Czech University of Life Sciences in Prague

Faculty of Economics and Management

Department of Economics

Master's thesis

Circular Economy Transition and Prospects: Case Study of Ireland

Bc. Sofia Valentová

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Circular Economy Transition and Prospects: Case Study of Ireland

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Objectives of thesis

The objective of this thesis is to address the development of circular economy strategies in the European Union and their practical implementation in Ireland. The research is focused on the assessment of EU circular economy policies and the EU monitoring framework to determine progress, potential barriers and prospects of circular economy advancement. The goal of the thesis is to evaluate the effectiveness of circular economy strategies by analysing Ireland's circular performance through key indicators aligned with the EU monitoring framework.

Methodology

The thesis consists of two interconnected parts. