Innovation and Energy Fund Gelderland is intended to be absorbed by circular companies. Most of the provinces also have special subsidies to promote the circular economy and spend a total of EUR 11.1 million per year.

Estonia has been supporting waste prevention through the Environmental Investment Centre. The Environmental Investment Centre offers 1-2 times a year a support to waste prevention and reuse activities from circular economy programme. For example, in 2021, the centre supported waste prevention and projects aimed at reusing products or product components (European Environment Agency, 2023c).

Summarising, the good practice of Belgium, the Netherlands and Estonia indicates that the development of secondary raw material markets requires proper legislation at both federal and municipal levels, right economic incentives and measures to promote recycling, proper support schemes for new infrastructures, adequate control and enforcement capacities, active awareness campaigns and environmental education of society.

3.2. Development of secondary raw material markets through the secondary raw material trading platforms

The activities of the major secondary raw material trading platforms which operate in the European Union are presented in Table 13.

Table 13. Secondary raw material trading platforms

Platform	Secondary raw materials in trade	Operation principle and detailed information
Cyrkl The international technology and consulting company specialising in circular waste management was established in the Czech Republic. Trading in secondary raw materials is the company's main activity	Plastics Paper Wood Glass Textile Building materials Metals Biowaste Machinery and equipment Chemicals Other waste	The platform unites over 20 thousand companies (not only from the EU). Any interested company can register for free, and buy and sell secondary raw materials by categories. Adverts provide the information on how many tonnes/units are sold, indicate prices, the minimum and total quantities of raw material for sale, the frequency of sale, the country or the nearest place of sale/purchase which can be selected, and a seller's contacts. There is an option, but only for plastic, to choose the desired form of the material (shredded, granulated, pressed, loose, ingots, powder, etc.) After the date when the sale was announced, the information about the sale can be tracked on the platform (24 hours, 3 days, 7 days, 30 days, monitoring all the time). Registration is free. During the research, more than 30 adverts by sellers from Lithuania, who sell various plastic, paper, glass, and metal secondary raw materials, were found.
Cirplus *Online platform for trading in recycled plastic, established in Germany*	*Plastics*	This is an international (not only EU) B2B trading platform for recycled and recyclable plastics, where any interested company can become a member after registering. The platform is partially supported by the German Federal Ministries of Education and Research, and Economic Cooperation and Development. The platform has its own technology advisory board that involves the R&D institutions working on plastic recycling in Germany.

		A seller can create an advert which includes the following criteria: source (post-consumer or industrial material), material type, colour, specifications, certificate(s), country of origin, quantities, price. A buyer can find a material by the above-mentioned criteria. Registration is free. During the research, no adverts by sellers from Lithuania were found.
Secontrade Online B2B platform for trading in secondary raw materials, established in Austria	Black metals Non-ferrous metals Plastics Glass Construction waste Wood waste Bio waste	This intelligent standardised platform ensures simple processing of information for sellers. Immediately after registration and company authorisation, a seller can present secondary raw materials for sale with all the necessary information, photos, certificates. Filters help to find the required amounts of secondary raw materials, their detailed descriptions, check the validity of the advertisement, and get a seller's contacts. Registration for buyers is simple; search and filter functions help to find the raw materials buyers need. Buyers have the option not only check the adverts, but also announce their call. Trading is conducted on the basis of an auction, where a seller can set a minimum price. Potential buyers are then informed about the appearance of the raw material they are interested in. The highest bidder usually wins, but the decision rests with the seller. Buyers can also bid on a part of the product on offer. When a sale is agreed upon, an unspecified percentage of the transaction amount is paid to Secontrade. Registration is free. Adverts are not available without registration; therefore, the number of buyers/sellers from Lithuania could not be identified.
European Recycling Platform (ERP) An international platform for the unification of stakeholders interested in the sorting and recycling of related waste streams, established in France	Waste electrical and electronic equipment batteries Textile Packaging	ERP brings together producers, consumers and public authorities from more than 20 countries around the world (mostly in Europe) and offers a wide range of services and solutions to improve cross-border sorting and recycling of products and packaging. After registering on the platform, both private companies and public organisations can use the online reporting system, where they upload and update their data on secondary raw materials, and download certificates of previous declarations. The members can also receive advice on compliance with waste stream regulations and implementation of related technologies. This platform is informative and consultative; the data on the trade in secondary raw materials by certain criteria are not provided.

Plasticker B2B trading platform for secondary raw materials, established in Germany	Plastics Machinery and equipment	An informative and large-scale trade platform which unites companies dealing mainly with plastics, and machinery and equipment. The platform provides the following information: list of sellers, price dynamics in the selected period, buyer's guide/instructions. It is not necessary to select/upload related certificates. The search criteria help to find the quantities of wanted/sold plastic/machines and devices by colour, country of origin, date of advert, shape, price. Registration is free. During the research, more than 70 buy/sell adverts from Lithuania were found. Most sellers trade in various plastics, to a lesser extent – in wood, glass.

Source: Innovation Agency (2023c), pp. 23-24.

The criteria/filters on secondary raw material trading platforms can make it easier for a buyer to find a seller, and vice versa. Trading platforms allow trading on an international scale, registration and the functions of the platforms are easy to understand. Secondary raw material trading platforms offer companies free registration, but more detailed information about the related (transaction, membership fee, etc.) costs are not publicly available without registration as a platform participant. According to a representative of the Lithuanian company, which collects and sorts plastic, paper, wood and glass suitable for recycling and has experience in selling plastic on international trading platforms, the annual fee on such platforms can be around EUR 650. However, fees may vary depending on the traded quantities and the operating model of a platform (Innovation Agency, 2023c).

International trading platforms mainly trade in the secondary raw materials with the highest recyclability to date, including metals and several main types of plastic (PET, HDPE, PVC, LDPE, PP, PS), as well as paper and cardboard, wood and glass. The trade in other secondary raw materials is less intensive.

The establishment of a secondary raw material trading platform in Lithuania is viewed with scepticism by the participants of the market value chain (including collectors, sorters, processors, manufacturing companies). Some industrial companies see this as an additional opportunity to sell the recyclable waste from their production and possibly earn from it. Nevertheless, the stakeholders who work with secondary raw materials and represent the entire value chain of related markets emphasise that there is no need to create a trading platform in Lithuania. First, it is related to the fact that Lithuania is a small market (Innovation Agency, 2023c).

Lithuania does not have a sufficient flow of properly sorted recyclable material. The trade in quantities that match the current capacities of the country and which are not bought/sold by bilateral agreements can be conducted on the exist-

ing platforms. Cases may vary depending on a specific secondary raw material, but the trend is general, starting with textile materials, which are poorly sorted and processed in Lithuania and throughout Europe, and which are not traded on international platforms. The same applies to plastic, the processing capacity of which is comparatively large, especially at the regional level, but companies should see the need for at least a 3-4 times higher flow of properly sorted plastic waste before a separate trade platform could be considered in Lithuania. The wood and biofuel trade platform "Baltpool," which operates on the basis of auctions, unites the countries in the region, so there is no need for an additional platform to be established.

Among the risks of participating in new or existing secondary raw material trading platforms, the experts indicate the problems of specification and standardisation: the quality of waste suitable for processing can vary greatly, so there is a risk of purchasing raw materials that will not be suitable for the technology available to a processor, even on trading platforms where product certificates are provided. Processors tolerate different composition and contamination of secondary raw materials, so Lithuanian companies operate mainly as suppliers or buyers on the basis of long-term bilateral agreements for direct cooperation, which allows for more efficient organisation of trade and negotiation of prices. Platform participants often act as resellers. This means an additional intermediary and additional costs of the negotiations regarding the specifications and condition of secondary raw materials. Some potential sellers from the construction sector indicate the costs related to the thorough testing of secondary raw materials, which is required to obtain certificates relevant for more efficient trading on platforms, as a major challenge.

Chapter 4

Legal Aspects of Trade in Waste and Secondary Raw Materials

4.1. Overview of the international regulation of trade in waste and secondary raw materials

If the trade in waste is not regulated and controlled, it can be harmful to the environment and human health. By establishing waste export restrictions and monitoring measures, the risks to the environment can be prevented or reduced. In addition to pollution prevention, regulation of the trade in waste can also ensure that the raw materials contained in the waste can be reused or recycled, which contributes to the development of the sustainable circular economy.

According to Barrie et al. the "unsustainable production, consumption and disposal of the world's resources are primary causes of the triple threat of pollution, climate change and biodiversity loss. This linear model is also a significant cause of social injustice, with most resource consumption and wealth accumulation occurring in the Global North and the worst environmental impacts and threats to human health in the Global South. Increasing geopolitical tension and the likelihood of further global supply-chain shocks and disruptions exacerbate these issues. A transition to an inclusive circular economy is essential to help address these challenges" (Barrie et al., 2022, p. 2).

The concept of the circular economy considers more efficient use of resources throughout their life cycle. The transition to the circular economy involves the methods which can reduce the level of extraction of natural resources. This determines the more efficient use of resources and promotion of sustainable management.

The concept of the circular economy prioritises the prevention of waste and the minimisation of resources, or the reuse, recycling and recovery of waste for sustainable development (Kirchherr et al., 2017).

The need to regulate the legal issues of trade in waste and secondary raw materials arose when the term "circular economy" was established with the Decision

No. 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet' (the 7th Environment Action Program), which came into force in 2014 and was scheduled to be implemented by 2020. To provide strategic guidelines for European environmental and climate policy, and to ensure predictable and coordinated actions in this area, the European Union agreed on environmental action programmes to be implemented in the Member States. The 7th Environment Action Programme also established the 2050 vision[3] and a detailed concept of an integrated environmental policy that helps to ensure sustainable economic growth, health and well-being of the population. The Programme also defines 9 priority action objectives (European Commission, 2019). Three topical priorities are aimed at: 1) protecting, conserving and nurturing the Union's natural capital, 2) making the Union's economy a competitive, resource-efficient, green and low-carbon economy, 3) protecting the Union's citizens from adverse environmental impacts and risks to health and well-being. The other two horizontal objectives are aimed at increasing the sustainability of the Union's cities and helping the Union address international environmental and climate challenges.

As early as 5 April 2006, the Directive 2006/12/EC of the European Parliament and of the Council established the legal framework for waste management in the Community. It provided the basic concepts, such as the concepts of waste, its use and disposal, and set the essential requirements for waste management, primarily the obligation for institutions or companies performing waste management operations to have a permit or be registered, and the obligation for the Member States to develop waste management plans. The Directive also laid down the key waste management principles, such as the obligation to manage waste without adverse effects on the environment and human health, the promotion of the waste hierarchy, and the 'polluter pays' principle which requires that waste disposal costs are borne by an owner, previous owners or a manufacturer of the product which generates waste.

This Directive was followed by a series of documents[4] which, in one way or another, tried to solve the issues of waste management in the EU. However, the solution of these important issues started being considered systematically only

[3] "In 2050, we will live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society" (European Commission, 2019).

[4] For instance, the Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.

when the EU circular economy action plan was adopted in 2015 (European Commission, 2015c).

In the circular economy document set, the European Commission defines the need for a circular economy as follows: "<...> the linear model of economic growth we relied on in the past is no longer suited for the needs of today's modern societies in a globalised world. We cannot build our future on a 'take-make-dispose' model" (European Commission, 2015a). The transition to the circular economy, where the value of products, materials and resources is increasing over cycles and less waste is generated, is extremely important. This transition is a key contribution to the EU's shaping of a sustainable and competitive economy based on low-carbon technologies and the sustainable use of resources. When the term 'circular economy' started to be used in the EU programme documents and legal acts, it became not only an economic or environmental, but also a legal category (Žilinskienė & Žilinskas, 2020).

It is to be regretted that scientific research on the topic of the implementation of the principles of the circular economy from a legal perspective is rather scarce, and previous studies only cover certain issues in a fragmentary way. It should be noted that scientific legal analyses on the topic under consideration in foreign literature are also rare. We can mention several scientific works and studies which focus on the legal issues related to the circular economy (Backes, 2017; Korhonen et al., 2018; Thomas, 2019; Mikichurova & Vlialko, 2021; Genovese & Pansera, 2020, 2021; Albaladejo et al., 2021; Steenmans & Lesniewska, 2023a,b). Since the EU Circular Economy Institute is fairly new, there is a perceived lack of the analysis on the relevant legal issues. Nevertheless, it should be noted that more and more studies are being devoted to certain legal issues of the circular economy, and these studies are integrated into interdisciplinary teams and projects.

Žilinskienė and Žilinskas (2020) argue that the necessary changes in the legal regulation which would help to implement the principles of the circular economy can be divided into two main groups: 1) the changes in the legal regulation that would facilitate the transition to the circular economy or would remove the obstacles to the implementation of the principles of the circular economy, and 2) the legal regulatory changes, the need for which will be determined by the functioning of the circular economy and the related changes in social relations.

Unadjusted legal regulation in the EU Member States, which creates obstacles for businesses to transport and manage waste and secondary raw materials, is a factor which impedes consistent implementation of the principles of the circular economy. The Circular Economy Package (European Commission, 2015b) proposed the amendments to some Directives (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing

certain Directives, OJ L 312, 22.11.2008; European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, OJ L 365, 31.12.1994; Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, OJ L 182, 16.7.1999; Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles – Commission Statements, OJ L 269, 21.10.2000; Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC, OJ L 266, 26.9.2006; Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast), OJ L 197, 24.7.2012) which regulate the management of particular types of waste. However, this document did not present the general principles of trade in waste and secondary raw materials, which would allow the EU to introduce a unified legal framework for the issues under consideration.

The Circular Economy Action Plan was updated on 11 March 2020 (European Commission, 2020b). The action plan requires to make products climate-neutral, resource-efficient and circular economy-friendly, reduce waste, and to gradually make the sustainability performance of cutting-edge agents the norm. For these purposes, the Commission is going to propose a legislative initiative on a sustainable products policy. The major objective of this legislative initiative is to extend the scope of the Ecodesign Directive to include not only energy-related products, but the widest possible range of products and ensure circularity (European Commission, 2020b).

As part of this legislative initiative, and, where appropriate, through complementary legislative proposals, the Commission considers establishing sustainability principles and other appropriate ways to regulate the following aspects:

- improving product durability, reusability, upgradability and reparability, addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency;
- increasing recycled content in products, while ensuring their performance and safety;
- enabling remanufacturing and high-quality recycling;
- reducing carbon and environmental footprints;
- restricting single-use and countering premature obsolescence;
- introducing a ban on the destruction of unsold durable goods;
- incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle;

– mobilising the potential of digitalisation of product information, including solutions such as digital passports, tagging and watermarks;
– rewarding products based on their different sustainability performance, including by linking high performance levels to incentives.

Definitions in international laws and operational plans are important because they indicate what is and what is not included in the scope of legal regulation. For example, despite the fact that the concept of circular economy is used in the titles of the documents, it is not defined in the European Union's Circular Economy Action Plan. It can, however, be found in other laws.

The legal regulation of trade in waste and secondary raw materials is a complex and multi-layered process that involves many legal issues.

Steenmans and Lesniewska (2023b, pp. 4-5) recommend that future studies on the circular economy (CE) law and policy pay particular attention to the following aspects:

> "1. Adopting a systemic approach in law and policy: a systemic approach to designing and implementing CE laws and policies is necessary to cover the possible multi-level, multi-actor, and multi-sector dimensions of the CE concept. As a first step, further research needs to develop what a systemic approach for adopting the CE concept in law and policy entails: what theoretical, practical, and methodological approaches need to be considered in designing CE laws and policies? This will then help evaluate the appropriateness of different approaches – for example, whether to approach the CE through a stand-alone CE law or policy or like France's Anti-waste and Circular Economy Law 2020, which amends many environmental as well as non-environmental codes, such as the Consumer, Education, Public Health, Public Property, Maritime, Highway, Insurance, Housing and Construction, and Regional and Local Authorities Codes. Simultaneously, the three other areas identified below need to be investigated to provide a foundation and evidence-base for such an approach.
> 2. Clarifying the boundaries of the CE concept: clearer boundaries and scale can ensure that the CE remains a meaningful concept that cannot be used for, inter alia, perpetuating business-as-usual and greenwashing. The questions surrounding the definition of CE could, at least in part, be addressed by adopting a heuristic, as has been proposed for industrial symbiosis. Industrial symbiosis is a strategy to promote a CE, as it involves different organisations engaging in mutually beneficial transactions to reuse, recycle, or recover waste and by-products to source inputs and optimise the value of the

residues of their processes. The proposed heuristic for industrial symbiosis is three different entities exchanging at least two different resources, as argues this "begins to recognise complex relationships rather than linear one-way exchanges." A heuristic developed for the CE could require a minimum number of reuse, recycling, or recovery operations, but would not necessarily need different organisations and would also need to incorporate prioritisation of minimal waste generation and resource use.

3. Addressing justice dimensions of the CE concept: "Bringing justice into the frame for legal and policy research is an absolute necessity if future CEs are to be sustainable, inclusive, and just." By purposively including justice requirements into law and policy, both substantively and procedurally, CEs will support a transformation away from an unjust status quo. Justice dimensions thus need to be equally integrated in practice: there needs to be more explicit incorporation of and engagement with discourse on the distribution of benefits and burdens, and recognition and procedural rights, of CE laws design and implementation. Mechanisms should be developed to monitor and evaluate justice dimensions of the CE, including to avoid "social washing." Social washing is akin to greenwashing in that it concerns practices of promoting the false perception that products are socially responsible.

4. Examining CE laws and policies' impacts, particularly within the Global South and marginalised communities in the Global North: to avoid unintended negative impacts of adopted laws and policies, there needs to be a broader evidence-base to inform CE transitions. There is no one-size-fits-all approach for CE approaches and instead dialogue needs to be facilitated on, among other things, different experiences, epistemological diversity, and cultural relationships with material flows. Critical research on CE laws needs to specifically focus on the Global South, which has been absent compared to the availability of research on the Global North on CE law and policy. There are numerous countries in the Global South who have implemented CE laws, as well as others that are intending to develop CE legal frameworks – e.g., China, Mexico, Uruguay, and Rwanda. Learning lessons from these countries, as well as marginalised communities in the Global North, can also inform an understanding of laws impacts at all scales from the micro to the meso."

By focusing on the four areas proposed by Steenmans and Lesniewska (2023b), the concept of the circular economy could be further analysed in a coherent and comprehensive way. The comprehensive concept could serve as a base for developing the regulatory framework and the relevant laws and policies. This requires interdisciplinary cooperation in legal matters.

A New Circular Economy Action Plan for cleaner and more competitive Europe (European Commission, 2020b) emphasises streamlining of the Single Market Transparency Directive (European Parliament and the Council, Directive (EU) 2015/1535). In line with a more strategic approach to the Commission's enforcement actions, the future implementation of the Single Market Transparency Directive will be based on four following directions: i) Member States will notify about all draft technical regulations related to goods and information society services; ii) the Commission will follow up on any notifications that raise concerns about their compatibility with the EU law; iii) by coordinating the follow-up, the Commission will pay particular attention to measures having the greatest impact on the single market; iv) the Commission will monitor the legal acts concerning which it has taken action under the Directive and which, if no appropriate adjustments are made, may lead to an infringement procedure.

The Commission will also encourage national authorities to respond to notifications from other Member States to establish a system of permanent communication between national regulatory authorities and authorities responsible for the implementation of the Single Market Transparency Directive and to promote national regulatory convergence. If the current level of harmonisation appears to be insufficient, the Commission will carefully consider whether greater harmonisation at the European level would be justified.

Having reviewed the directives and operational plans which may have effects on the regulation of trade in waste, we will analyse the specific requirements applied for transportation of waste.

The Communication from the European Commission 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality (European Commission, 2021b) notes that waste management remains one of the most important environmental challenges for our planet. It is particularly relevant in emerging and developing economies where, due to rapid urbanisation and improved living standards, waste generation is expected to increase dramatically. Many of these countries have no policies, legislation and infrastructure to deal with the rapidly growing amount of domestic and industrial waste. Substantial amounts of waste exported legally or illegally from the EU could exacerbate the problems these countries are already facing in managing their own waste. The EU, together with its international partners, should, therefore, prioritise better control of the global trade in waste, thus improving waste management in third countries and combating illegal trade in waste.

The EU has a system to supervise and control shipments of waste within its borders, and with countries that have signed the Basel Convention.

Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste transposes the provisions of the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, and the relevant OECD decision into EU law. The EU has been a party to this United Nations agreement since 1994. In addition, the EU waste transportation regulations are based on the 2001 decision of OECD, which establishes a waste management control system in the OECD countries (most EU Member States are also the members of the OECD). The regulation applies to the export and import of waste between the EU and third countries, as well as transportation of hazardous and non-hazardous waste from one EU member state to another. It primarily prohibits the export of hazardous waste from the OECD and the EU countries to non-EU and non-OECD countries. The regulation also sets out the notification and consent procedures applicable to the shipment of waste.

The EU waste transportation rules, first adopted in 2006, regulate the following areas: the export of waste from the EU and import to non-EU countries, and the transportation of waste within the EU. This regulation establishes the waste transportation procedures and control regime depending on the waste origin, destination and transportation route, the type of waste transported, and the method of its management at the destination. The regulations apply when: i) transporting waste between the EU Member States, within the Community or in transit through third countries; ii) waste is exported from the Community to third countries; iii) waste is transported in transit through the Community between third countries. The regulations apply to all types of waste.

The EU permits transportation of both hazardous and non-hazardous waste. On the other hand, when waste is transported outside the EU, it is prohibited to export hazardous waste from the EU countries to non-EU and non-OECD countries. The regulations set out the procedures for notification of waste transportation and obtaining the consent required.

However, since the regulation was adopted in 2006, the exports of waste from the EU to third countries, in particular to non-OECD countries, have increased significantly. In the absence of comprehensive provisions to ensure that waste is managed sustainably, the enforcement of the regulation has been poor, which has led to numerous environmental and public health problems in destination countries.

In light of this, the EU aims to update the regulations of waste transportation to better manage trade in waste within the EU and with non-EU countries. In line with the European Green Deal and the Circular Economy Action Plan, the revised EU Waste Shipment Regulation aims to promote the circular economy in the EU, ensure that the export of waste does not harm the environment and human health, and combat illegal transportation of waste.

According to Romina Pourmokhtari, Swedish Minister of Climate and Environment, "We can no longer 'export' our waste problems. This regulation will give us more guarantees that the waste we send abroad will not harm health and the environment. Within the EU, it will promote the use of waste as a secondary material so that it gives us positive economic value and contributes to a more circular economy."

The proposal to revise the Waste Shipment Regulation aims to: 1) ensure that waste is sent only to the destinations where it will be properly managed; 2) modernise, harmonise, and digitalise transportation procedures within the EU and promote the transportation of waste for recycling; 3) combat the illegal transportation of waste, which is still carried out due to different procedures and a lack of control.

On 17 November 2021, the Commission adopted the proposal to update the Waste Shipment Regulation (European Commission, 2021d). The European Parliament set the position in January 2023, and the Council approved the negotiating mandate in March 2023 (Council of the European Union, 2023). In the adopted communication, the Commission emphasised that a robust and integrated market for secondary raw materials is an important element of a well-functioning circular economy. Treating waste as a resource requires facilitating its movement so that it can become valuable material flows that contribute to more sustainable and resilient production, product renewal and reuse.

The EU waste exports have increased by 75% since 2004, with almost half of the waste going to non-OECD countries. Due to improper waste management, pollution is increasing in many countries of destination. Much of the waste exported from the EU ends up in open dumps or is open burnt, which leads to air and water pollution, harmed public health, and large emissions of greenhouse gases. This is particularly problematic in developing and emerging economies, which are already facing significant challenges in managing their waste and are expected to rapidly increase their waste volumes in the future.

In addition, illegal trade in waste, both within and outside the EU, is one of the most serious forms of environmental crime and involves organised crime networks. Coordinated enforcement campaigns suggest that perhaps 15-30% of waste is transported illegally, meaning that the illegal waste market in the EU is worth EUR 9.5 billion annually. Apart from the environmental damage, the illegal trade in waste poses a security threat, especially in cases when criminal groups operate in several countries. It is, therefore, essential that the EU and the Member States make the fight against the illegal trade in waste a higher priority for enforcement authorities, improve the cooperation of all relevant authorities, and ensure that the sanctions for criminal activities in the waste sector are truly deterrent.

By modernising its waste transportation policy and legislation, and moving towards digital solutions, the EU will be able to promote transportation of waste for reuse and recycling, and will provide the incentives to reduce waste generation.

Accompanying the Commission's proposal for the New Waste Shipments Regulation, this Communication sets out the EU priority actions to ensure that:

- it is easier to transport waste to prepare it for reuse and recycling in the EU,
- the EU does not transfer waste-related problems to third countries, and
- the fight against illegal transport of waste is more effective.

The EU Waste Shipments Regulation was adopted through the ordinary legislative procedure. The Council and the European Parliament act as co-legislators and must agree on the final text of the updated regulations.

After the European Commission submitted a proposal for the revision of the rules in November 2021, technical discussions of the representatives from the Member States were held in the Council's Environment Working Group.

In May 2023, the EU Member States in the Council agreed on the mandate to conduct negotiations with the European Parliament. In November 2023, the Council and the European Parliament reached an agreement. The agreement is preliminary, both institutions have yet to officially adopt this legal act.

As stated by Teresa Ribera Rodríguez, Acting Third Deputy Prime Minister of Spain and Minister of Ecological Transformation and Demographic Challenges, "If we want to move towards a circular economy, it is very important to consider waste as a valuable resource, not something to be disposed of. With today's agreement, we will put in place the necessary framework to better use and reuse waste as a secondary material. In addition, it will help us to ensure that the waste we export does not harm the environment and human health. Today's agreement is another important step towards the EU's zero pollution and climate neutrality goals."

On 17 November 2023 (updated on 7 December), the Council of the EU announced that the negotiators of the Council and the European Parliament reached a preliminary political agreement to update the Waste Shipments Regulation. The report declares that the review of the Regulation aims to reduce the transportation of problematic waste outside the EU, update the transportation regime to comply with the objectives of the circular economy, and improve enforcement. It establishes a transport procedure and a control regime to ensure that the international transportation of waste does not pose a threat to human health and the environment, and to promote the use of waste as a resource in the circular economy in the EU.

The Council provided several clarifications and included several amendments (in particular, the objectives of the Regulation comply with the goal of achieving climate neutrality). It also harmonised several definitions throughout the text, such as 'carriage', 'illegal carriage', 'carrier', 'route', and ensured their compatibility with other legal acts.

Legislators agreed to expand the Regulation's objectives to include climate neutrality and the pursuit of the circular economy and zero pollution.

The Regulation applies to the transportation of waste within the EU (in transit through third countries or not), to waste imported from and exported to third countries, as well as to the transportation of waste in transit through the EU to or from third countries.

Shipments of waste within the EU. The agreement prohibits the transportation of all waste for disposal within the EU, unless it is agreed and permitted under strict conditions of a prior written notification and consent procedure and in duly justified cases. On the other hand, waste intended for use will continue to be allowed to be transported within the EU under the less stringent procedure set out in the general information requirements (green-listed waste).

The text of the agreement provides for a derogation for the transportation of waste that is clearly intended for laboratory research and experiments, if the weight of such waste does not exceed 250 kg. When transporting such waste, it will be necessary to comply with the general information requirements set out in the Regulation.

The added value of these amendments to the Regulation is that they allow digitalisation of procedures. The Council agreed to simplify and digitalise notification, consent and information procedures for intra-EU shipments of waste. The Council has made several amendments to ensure clarity and consistency throughout the Regulation as far as the electronic document exchange system is concerned. The Council has also extended some notification deadlines to allow competent authorities sufficient time to receive and assess the information and documents.

Shipments of waste outside the EU. In accordance with the procedure for a written notice and consent, carriers in the EU and exporters must notify the third states before exporting waste and obtain a written approval from the countries of dispatch, destination and transit. The notice and other documents required in the Regulation must be submitted and exchanged through the central electronic system managed by the Commission.

The agreement establishes the specific requirements for the notice, the requests of the competent authorities to provide additional information, and the

decisions of such institutions on the validity of the notice. Upon agreement of the legislative authorities on the terms, the proceedings will be ensured not to last disproportionately long, and the competent authorities will be given sufficient time to obtain and assess documents, to examine and respond to requests.

The text of the agreement also sets the deadlines within which notifiers must respond to a written consent of the competent authorities, and the receiving facility must inform the notifier and the competent authorities about the acceptance of waste.

To ensure transparency, the co-legislators agreed to ask the Commission to facilitate the public's access to the information on waste shipments by publishing and regularly updating shipment notification data on its website.

Export of waste. The agreement prohibits the Member States from exporting waste for disposal to third countries and from exporting hazardous waste for use in non-OECD countries. As regards waste shipment outside the EU, the legislative authorities have agreed that the audit of waste management facilities in countries of destination should be conducted by independent bodies every three years. The audit should confirm that the facilities manage waste in an environmentally safe manner, and only then operators will be allowed to export waste to these facilities. The Member States proposed the creation of a register managed by the Commission, containing the information on audited installations to help waste exporters prepare for waste shipments. Nevertheless, exporters would still be responsible for ensuring that their exports are environmentally safe. The Council also clarified which waste, especially non-listed, can be exported and how it can be exported.

The Council agreed to authorise the Commission to adopt the acts which determine the criteria for the separation of used goods and waste, so that waste is not illegally transported as used goods. The Commission could also harmonise the classification of waste at the EU level, in particular by adopting delegated acts to set criteria, such as waste contamination thresholds, to evaluate the harmfulness of waste and prevent misunderstandings as to whether the waste should be subject to the notification procedure.

Export of plastic waste. The preliminary agreement establishes stricter regulations for the export of plastic waste to third countries. Firstly, it bans the export of non-hazardous plastic waste (B3011) to non-OECD countries. The agreement allows non-OECD countries (if they meet strict waste management standards) to submit a request to the Commission indicating that they wish to import the EU plastic waste no earlier than five years after the date of entry into force of the Regulation. If a request is approved, the Commission will adopt a delegated act eliminating the ban on these countries.

Legislators have agreed to allow exports of non-hazardous plastic waste to the OECD countries subject to a prior written notification and consent procedure. The agreement calls on the Commission to strictly monitor exports of plastic waste to the OECD countries to ensure that such exports do not have any significant impact on the environment or human health, and that waste imported from the EU is managed properly.

Illegal shipment of waste. The Council endorsed the Commission's proposal to establish a Waste Shipment Enforcement Group to facilitate and improve cooperation and coordination between the Member States to prevent and detect the cases of illegal shipments of waste.

The Member States have agreed to authorise the Commission to conduct investigation and coordination actions related to the illegal shipment of waste. These actions would support and complement the enforcement activities of the Member States but would not interfere with criminal prosecutions or national judicial processes.

On the issue of sanctions for infringements, the Council provided the Member States with the flexibility to adapt the provisions on sanctions in compliance with their national legal frameworks.

The Council included a provision on tacit consent for shipment between an outermost region and a Member State in transit through another Member State. It also provided for the right to object to the import of mixed municipal waste due to national circumstances or the risk that the waste will not be used in an environmentally safe manner.

The preliminary agreement calls on the Member States to establish effective, proportionate and dissuasive sanctions for violations of the regulations. Where relevant, this may include fines and the revocation or suspension of permits related to waste management and shipment.

The agreement also establishes the requirements for the Member States to ensure effective implementation of the regulation by creating effective cooperation mechanisms at the national level and by exchanging the relevant information and examples of good practice.

To give the Member States more time to prepare, the Council stipulated that the new waste export conditions should come into force after three years. The provisions related to the activities of the Commission should be applied immediately, and the main date of application of the new Regulation should be 24 months after its entry into force.

The preliminary agreement will now be submitted to the representatives of the Member States in the Council (the Permanent Representatives Committee) and the Parliament's Environment Committee for approval.

Currently, when conducting the trade in waste and secondary raw materials in the EU, it is necessary to comply with other international regulations (Regulation (EU) No 660/2014 of the European Parliament and of the Council of 15 May 2014 amending Regulation (EC) No 1013/2006 on shipments of waste; Commission Delegated Regulation (EU) 2020/2174 of October 2020; Commission Regulation (EU) 2021/1840 of 20 October 2021 amending Regulation (EC) No 1418/2007 concerning the export for recovery of certain waste; Correspondents' guidelines No. 12 which represent the common understanding of all Member States on how the Regulation (EC) No 1013/2006 on shipments of waste should be interpreted, etc.).

Every 3 years, the Commission must report on the implementation of the waste shipment regulation (European Commission, 2024).

The above-discussed EU regulations related to the shipment and management of waste reveal the path to the circular economy and more environmentally friendly waste management. The EU policies set ambitious standards for waste management and consider waste as a valuable resource rather than something to be disposed of.

The preliminary agreement establishes several important measures:

1. More control and transparency. The Waste Shipment Enforcement Group was established to coordinate actions and prevent the illegal shipment of waste. It also ensures better access to the information and documents, related to waste shipment, through the central electronic system.
2. Stricter requirements for the export of plastic waste. The regulations of the export of plastic waste are becoming stricter to prevent the illegal export of plastic waste to third countries. The agreement requires that the countries which meet strict waste management standards obtain a permit to import plastic waste from the EU.
3. Sanctions and stronger control. The Member States will have to establish effective, proportionate, and deterring sanctions/penalties for breaches of the regulations. The penalties include fines and the revocation or suspension of the permits which are related to waste management and shipment. In addition, waste management facilities will have to be audited every three years.
4. Strengthening of international cooperation. The aim is to improve cooperation and coordination between the Member States to prevent and detect the cases of illegal shipments of waste. The Waste Shipment Enforcement Group will be established for this purpose. The Group is expected to facilitate and improve cooperation between the Member States.

The preliminary agreement, which will be forwarded to representatives of the Member States in the Council and the Parliament's Committee on Environment, emphasises a clear commitment to moving towards the circular economy and ensuring that waste is treated as a valuable resource. This agreement reflects the EU's efforts not only to solve the problems associated with waste shipment, but also to achieve the goals of zero pollution and climate neutrality.

4.2. Peculiarities of the national regulation of trade in raw materials and secondary raw materials

To promote the circular economy, which is the key to greater competitiveness, sustainable economic growth, and creation of new jobs, the European Commission adopted an ambitious new Circular Economy Package on 2 December 2015 (European Commission, 2015a). On 17 June 2016, the European Affairs Committee of the Seimas (Lithuanian Parliament) considered this set of documents, the principles of the EU circular economy, the action plan approved by the EC in the Communication "Closing the loop – an EU action plan for the Circular Economy" (European Commission, 2015c), the measures and recommendations proposed to achieve the ambitious goals of the EU circular economy.

> Insufficient or incorrect implementation and lack of enforcement has damaging consequences, both at the European and national level. Citizens and businesses cannot fully benefit from their free movement rights, businesses cannot realise the economies of scale that the single market can offer, consumers are put at risk by non-compliant products or enjoy less choice, security of energy supply is endangered, and EU environmental and climate goals become more difficult to achieve. Law-abiding businesses lose market share due to unfair competition from businesses that do not follow the rules and that offer non-compliant products or disregard social protection rules.
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> <...>
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> Member States must ensure compliance with single market law if the rights of individuals or businesses are to be protected. This must start at the stage of designing national legislation, and be carried through to individual judicial or administrative decisions. The Commission has the task to support Member States in preventing the creation of new barriers to the single market, in the transposition and application of EU law and to initiate remedial action where necessary (Long term action plan for better implementation and enforcement of single market rules, European Commission, 2020c).

Table 14. Tasks and responsibilities related to the compliance with and enforcement of Single Market regulations

Member States	Commission
Timely and accurate transposition of the EU regulations into national law, prevention of excessive regulation, assurance of equal conditions	Helping Member States to transpose the EU regulations into national law in a proper, comprehensive and timely manner
Assurance of the proportionate and non-discriminatory national legislation	Helping Member States to apply the EU regulations
Assurance of the sufficient and proportionate administrative checks and controls to detect violations	Monitoring of how the EU regulations are transposed into national law and how they are applied
Avoidance of the national measures that would conflict with or impede the application of the EU regulations	Fighting against violations of the EU regulations and, if necessary, take official steps to investigate the cases
Effective cooperation to ensure compliance with the EU regulations	

Source: own elaboration.

To ensure the consistent implementation of the EU Single Market regulations, it is essential that all those responsible for the implementation and enforcement of the Communication's Long-term action plan for better implementation and enforcement of Single Market rules support a true partnership at the European level. Only through adoption of harmonised regulatory acts for the Single Market it will be possible to undertake targeted enforcement actions.

To ensure that the rules of the Single Market are enforced, it is first and foremost necessary that the rules are properly applied in each Member State and by each European authority, and that infringements are sanctioned, including through infringement procedures when necessary.

The main document regulating waste management in Lithuania is the Law on Waste Management with all subsequent amendments (Parliament of the Republic of Lithuania, 1998b). This Law establishes the general requirements for waste prevention and management in order to prevent the negative impact of waste on public health and the environment. It also establishes the conditions under which a material or an item may not be considered waste; state regulation of waste management; basic principles of organising and planning waste management systems; requirements for waste holders and waste managers; economic and financial means of waste management; rights and obligations of manufacturers, importers, distributors of oils, electrical and electronic equipment, vehicles, taxable products, products made from aerobically degradable plastic, single-use plastic products, fishing gear containing plastic and packaging.

Pursuant to Article 26 of the Law on Waste Management of the Republic of Lithuania, a State Waste Prevention and Management Plan is prepared to implement the requirements specified in this Law. The Plan must be coordinated with stakeholders and the public in accordance with the procedure established by the Government or its authorised institution. Part 2 of Article 26 stipulates that the State Waste Prevention and Management Plan and its implementation measures are developed by the Ministry of Environment and approved by the Government.

Based on the State Waste Prevention and Management Plan approved by the Government, regional and municipal Waste Prevention and Management Plans are developed and approved to provide the measures that can help to achieve the goals of the circular economy.

On 12 April 2002, the Government of the Republic of Lithuania, in accordance with Article 26, Part 2 of the Law on Waste Management of the Republic of Lithuania and in compliance with the Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing some directives, with the last amendments made in on 30 May 2018 by the European Parliament and the Council in the Directive (ES) 2018/851, Article 28, Parts 3 and 5, and Article 29, Parts 1, 2 and 2a, issued the Resolution No. 519 to approve the State Waste Prevention and Management plan for 2021-2027. The purpose of this plan is to analyse the current situation of waste prevention and management, and to develop waste prevention and management measures necessary for achieving the strategic goals outlined in the National Progress Plan and its objective 1.4 "To reorient the industry towards a climate-neutral economy." The major tasks are to increase the use of secondary raw materials (circularity level) by 2025, so that it is not lower than the EU average, to achieve state waste prevention and management objectives for municipalities, and to follow the national and the EU structural support directions. The 2021-2027 plan for waste prevention and management pays special attention to waste prevention: green public procurement, green innovations, digitalisation, low-waste and zero-waste technologies, eco-design, creating, repairing, and renewing long-term products, the secondary use of products, waste for recycling, innovative and modern waste processing infrastructure. Following this Plan, Lithuania is developing more and more measures to involve society, business, scientific and public sectors in sustainable product development, consumption, and sustainable use of resources.

On 16 April 2014, the Government of the Republic of Lithuania issued the Resolution No. 366 "On amendment of the Resolution of the Government of the Republic of Lithuania of 12 April 2002 No. 519 On the approval of the state strategic waste management plan" (Government of the Republic of Lithuania, 2014).

Pursuant to Article 26, Part 3 of the Law on Waste Management of the Republic of Lithuania, Directive 2008/98/EC of the European Parliament and Council of 19 November 2008 on waste and repealing some directives (OJ 2008 L 312, p. 3), Directive 94/62/EC of the European Parliament and the Council of 20 December 1994 on packaging and packaging waste (OJ 2009 L 87, p. 109), Repeal of Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and Directive 91/157/EEC (OJ 2008 L 327, p. 7), Directive 2012/19/EU of the European Parliament and the Council of 4 July 2012 on waste electrical and electronic equipment (OJ 2012 L 197, p. 38), Council Directive 1999/31/EC of 26 April 1999 on waste landfills (OJ 2008 L 311, p. 1), and the 2012-2016 programme of the Sixteenth Government, which was approved by the Resolution of the Parliament of the Republic of Lithuania of 13 December 2012 No. XII-51 "On the programme of the Government of the Republic of Lithuania," Clause 377, the Government of the Republic of Lithuania approved the State Waste Management Plan for 2014-2020 (the Government of the Republic of Lithuania, 2014). The purpose of this Plan was to set the strategic objectives of waste management until 2020, to develop the tasks and measures to achieve the objectives, to set state waste management objectives and waste management objectives for municipalities, to define the national and the EU structural support directions and Plan implementation criteria.

On 21 June 2023, the Government of the Republic of Lithuania approved the Guidelines for Lithuania's transition to the circular economy till 2035. The Guidelines set a new, environmentally friendly and climate-neutral direction of the economy through advanced technologies, responsible consumption, environmentally friendly production systems, the efficient use of resources, sustainable economic growth, competitiveness, and creation of new jobs (Government of the Republic of Lithuania, 2023).

The Guidelines were approved with consideration of: the Resolution of the Government of the Republic of Lithuania of 10 March 2021 No. 155 "On approval of the implementation plan of the provisions defined in the programme of the Eighteenth Government of the Republic of Lithuania," Measure No. 6.1.10 "With participation of stakeholders and socio-economic partners, to develop and approve the plan for Lithuania's transition to the circular economy (to involve all relevant institutions and coordinate the implementation and development of the circular economy in the country) till 2035"; the 2021-2030 National Progress Plan, approved by the Government of the Republic of Lithuania on 9 September 2020 with Resolution No. 998 "On approval of the National Progress Plan for 2021-2030"; the 2050 vision "Lithuania's economy is circular and climate-neutral"

established in the National Climate Change Management Agenda, approved by the Parliament of the Republic of Lithuania on 30 June 2021 with Resolution No. XIV-490 "On approval of the National Climate Change Management Agenda"; Development Programme for environmental protection and climate change management of the Ministry of the Environment of the Republic of Lithuania, manager of the 2022-2030 Development Programme, approved by the Government of the Republic of Lithuania on 30 March 2022 with Resolution No. 318 "On the approval of the development programme of the Ministry of the Environment of the Republic of Lithuania, the manager of the development programme, for 2022-2030"; the National Environment Protection Strategy, approved by the Parliament of the Republic of Lithuania on 16 April 2015 with Resolution No. XII-1626 "On approval of the National Environmental Protection Strategy"; the National Energy and Climate Action Plan for 2021-2030, which was considered and approved by the Government of the Republic of Lithuania on 30 December 2019 with Protocol Decision No. 52; the State Waste Prevention and Management Plan for 2021-2027, approved by the Government of the Republic of Lithuania on 1 June 2022 with Resolution No. 573 "On approval of the State Waste Prevention and Management Plan for 2021-2027"; the concept of implementation of scientific research and experimental development and innovation (smart specialisation) priorities, approved by the Government of the Republic of Lithuania on 17 August 2022 with Decision No. 835 "On approval of the concept of scientific research and experimental development and innovation (smart specialisation)"; the 2020-2023 Measure Plan for the Road Map of the Digitalisation of Lithuanian Industry, approved the Minister of Economy and Innovation, the Minister of Social Security and Labour, the Minister of Education, Science and Sports, and the Minister of Finance on 11 May 2020 with Order No. 4-297/V-696/A1-392/1K-135; the "New Generation Lithuania" plan for economic recovery and increasing resilience, approved by the European Council on 28 July 2021 with Implementing Decision No. CM4171/21 "On the approval of the evaluation of the plan for revitalising the Lithuanian economy and increasing its resilience"; the roadmap for the integration of Lithuanian industry into European value chains, which was prepared in 2021 and presented to the Industry 4.0 commission for approval; the Roadmap for Lithuanian's Industrial Transition to a Circular Economy; the 2023-2027 strategic plan for Lithuanian agriculture and rural development, approved by the European Commission on 21 November 2022 with Implementing Decision No. C (2022) 8272; the Long-term renovation strategy, which was approved by the Government of the Republic of Lithuania on 31 March 2021 with Protocol Decision No. 18; the Lithuanian transport infrastructure development plan till 2030, approved by the

order of the Minister of Transport of the Republic of Lithuania, dated 9 February 2022 No. 3-86 "On the approval of the plan for the development of Lithuanian transport infrastructure till 2030"; the new circular economy action plan, which aims for a cleaner and more competitive Europe, presented in the Commission's communication of 11 March 2020 to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

In 2023, the Ministry of the Environment proposed a new package of amendments to the laws that would strengthen the responsibility of manufacturers and importers of tires, oil, electrical and electronic equipment, batteries, accumulators, packaging waste and end-of-life vehicles. The purpose is to create a favourable environment for the development of a circular economy by reducing the administrative and financial burden for waste managers. The proposal was intended to organise the management of taxable product waste and unusable vehicles only collectively, to expand the producer and importer responsibility by including certain products, to simplify the requirements for waste management companies, and to specify which municipal waste management costs are not included in the price regulated by the State Energy Price Regulation Council. The amendments were made in the national Laws on Waste Management (No. VIII-787), Packaging and Packaging Waste Management (No. IX-517), Tax for Environmental Pollution (No. VIII-1183), Environment Protection (No. I-2223), and the Code of Administrative Offenses (No. 2015-11216).

Companies in Lithuania are not liable for non-use of secondary raw materials when implementing the strategy of the circular economy. All adopted strategic plans or circular economy directions are of a recommendatory nature and promote the development of the circular economy. Administrative responsibility arises only for improper waste management (utilisation accounting, etc.).

In accordance with the Law on Waste Management, Chapter XVIII of the Code of Administrative Offenses of the Republic of Lithuania (Parliament of the Republic of Lithuania, 2017), titled "Administrative Offenses Related to Environmental Protection, Use of Natural Resources and Heritage Protection," contains several articles which provide for liability for inappropriate waste management:

- Article 247 "Failure to comply with the requirements of the legal acts regulating waste management" provides for penalties which include a warning or a fine from EUR 30 to 3,000, depending on whether a natural or legal person is brought to administrative responsibility;
- Article 247-1 "Failure to comply with the requirements for the management of biological waste (except for biodegradable garden and park waste)" provides for penalties which include a warning or a fine from EUR 60 to

1,150 or a warning or a fine from EUR 260 to 5,250 for managers of legal persons or other responsible persons;
- Article 248 "Failure to comply with the requirements for the management of packaging and packaging waste" provides for a fine from EUR 120 to 3,400 for managers of legal persons or other responsible persons; for the offenses described in Clause 9 of this Article, the penalty is a warning or a fine from EUR 30 to 60 for packaging sellers and/or distributors who are natural persons, and a fine from EUR 100 to 200 for packaging sellers and/or distributors who are managers of a legal person or other responsible persons;
- Article 248-1 "Failure to comply with the requirements for the management of the waste of tobacco products with filters and/or filters sold for use together with tobacco products" provides for a warning or a fine from EUR 150 to 6,000 for managers of legal persons or other responsible persons;
- Article 248-2 "Failure to comply with the requirements for the management of wet wipes and/or air balloons waste" provides for a warning or a fine from EUR 150 to 6,000 for managers of legal persons or other responsible persons;
- Article 248-3 "Failure to comply with the requirements for the management of the waste of fishing gear containing plastic" provides for a warning or a fine from EUR 150 to 6,000 for managers of legal persons or other responsible persons;
- Article 249 "Failure to comply with the requirements for the management of electrical and electronic equipment and/or this equipment waste" provides for a fine from EUR 120 to 6,000;
- Article 250 "Failure to comply with the requirements for the management of oil and/or oil waste" provides for a fine from EUR 120 to 6,000;
- Article 251 "Failure to comply with the requirements for importing waste into the Republic of Lithuania or exporting waste from the Republic of Lithuania and transporting waste in transit through the territory of the Republic of Lithuania" provides for a fine from EUR 30 to 3,000.

Improper waste accounting is subject to administrative liability. The Ministry of the Environment calls on all waste generators who are required to keep waste records in the Unified Products, Packaging and Waste Accounting Information System to perform their duties responsibly. If waste generators do not perform these duties properly or do not perform them at all, waste managers cannot account for the disposal of the waste transferred to them and issue the necessary documents. Failure to keep waste records or improper keeping of waste records is subject to administrative liability – a warning or a fine from EUR 230 to 430.

Implementation of the principle of producer responsibility. Following the principle of producer responsibility, producers and importers are responsible for the development and maintenance of waste collection infrastructure, organisation of waste management and shipment, public education on waste prevention and management issues, including covering the costs of these activities. Pursuant to the provisions of the Law on Waste Management, the principle of producer responsibility applies to plastic filters for tobacco products since 2023, and to disposable plastic wet wipes, air canisters, and fishing tools containing plastic since 2024. Since 2024, there has also been an additional obligation to cover the costs associated with the treatment of this waste in the environment and waste thrown into public collection systems.

Since 2023, the Ministry of the Environment has been motivating companies and institutions to make as many green purchases[5] as possible. The Minister of Environment approved the Order of 13 December 2022 No. D1-401 "Regarding the Order of the Minister of the Environment of the Republic of Lithuania of 28 June 2011 No. D1-508 Regarding the amendment of the list of Products public procurement and purchase of which are subject to the Environmental Protection Criteria, of the Environmental Protection Criteria, and of the Environmental Protection Criteria which must be applied by procuring organisations and procuring persons when purchasing goods, services or works."

The European Commission (2016) has a Handbook on Green Public Procurement, which is a guidance document developed by the Commission's Services. It should also be noted that the content of the guide can be changed in line with the development of the EU legislation, including the revision of public procurement directives and the practice of the Court of Justice. In compliance with these guidelines, the Public Procurement Service in Lithuania is responsible for the prevention of public procurement violations. It regularly issues green public procurement newsletters which provide relevant information to institutions and bodies conducting green procurement.

The Regulation (EC) of the European Parliament and the Council of 14 June 2006 No. 1013/2006 on shipments of waste applies to the cross-border transportation of waste in the European Community (with or without transit through third countries), from the Community to third countries, to the Community from third countries, and from one third country to another in transit through the Community.

[5] Green public procurement is an important tool for achieving environmental policy objectives related to climate change, resource use and sustainable consumption and production, especially given the amount of the public sector's spending on goods and services in Europe.

In compliance with Article 4, Part 5 of the Law on Waste Management of the Republic of Lithuania and implementing Regulation (EC) of the European Parliament and of the Council of 14 June 2006 No. 1013/2006 on shipments of waste with the last amendments made by the Commission's Delegated Regulation (EU) of 19 October 2020 No. 2020/2174, which partly amend the Regulation (EC) of the European Parliament and of the Council No. 1013/2006 on shipments of waste, Annexes IC, III, IIIA, IV, V, VII and VIII, the Minister of the Environment of the Republic of Lithuania issued the Order of 27 April 2004 No. d1-207 "On the approval of the description of the procedure for interstate transportation of waste." The purpose of this approval is to ensure the implementation of the Regulation (EC) of the European Parliament and of the Council of 14 June 2006 No. 1013/2006 on shipments of waste with the last amendments made by the Commission's Delegated Regulation (EU) of 19 October 2020 No. 2020/2174, which partly amend the Regulation (EC) of the European Parliament and of the Council No. 1013/2006 on shipments of waste, Annexes IC, III, IIIA, IV, V, VII and VIII.

For the cross-border shipments of waste, the following rules apply depending on the hazard of the waste, the way it is managed, and the countries of dispatch and destination:

- Authorisation procedure (Environment Protection Agency, 2020a) ("Prior written notification and authorisation," Articles 4 – 17);
- Simplified procedure (Environment Protection Agency, 2020b) ("General information requirements," Article 18);
- Shipment prohibition (in certain cases of waste import to or export from the European Community).

To import waste into Lithuania, a sender of waste must apply for a permit to the competent authority of the country from which the waste is due to be sent.

Pursuant to Article 4, Part 10 of the Law on Waste Management, companies that collect and transport waste, waste dealers and intermediaries can carry out their activities only after being registered in the State Register of Waste Managers, i.e. companies which are involved in waste collection and/or transportation (including entry (import) and exit (export)), waste trade and/or mediation must register with the State Register of Waste Managers. Companies are registered in the State Register of Waste Managers in compliance with the procedure established in the Regulations of the Register and the Rules for Managing the State Register of Waste Managers.

Waste import into Lithuania is prohibited pursuant to Article 4, Clause 41 of the Law of the Republic of Lithuania on Waste Management: it is prohibited to enter (import) into Lithuania municipal and hazardous waste from other countries

intended for disposal and/or obtaining energy, and residuals from the incineration of municipal waste (ashes and slags).

Issuance of permits for cross-border waste shipment is being digitalised in accordance with the Environmental Protection Agency's 2020 Activity Priority "Digitalisation of Services and Processes" (European Environment Agency, 2021a).

Summarising the peculiarities of the national regulation of trade in raw materials and secondary raw materials, it can be stated that the EU circular economy package, announced in 2015, and the Commission's Long term action plan for better implementation and enforcement of single market rules play a special role in the national legislation when protecting the rights of citizens and businesses, ensuring equal conditions, and pursuing the EU's environmental and climate goals. The Member States have to ensure that their national legislation complies with the EU regulations, is proportionate and non-discriminatory, and that administrative checks and controls help identify any infringements.

Implementation of the principles of the circular economy on Lithuania is based on several strategic documents and plans, such as the National Progress Plan, the National Climate Change Management Agenda, the State Waste Prevention and Management Plan, and others. These documents promote a sustainable economy, efficient use of resources, low-waste and zero-waste technologies, and economic growth based on green innovation. On 21 June 2023, the Government of Lithuania approved the guidelines for Lithuania's transition to the circular economy till 2035. These guidelines set a new eco-friendly and climate-neutral economic direction, promoting the efficient use of resources, sustainable economic growth, and the creation of new jobs.

The main document which regulates waste management in Lithuania is the Law on Waste Management which establishes the general requirements for waste prevention and management, and the conditions under which a material or an item may not be considered waste. The Law also provides for the state regulation of waste management and the basic principles of organising and planning waste management systems. Pursuant to this Law, the State Waste Prevention and Management Plan is the main document for waste management policies and strategies in Lithuania. This plan, approved by the Government, provides measures to implement the principles of the circular economy and improve the waste management system.

The Law on Waste Management and the Code of Administrative Offenses of the Republic of Lithuania establish liability for improper waste management. Penalties for various waste management violations include warnings and fines for natural and legal persons. However, administrative responsibility for non-use of secondary raw materials is not established in the circular economy strategy, and most of the measures are of an advisory nature.

4.3. National court practice concerning waste management

> According to the European Commission "Long term action plan for better implementation and enforcement of single market rules": "Enforcement of single market rules requires first of all that rules are correctly applied within each Member State and by every European public authority, and that breaches are sanctioned, including through infringement procedures when needed. It also requires the surveillance, inspection and sanctioning of economic operators, removing their illegal products from the market, whether they are dangerous, counterfeit or non-compliant with environmental, energy efficiency regulations or other rules." (European Commission, 2020c).

To reap the benefits of the single market, enforcement needs to be broader, covering all stages of the application of the relevant rules, from their creation to application. This requires cooperation at all levels of the EU governance, including local and regional authorities and courts, all the way to the European level. Furthermore, it is important that enforcement is seen as a constant activity, involving the development of the rules, their transposition into national law, and the ways to implement sanctions for violations of the rules. It is also necessary to strengthen the cooperation between the Member States and the European Commission, and take joint responsibility for the proper implementation of the rules of the single market.

The Long term action plan for better implementation and enforcement of single market rules (European Commission, 2020c) also indicates that "when it has not been possible to ensure *ex ante* compliance with single market rules, citizens and businesses may find themselves facing regulatory or administrative obstacles and thus expect them to be removed by an effective *ex post* intervention. Enforcement authorities need to be well functioning, procedures as well as monitoring have to be fit for purpose, and actors on the ground such as public officials or judges need to understand and be able to apply EU law in day-to-day business."

Further in this section, we will review the national court practice concerning implementation of the principles of the circular economy in Lithuania. We will start from reviewing the decisions of by the Constitutional Court of the Republic of Lithuania (hereinafter – the Constitutional Court).

Case No. 47/2011, in which the Constitutional Court issued the decision of 9 May 2014 No. KT18-N7/2014 "On compliance with the Constitution of the Republic of Lithuania of Clause 166.4 in the State Strategic Waste Management Plan, approved by the decision of the Government of the Republic of Lithuania of 12 April 2002 No. 519 "On approval of the State Strategic Waste Management Plan" (editions of 31 October 2007, and of 1 December 2010)." The applicant in this case was the Supreme Administrative Court of Lithuania which stated that

Clause 166.4 in the State Strategic Waste Management Plan, approved by the decision of the Government of the Republic of Lithuania of 12 April 2002 No. 519 "On approval of the State Strategic Waste Management Plan" (editions of 31 October 2007, and of 1 December 2010)," established the imperative task of oil waste management as an important condition for the economic activity of oil producers and importers. "Oil producers and importers are not always holders of used oil waste; therefore, in order to fulfil the task set out in the contested provision of the Waste Management Plan – to collect (ensure that it is collected) at least 30 percent of used oil, estimated from the amount of oil supplied to the market in the relevant year, they must be active. Even after taking proactive steps, oil producers and importers may not collect the abovementioned amount of used oil for reasons beyond their control. With consideration of the established legal regulation, the circumstance that a waste holder does not transfer the oil waste to its manager does not affect the extent of the obligation of oil producers and importers to regenerate or process oil waste into fuel. In addition, the collection of this waste from waste holders and/or recycling may be completely economically unreasonable and inadequate (for example, an applicant would have to offer waste holders an extremely large amount of money to deliver the oil waste to the applicant or the applicant's authorised persons); this can essentially force the abandonment of oil production or import activities.

The duty imposed on oil producers and importers depends on the amount of oil supplied to the market, but part of this oil may not be used in the relevant (reporting) year (e.g. kept as a reserve, exported, etc.), i.e. oil waste which producers and importers are obliged to regenerate or process into fuel may not be generated."

The Constitutional Court in this case recognised that Clause 166.4 in the State Strategic Waste Management Plan, approved by the decision of the Government of the Republic of Lithuania of 12 April 2002 No. 519 "On approval of the State Strategic Waste Management Plan" (editions of 31 October 2007, and of 1 December 2010), which established a mandatory task for oil producers and importers to regenerate or recycle (or otherwise use) at least 30 percent of oil waste, estimated from the amount of oil supplied to the market during the year, does not contradict (did not contradict) the Constitution of the Republic of Lithuania.

Case No. 44/2011 in which the Constitutional Court issued the decision of 5 March 2015 No. KT9-N5 "On compliance with the Constitution of the Republic of Lithuania of Article 30, Part 4 of the Law on Waste Management of the Republic of Lithuania (edition of 1 July 2002)." The applicant in this case was the Supreme Administrative Court of Lithuania which had examined the administrative

case where the decision of the Competition Council of the Republic of Lithuania of 24 December 2008 No. 2S-27 "On legality of the compliance of municipal decisions regarding the transfer of functions to regional waste management centres with the requirements of Article 4 of the Competition Law of the Republic of Lithuania." With its decision, the Competition Council recognised that the provisions of the decisions adopted by municipalities of Klaipėda, Šiauliai and Telšiai districts and (or) the provisions of contracts based on these decisions, as far as they relate to the assignment of municipal waste utilisation and disposal functions to certain regional waste management centres, without creating equal competition conditions for other business entities to provide these services, contradicted the requirements of Article 4 of the Competition Law of the Republic of Lithuania.

The applicant appealed to the Constitutional Court, questioning the provisions of Article 30, Part 4 of the Law on Waste Management of the Republic of Lithuania (edition of 1 July 2002) stipulating that "Municipalities can entrust (as a mandatory task) the operation of the municipal waste management system to a company established by the municipality or to a waste management institution, company or organisation established by several municipalities," which the Competition Council grounded its decisions on.

The Constitutional Court in this case recognised that Article 30, Part 4 of the Law on Waste Management of the Republic of Lithuania (edition of 1 July 2002) stipulating that municipalities can entrust (as a mandatory task) the operation of the municipal waste management system to a company established by the municipality or to a waste management institution, company or organisation established by several municipalities does not contradict (did not contradict) the Constitution of the Republic of Lithuania to the extent that, according to the legal regulation established therein, municipalities could entrust (as a mandatory task) a company established by a municipality or a waste management institution, company or organisation established by several municipalities to carry out municipal waste utilisation and disposal activities.

Case No. 8/2016 in which the Constitutional Court issued the decision of 30 May 2017 No. KT6-N5/2017 "On compliance with the Constitution of the Republic of Lithuania of Article 34^{23}, Part 19, Clause 6 of the Law on Waste Management of the Republic of Lithuania." The applicant in this case was the group of the Members of Parliament who questioned the compliance of the provisions of Article 34^{23}, Part 19, Clause 6 of the Law on Waste Management of the Republic of Lithuania (edition of 22 December 2011) with Article 46, Parts 1, 2, 3 of the Constitution of the Republic of Lithuania. The Members of the Parliament provided the following arguments:

1.1. Article 34[23], Part 19, Clause 6 of the Law on Waste Management of the Republic of Lithuania (edition of 22 December 2011) stipulates that the validity of the license issued for an organisation that manages product and/or packaging waste (hereinafter referred to as the license) is revoked if the license holder has been warned about the possible suspension of the license 3 times in the last two years.

Under this disputed legal provision, license revocation is allowed not only on the basis of three valid warnings, but also on the basis of three issued and cancelled warnings (i.e. reversed violations). Therefore, the revocation of the license as a measure of impact is not associated with the constitutional aspiration to protect other market participants and the public from the harmful activities of a legal person, but with punishing the legal person for violation of the terms of the licensed activity, although the violation was reversed, i.e. the activities of the legal person no longer possess any threat to the public or other market participants, but the legal person is subject to the sanction of revoking the validity of the license, the purpose of which in this case is not to protect the public interest, but to punish the legal person. Thus, the disputed provision negates the freedom and initiative of a person's economic activity enshrined in Article 46, Part 1 of the Constitution, and contradicts Article 46, Part 2 of the Constitution, which presupposes the duty of the state and municipal institutions and officials not to hinder the expression and development of a person's initiative by any of their decisions or actions, if it is not harmful to the public.

In addition, if the disputed provision is complied with, the activity of the licensee may be restricted more than is necessary to ensure the public interest: although the violation for which the warning had been issued was reversed within the specified time, the warning was cancelled and the activity of the licensee meets the requirements imposed on it, the validity of the license must still be repealed within two years after receiving 3 warnings, i.e. a legal person can be excluded from the market, although the activity meets all the requirements in legal acts. Thus, the requirement arising from Article 46, Part 3 of the Constitution to regulate economic activity so that it serves the general well-being of the nation is violated.

The applicant emphasised that, following the practice of administrative courts, a warning about the possible suspension of the validity of a license cannot be appealed to the court because it causes procedural, not material, consequences for a license holder.

1.2. The provision established in Article 34[23], Part 19, Clause 6 of the Law on Waste Management of the Republic of Lithuania (edition of 22 December

2011) may be applied upon detection of any (even completely insignificant, having no impact on public health, safety or public interest) violations; thus, this measure of enforcement is disproportionate (inadequate) to the violation of the law and there is no correct balance (proportionality) between the measure and the purpose to punish a violator (license holder) and prevention of violations of the law.

In addition, the restriction enshrined in the disputed provision is disproportionate in the context of other restrictions established by the law, because after receiving 3 warnings within two years, the sanction – the suspension of the validity of the license – can no longer be applied, but the strictest sanction – the cancellation of the validity of the license – is immediately applied. Thus, the disputed provision may contradict the constitutional principle of the rule of law."

The Constitutional Court in this case recognised that Article 34^{23}, Part 19, Clause 6 of the Law on Waste Management of the Republic of Lithuania (edition of 22 December 2011) does not contradict the Constitution of the Republic of Lithuania.

Case No. 19/2018 in which the Constitutional Court issued the decision of 18 February 2020 No. KT6-N3/2020 "On compliance with the Constitution of the Republic of Lithuania of the Law on Waste Management of the Republic of Lithuania, the Law on Amendments to Articles 2 and 4 of the Law on Waste Management of the Republic of Lithuania No. VIII-787, and the description of the procedure for the establishment and recognition of waste management facilities as objects of state importance, approved by Resolution No. 113 of the Government of the Republic of Lithuania on 2 February 2000 (edition of 19 February 2014)."

The applicant in this case was a group of the Members of Parliament who applied to the Constitutional Court and based their statement on the following arguments:

1.1. The prohibition on building waste incineration plants closer than 20 kilometres from the residential area, enshrined in Article 2 of the Law on Amendments to Articles 2 and 4 of the Law on Waste Management of the Republic of Lithuania No. VIII-787 disproportionately limits or even denies the very right to operate a waste incineration plant since, taking into account the density and distribution of the Lithuanian population, it is practically impossible to build such facilities throughout the entire territory of the country. If modern waste incineration power plant projects are not implemented, it will be difficult to ensure public health because waste disposal in landfills remains the main method of waste management in Lithuania. This

method, according to the applicant, is the most polluting, harmful to the health of every resident, and has a negative effect on groundwater, soil, and pollutes the air. In compliance with the Constitution, a person's economic activity must be regulated so that it serves the general well-being of the nation. In the applicant's opinion, the disputed provision contradicts Article 46, Part 3 of the Constitution, because it does not regulate the economic activity of waste incineration in a way that serves the general well-being of the nation, it does not comply with the constitutional imperative not to restrict the freedom of economic activity, if, among other things, the restrictions do not negate the nature of rights and freedoms, and the principles of the constitutional proportionality are observed.

1.2. The applicant also doubts whether Article 3, Part 3 of the Law on Amendments to the Law on Waste Management does not contradict Article 46, Parts 1-3 of the Constitution and the constitutional principle of the rule of law since it stipulates that "the Government of the Republic of Lithuania considers the interests of public health when making decisions on further implementation of projects of waste incineration facilities started before the entry into force of this law." According to the applicant, in compliance with this regulation, the Government can make decisions, among other things, regarding further implementation of waste incineration facility projects started before the entry into force of the Law on Amendments to the Law on Waste Management, i.e. regarding waste incineration plants already under construction in Vilnius and Kaunas. Consequently, the disputed provision creates the prerequisites for questioning the projects of waste incineration facilities that are currently being implemented by authorising the Government to set new restrictions for waste incineration power plants that were started to be built in Vilnius and Kaunas before the law came into force. In other words, according to the disputed legal regulation, the decisions of the Government, made, among other things, by following an undefined criterion (taking into account the interests of public health), may have retroactive effect.

According to the applicant, following this provision, the Government can by its decisions stop the ongoing projects of waste incineration facilities, without the implementation of which the disposal of waste to landfills will not be reduced, as required by the obligations to the European Union. If the projects of waste incineration facilities, currently being carried out in Vilnius and Kaunas and requiring significant investment, are stopped, the state will suffer significant financial losses and will not be able to reduce heating prices; due to the growing amount of waste

disposed of in landfills, environmental pollution and the landfill tax will increase, and it will become more difficult to ensure the protection of public health, because, as previously mentioned, waste disposal in landfills is the most harmful way of waste disposal. In addition, if the Government makes any decisions, the expectations of the executors of ongoing projects can be violated. Thus, in the applicant's opinion, the current legal regulation may contradict Article 46, Parts 1-3 of the Constitution, the constitutional principles of legal certainty, legal security, protection of legitimate expectations, and the constitutional principle of the rule of law.

The Constitutional Court in this case recognised that Article 4, Part 6 of the Law on Waste Management of the Republic of Lithuania (edition of 25 October 2018; TAR 2018-10-29, No. 17068) contradicts Article 46, Parts 1, 3 of the Constitution and the constitutional principle of the rule of law to the extent that it establishes that waste management facilities of state importance, in which municipal waste with energy value, remaining after sorting and unsuitable for processing, can be used or planned to be used as fuel for energy production, can be built no closer than 20 kilometres from the residential area, and to the extent that it obliges the Government of the Republic of Lithuania to establish the criteria for recognition waste management facilities, in which municipal waste with energy value, remaining after sorting and unsuitable for processing, can be used or planned to be used as fuel for energy production, as objects of state importance.

The Constitutional Court in this case also recognised that that Article 3, Part 3 of the Law on Amendments to Articles 2 and 4 of the Law on Waste Management No. VIII-787 (TAR, 2018-10-29, No. 17068) contradicts Article 46, Parts 1, 3 of the Constitution and the constitutional principle of the rule of law; the Court recognised that Clauses 5 and 6 in the description of the procedure for the establishment and recognition of waste management facilities as objects of state importance, approved by Resolution No. 113 of the Government of the Republic of Lithuania on 2 February 2000 (edition of 19 February 2014; TAR, 2014-02-21, No. 1908) contradict Article 46, Parts 1, 3 of the Constitution and the constitutional principle of the rule of law.

The Constitutional Court of the Republic of Lithuania ensures the supremacy of the Constitution in the legal system and constitutional justice by deciding whether laws and other acts adopted by the Parliament do not contradict the Constitution, as well as whether the acts issued by the President and the Government do not contradict the Constitution or laws. Therefore, all the decisions made by the Constitutional Court, in which the Court states that the provisions of particular laws contradict the Constitution of the Republic of Lithuania, must be implemented taking into account the contradictions identified.

The Supreme Administrative Court of Lithuania is a specialised court and an appellate instance for cases which were examined by administrative courts as courts of first instance; it is the only and final instance for cases regarding the legality of regulatory administrative acts adopted by central state administration bodies, the legality of general acts adopted by communities, political parties, political organisations or associations, the final instance for cases based on complaints about the decisions or inaction of the Supreme Election Commission, except for those assigned to the competence of the Constitutional Court of the Republic of Lithuania.

The Supreme Administrative Court of Lithuania also has a number of decisions related to the issue of waste management. Below we will mention only a few of the decisions issued by the Supreme Administrative Court of Lithuania.

With Decision of 15 June 2015, the extended panel of judges of the Supreme Administrative Court of Lithuania approved the conclusions of the Competition Council of the Republic of Lithuania (hereinafter – the Competition Council) regarding the violations of the Competition Law of the Republic of Lithuania in the municipal waste sector of Klaipėda and Šiauliai districts (Case No. A-1581-502-2015).

In this case, the Supreme Administrative Court of Lithuania assessed whether the Competition Council in its decision of 24 December 2008 reasonably decided that the municipalities of Klaipėda and Šiauliai districts privileged the regional waste management centres, established by the district municipalities, by assigning them the functions of the use and disposal of municipal waste, thereby failing to provide equal conditions of competition for other businesses and violating the regulations of the Law on Competition.

The Supreme Administrative Court of Lithuania noted that when selecting how to organise the provision of municipal waste utilisation and disposal services, municipalities must stimulate the initiative of private economic agents and assess the potential of these agents in the market. A company established by a municipality or several municipalities can be entrusted with the provision of municipal waste utilisation and disposal services only in exceptional cases when, for objective reasons, it is not possible to ensure the continuity, decent quality and availability of these services. As noted by the extended panel of judges that examined the case, in the case under consideration, the municipalities should have announced a tender or other competitive procedure for the provision of municipal waste use and disposal services.

Taking into account the circumstances explicated above, the extended panel of judges of the Supreme Administrative Court of Lithuania recognised that the decisions of the municipalities examined in the case did not allow other economic

agents to offer their services, thus deteriorating competition under equal conditions for the rights to operate the infrastructure objects of the regional waste management system. The Supreme Administrative Court of Lithuania also emphasised that the municipalities did not indicate that there were exceptional, objective circumstances which led to the necessity of entrusting the regional waste management centres with the provision of municipal waste use and disposal services without a tender or other competitive procedure. Taking into account the circumstances explicated above, the extended panel of judges rejected the appeals of the applicants who contested the decision of the Competition Council.

On 3 April 2019, the Supreme Administrative Court of Lithuania made the Decision in the administrative case No. I-6-822/2019 regarding the legality of Clauses 53 and 54 in the Order of the Minister of the Environment of the Republic of Lithuania of 20 May 2013 No. D1-359 which describe the procedure for issuing documents proving the disposal of product and/or packaging waste. Having examined the arguments provided by the applicant and the defendants, the Supreme Administrative Court of Lithuania recognised that Clauses 53 (edition issued by Order No. D1-971 on 20 November 2018) and 54 (edition issued by Order No. D1-971 on 20 November 2018) in the Order of the Minister of the Environment of the Republic of Lithuania of 20 May 2013 No. D1-359 (new edition issued by Order No. D1-833 on 10 October 2018) which describe the procedure for issuing documents proving the disposal of product and/or packaging do not contradict Article 3, Clause 1 of the Law on Public Administration of the Republic of Lithuania (edition issued by Order No. XI-283 on 1 June 2009) and the principle of the hierarchy of legal acts arising from the constitutional principle of the rule of law to the extent that they are related to the competence of the Ministry of the Environment of the Republic of Lithuania to regulate the procedures for invalidating approvals issued by licensed manufacturers and importers' organisations regarding the management of packaging waste.

The extended panel of judges of the Supreme Administrative Court of Lithuania examined the normative administrative case No. I-11-822/2022 initiated by a group of the Members of Parliament. On 21 December 2022, the Court announced the Decision which recognised that Subclause 2.2.2 in the Order No. D1-123 of 29 April 2022 "On the approval of the necessary requirements for the provision of the sorted collection and transportation service of packaging waste generated in the municipal waste stream and the necessary conditions of the agreement for organising and financing the packaging waste management," issued by the Minister of the Environment of the Republic of Lithuania, contradicts the constitutional principle of the rule of law.

Clause 2.2.2, recognised as contradicting the constitutional principle of the rule of law, establishes that 10 percent of the costs of the services – the sorted collection and transportation service of packaging waste and secondary raw materials generated in the municipal waste stream, and installation, maintenance, renewal and development of the infrastructure of the sorted collection system – are covered from the local fees or other contributions paid by generators of municipal waste for the collection and management of this waste.

Having taken into account the laws regulating local fees, the extended panel of judges concluded that Clause 2.2.2 in the Order issued by the Minister of the Environment of the Republic of Lithuania essentially established the obligation for municipalities to pay a part of the costs of the sorted collection and transportation service of packaging waste and secondary raw materials generated in the municipal waste stream, and the service of installation, maintenance, renewal and development of the infrastructure of the sorted collection system from their financial resources (municipal budgets). In other words, the Minister of the Environment established the obligation for municipalities to partly cover the costs of providing the abovementioned services from their own funds.

Article 10, Part 4, Clause 2 of the Law on Packaging and Packaging Waste Management authorises the Minister of the Environment to approve the necessary requirements for the provision of the services of sorting and transporting packaging waste generated in the municipal waste stream, the services of installing, maintaining, renewing and developing the infrastructure of the sorted collection system (including the requirements for the type, size, placement density, marking, installation of an identification system, and frequency of emptying), the requirements for financing and administrating these services, the procedures for covering the costs, and the necessary conditions for establishing packaging waste management organising and financing contracts. However, according to the Supreme Administrative Court of Lithuania, the procedure for the provision of the sorted collection and transportation service of packaging waste and secondary raw materials generated in the municipal waste stream, and the service of installing, maintaining, renewing and developing the infrastructure of the sorted collection system must be established by the Minister of the Environment in accordance with the relevant legal acts, among others, the requirements set out in the above-mentioned law.

Having examined the relevant obligations of municipalities established in the Law on Waste Management, the Supreme Administrative Court of Lithuania did not find that this law establishes the obligation of municipalities to cover the costs of providing the sorted collection and transportation service of packaging waste and secondary raw materials generated in the municipal waste stream, and the

service of installing, maintaining, renewing and developing the infrastructure of the sorted collection system.

This obligation of municipalities does not arise from the provisions of other laws, which the Minister of the Environment was guided by when issuing the Order, since these legal norms regulate other legal relationships. Neither the Minister of the Environment, when issuing the Order, nor the Ministry of the Environment, when responding to the statement, indicated the legal norms which would establish the above-discussed obligations of municipalities. The Court noted that municipal budget funds, which also include local fees, are used only for those functions that are assigned to municipalities according to the Constitution or laws. The Minister of the Environment is not assigned the function of redistributing municipal budgets.

Thus, by issuing the legal order discussed above, the Minister of the Environment intervened in the process of allocation of municipal budgets, including local fees, which, as already mentioned, does not fall within the competence of the Minister of the Environment. The Court finally found that the Minister of the Environment ignored the obligation arising from the constitutional principle of the rule of law for the legislative bodies that issue laws not to exceed their powers, not to violate the hierarchy of legal acts, the imperatives of the supremacy of laws, and to establish the legal norms which would be based on the relevant law and would detail it only within the limits established by law. As a result, Subsection 2.2.2 of the Order was recognised to contradict to the constitutional principle of the rule of law.

On 21 December 2022, the Supreme Administrative Court of Lithuania made the Decision in the administrative case No. I-11-822/2022 regarding the legality of Clause 2.2.2 in the Order of the Minister of the Environment of the Republic of Lithuania of 29 April 2029 No. D1-123 "On the approval of the necessary requirements for the provision of sorted collection and transportation services of packaging waste generated in the municipal waste stream and the necessary conditions for establishing the packaging waste management organising and financing contracts." The Supreme Administrative Court of Lithuania examined whether Clause 2.2.2 in the above-mentioned Order does not contradict the constitutional principle of the rule of law, the principles of supremacy of law enshrined in Clause 4 of Article 3 and the principles of non-abuse of power enshrined in Clause 8 of Article 3 of the Law on Public Administration of the Republic of Lithuania, the "polluter pays" principle enshrined in Article 32 of the Law of the Republic of Lithuania on Waste Management and the Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with re-

gard to the prevention and remedying of environmental damage, Clause 37 of Part 2 of Article 16 of the Law on Municipal Government of the Republic of Lithuania, Clause 8 of Part 1 of Article 11 of the Law on Tolls of the Republic of Lithuania, and Clause 2 of Part 1 of Article 7 of the Law on Packaging and Packaging Waste Management of the Republic of Lithuania.

In their statement, the applicants (a group of the Members of Parliament) indicated that the Minister of the Environment does not have the right to impose an obligation on municipalities to pay 10% of the costs incurred as a result of the separate collection of packaging waste and secondary raw materials, because by-laws cannot regulate legal relations, which can only be regulated by law.

After examining all the material, the Supreme Administrative Court of Lithuania issued the Decision that Clause 2.2.2 in the Order of the Minister of the Environment of the Republic of Lithuania of 29 April 2029 No. D1-123 "On the approval of the necessary requirements for the provision of sorted collection and transportation services of packaging waste generated in the municipal waste stream and the necessary conditions for establishing the packaging waste management organising and financing contracts" contradicts the constitutional principle of the rule of law.

Summarising, it can be stated that the enforcement of the rules of the single market in the European Union is an essential element that ensures compliance with the rules and the application of sanctions for violations. To ensure effective enforcement, it is necessary to actively monitor and control economic agents, impose the relevant sanctions, and remove illegal products from the market. This requires extensive cooperation within the EU governance levels and the constant review and application of rules.

The analysis of the national court practice in Lithuania revealed several important aspects which are related to the implementation of the principles of the circular economy:

- Case No. 47/2011 – the Constitutional Court recognised that the established mandatory task of oil waste management does not contradict the Constitution of the Republic of Lithuania. However, this poses challenges for manufacturers and importers who, for independent reasons, are not always able to collect the required amount of waste.
- Case No. 44/2011 – the Constitutional Court recognised that the decisions of municipalities regarding the assignment of municipal waste management to regional centres do not contradict the Constitution. It was also confirmed that municipal waste management systems can be operated through institutions established by municipalities themselves.

- Case No. 8/2016 – the Constitutional Court found that the provisions of the laws on the cancellation of licenses for receiving three warnings within two years are constitutional, although raise doubts about disproportionality and severity.
- Case No. 19/2018 – the Constitutional Court considered the amendments to the laws prohibiting the construction of waste incineration facilities closer than 20 km from residential areas. The Court recognised that these restrictions can be considered disproportionate and can violate the right to conduct the economic activity of waste incineration, so the question of their compliance with the Constitution was raised.

The practice of the Supreme Administrative Court of Lithuania in the area of waste management:

- Case regarding unfair competition in Klaipėda and Šiauliai districts (Decision of 15 June 2015, case No. A-1581-502-2015): the Supreme Administrative Court of Lithuania recognised that Klaipėda and Šiauliai district municipalities violated the requirements of the Law on Competition by entrusting the functions of municipal waste use and disposal to the regional waste management centres established by the municipalities themselves without a competitive procedure. The municipalities should have promoted the initiative of private agents and organised a competitive procedure instead of privileging the regional waste management centres.
- Case regarding the legality of the documents for the management of product and packaging waste (Decision of 3 April 2019, case No. I-6-822/2019): the Supreme Administrative Court of Lithuania recognised the description of the procedure for issuing documents for the management of product and packaging waste, approved by the Order of the Minister of the Environment of the Republic of Lithuania, as legal. The court found that these regulations do not contradict the requirements of the Law on Public Administration and the constitutional principle of the rule of law.
- Case regarding organising and financing packaging waste management (Decision of 21 December 2022, case No. I-11-822/2022): the Supreme Administrative Court of Lithuania found that Subclause 2.2.2 of the Order of the Minister of the Environment of the Republic of Lithuania No. D1-123, which established the obligation for municipalities to cover a part of the costs of the sorted collection and transportation service of packaging waste generated in the municipal waste stream from municipal budgets, contradicts the constitutional principle of the rule of law. The Court found

that this duty can only be imposed by law, not by by-law, and therefore the Minister's Order exceeded the competence of the Minister.

In conclusion, to effectively implement the principles of the circular economy and ensure the implementation of the rules of the single market in Lithuania, it is necessary to further strengthen the compatibility of legal acts with constitutional provisions and ensure proportional, fair and effective regulation and the application of sanctions. This includes the proper development of the relevant regulations, their transposition into national law, effective enforcement, continuous monitoring, and improvement of the legal environment.

Conclusions

The evolution of waste management is inextricably linked to the development of communities, population growth, and international trade. As awareness of the necessity to reduce waste generation and manage waste efficiently has grown, the holistic 4R method ("reduce-reuse-recycle-redesign") has gained prominence, contrasting with the traditional linear model of "take-make-use-discard." The EU's waste management policy, which is based on a hierarchy of prevention, preparation for reuse, recycling, recovery, and final disposal, constitutes a pivotal step towards sustainable development and environmental protection. The objective of this policy is to minimise the environmental impact of waste while promoting resource efficiency, thereby making a significant contribution to the circular economy.

Secondary raw materials are derived from the recycling and recovery of used products and include plastics, paper, glass, metals, and other materials that are reintroduced into the production cycle. These materials assist in maintaining equilibrium in the availability of resources, including paper, aluminium, and plastics. The primary challenge for manufacturers is to enhance production efficiency by increasing the utilisation of secondary raw materials in their processes.

The Circular Economy Monitoring System employs a range of indicators to represent the use of secondary raw materials, including material consumption, green public procurement, waste generation, food waste, waste management, general and specific recycling rates, the proportion of recycled materials in raw material demand, trade in recyclable raw materials, private investment, job creation, value addition, and patents.

In the European Union, secondary raw material markets for aluminium, paper, cardboard, and glass are well-functioning and meet all the criteria proposed by the European Environment Agency. These markets are substantial and demonstrate a reduced dependence on policy frameworks for material supply. In contrast, less developed markets for plastics, bio-waste (compost), construction and demolition waste, and textiles encounter a number of challenges, including unstable and insufficient supply, weak demand, low technical standards, and a high reliance on regulatory frameworks.

The development of secondary raw material markets in Belgium, the Netherlands, and Estonia is regarded as a success, largely due to the implementation of various measures, including promotive regulation, Extended Producer Responsibility, organised systems for the collection of secondary raw materials, the "Pay As You Throw (PAYT)" principle, landfill taxes, public education on waste recycling, and project financing for businesses.

In Lithuania, waste management is primarily regulated by the Law on Waste Management, which sets out the general requirements for waste prevention and management with the objective of mitigating the negative impacts on public health and the environment. This legislation is implemented through the State Waste Prevention and Management Plan, which is prepared by the Ministry of Environment and approved by the Government. Regional and municipal Waste Prevention and Management Plans are then developed in accordance with this state plan. In alignment with the EU Green Deal 2050 strategy, Lithuania's guidelines for transitioning to a circular economy by 2035 aim to establish an environmentally friendly, climate-neutral economic direction, promoting efficient resource use, sustainable economic growth, and job creation.

Lithuania does not impose direct liability on companies for failing to utilise secondary raw materials. Administrative liability is only enforced for improper waste management in accordance with the Law on Waste Management and relevant articles of the Code of Administrative Offences, which prescribe fines for various violations of waste management regulations.

A review of the decisions of the Constitutional Court of the Republic of Lithuania on waste management reveals a total of only four cases since 2016. Similarly, the practice of the Supreme Administrative Court of Lithuania in matters pertaining to waste management is constrained.

Based on the study results and provided conclusions some recommendations could be provided. In order to reduce the quantity of waste entering landfills and incinerators, it is recommended that reverse logistics be implemented in all EU Member States. A principal strategy is the Deposit Return Scheme (DRS), which should be adopted by Member States that have not yet implemented it. Presently, European countries can be classified into three categories: those that have already implemented DRS, those that have adopted relevant legislation, and those where DRS implementation is being discussed. It is noteworthy that seven European countries have not yet implemented DRS (see Annex 2).

It is of the utmost importance to implement comprehensive public education and awareness campaigns with the objective of modifying traditional economic attitudes and fostering sustainable behaviour. It is recommended that these cam-

paigns encompass general education, public involvement and infrastructure improvement in order to effectively communicate the importance of waste reduction and resource efficiency.

The adaptation of examples of successful practices in the sustainable management of secondary raw materials from other countries can prove highly beneficial (see Table 3). By way of illustration, the PET recycling system in Switzerland, Germany's comprehensive and efficacious deposit return system, and Stockholm's energy production from residual energy and biofuels provide examples that other EU Member States may wish to emulate.

It is of the utmost importance to assess the secondary raw material markets in the various Member States of the European Union. By classifying these markets as either well-functioning or poorly functioning, it is possible to develop targeted measures to enhance the competitiveness of poorly functioning markets.

It is recommended that platforms for trading secondary raw materials be created in order to better match supply with demand, thereby facilitating more efficient market operations. To guarantee the effective enforcement of market regulations, it is essential to proactively monitor and regulate economic actors, impose appropriate penalties, and remove illicit products from the market. This necessitates the maintenance of continuous cooperation between the various EU management levels, together with a consistent review and application of the rules.

The implementation of these recommendations will enable EU Member States to advance their waste management practices, promote the circular economy and enhance environmental sustainability across the region.

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Annex 1

Assessment of a well-functioning market

Criterion	Application				
	Secondary wood market	Secondary plastics market	Secondary compost market	Secondary market of construction and demolition waste	Secondary textile market
Market size and growth					
1.1. Large supply and demand shares compared to the total market size	No, small shares	Partly. High supply of plastic waste but low demand due to inadequate quality, except for certain plastic waste streams, such as PET bottles	No. Low demand due to the inadequate quality of biological waste	Partly. High supply but varying demand in the EU	No. Low demand, use of textile waste for other purposes. For this reason, low-quality textile waste is collected
1.2. Sufficiently stable or increasing supply and demand	No	Partly. Plastic packaging recycling targets will increase supply. There is a growing demand for recycled content from multiple brand owners. Nevertheless, very little recycled plastic is used	No. Low demand	Partly. Large supply. Demand depends on the quality and availability of raw aggregates	No. Low demand
1.3. Open international trade and high turnover	No. Markets usually operate at the national level	Yes. International trade in bulk plastic waste (e.g. PET)	No. Some countries have local markets but there is a lack of international or organised trade	No. Only relevant for local markets due to transport costs, heavy weight and low price	Yes. Large international trade

1.4. Large industrial capacities creating demand for the use of secondary raw materials	Partly. Only to a certain extent, for example, for the production of chipboards	Partly. The technology is still being developed, except for certain polymers (PET)	Partly. It is difficult to estimate municipal biowaste treatment capacity in Europe, as only a limited number of countries have data on their installed and intended treatment capacity for this waste fraction	Partly. Estimating treatment capacity in Europe is difficult, as only a limited number of countries have data on installed and intended treatment capacity for this waste fraction	No. Limited textile-to-textile processing
Policy drivers in market development					
2.1. Supply and demand are not driven by politics	No. Waste Framework Directive establishes separate collection requirements and wood waste recycling targets that increase the availability of raw material for recycling	No. Waste Framework Directive sets separate collection requirements and recycling targets for plastics and waste, thus increasing the quantities of raw materials available for recycling. Requirement for recycled content in bottles creates demand (e.g. PET)	No	No. Waste Framework Directive establishes separate on-site collection requirements and construction waste recycling targets	No. Waste Framework Directive establishes an obligation for the Member States to collect textile products separately by 1 January 2025. The EU reuse/recycling targets are intended
2.2. Included under packaging waste or extended producer responsibility schemes	Yes. In most Member States, wood packaging waste is covered by EPR systems, which will become mandatory by 2024	Yes. At the national level, most Member States have EPR schemes which will become mandatory by 2024	Not relevant	Not relevant	Partly. Only a few EU member states have EPR schemes, but they are intended to be introduced at the EU level
2.3. No competition with the use of energy recovery	No. Use for energy recovery competes strongly with recycling	Partly. Competes with the use of energy recovery, but source-separated plastic waste is rarely incinerated	Partly. Separated biological waste is rarely incinerated	Not relevant	No. A large part is dedicated to energy recovery even after textile is collected separately

Prices					
3.1. International or national reference price	No	Partly. Only for certain polymers	No	No. Only domestic markets exist	No
3.2. „Organised markets" for trading (e.g. futures))	No	Partly. There are certain trading platforms for plastic waste (PET)	No. Lack of organised and/or international markets and trade	No. Lack of organised and/or international markets and trade	No. Lack of organised and/or international markets and trade
3.3. Sufficient information is available to both demand and supply agents	No	Partly. There is reliable information on the market for some plastics (e.g. PET)	No. Information is not available	No. Information is not available	No. Information is not available

Annex 2

The Deposit Return System status in some of the countries

Country	State of DRS	PET bottles collection rate	Implementation year
Cyprus	Legislation adopted	N/A	2025
Turkey	Legislation adopted	N/A	2023
Belgium	Ongoing discussion	N/A	
Greece	Legislation adopted	28 %	2023
Hungary	Legislation adopted	42 %	2024
Poland	Legislation adopted	43 %	2024
Portugal	Legislation adopted	45 %	2024
Italy	Ongoing discussion	46 %	
France	Ongoing discussion	47 %	
Romania	Implemented	52 %	11/2023
Latvia	Implemented	54 % (first six months)	2022
Luxembourg	Ongoing discussion	58 %	
England	Legislation adopted	59 %	2023
Scotland	Legislation adopted	59 %	2024
Ireland	Legislation adopted	62 %	2024
Slovenia	Ongoing discussion	65 %	
Spain	Ongoing discussion	66 %	
Netherlands	Implemented	70 %	2005
Austria	Legislation adopted	75 %	2024

Malta	Implemented	80 %	2022
Czech Republic	Ongoing discussion	82 %	
Croatia	Implemented	86 %	2006
Estonia	Implemented	87 %	2005
Sweden	Implemented	88 %	1984
Lithuania	Implemented	90 %	2016
Iceland	Implemented	91 %	1989
Slovakia	Implemented	92 %	2022
Norway	Implemented	92 %	1999
Denmark	Implemented	93 %	2002
Finland	Implemented	97 %	1996
Germany	Implemented	98 %	2003

Source: https://sensoneo.com/waste-library/deposit-return-schemes-overview-europe/

Summary

The book offers a comprehensive examination of the theoretical and practical aspects of secondary raw material markets within the context of the circular economy. The utilisation of secondary raw materials is of vital importance in the reduction of reliance on non-renewable primary resources, and plays a pivotal role in the development of circular economy business models, as emphasised by the OECD and the EU Circular Economy Action Plan. The study highlights the significance of secondary raw materials (i.e. aluminium, plastics, textiles, etc.) in promoting sustainability and competitiveness, particularly in sectors characterised by high resource consumption. The monograph seeks to provide a multifaceted understanding of secondary raw material markets, offering valuable insights into their development and the legal frameworks necessary to support a sustainable circular economy.

The book is structured into four chapters, each addressing a discrete aspect of the secondary raw material market. The initial chapter addresses the sustainable management of these materials, examining the challenges and opportunities encountered by businesses and including case studies that illustrate successful practices. The second chapter explores the conceptual aspects of the secondary raw material market, examining its role within the circular economy and identifying key indicators and challenges for future market development. The third chapter presents exemplary practices from countries such as Belgium, the Netherlands, and Estonia, with a particular focus on innovative strategies and the role of trading platforms in market advancement. The concluding chapter examines the legal dimensions of trade in waste and secondary raw materials, contrasting international and Lithuania's national regulatory frameworks and analysing judicial practices to elucidate their implications for sustainable resource management.

This monograph represents the collective output of scientific collaboration between authors affiliated with the Public Security Academy of Mykolas Romeris University (Lithuania) and the Strategic Analysis Department of the Krakow University of Economics (Poland).

Keywords: secondary raw materials, secondary raw materials markets, management of raw materials, waste management, good practices

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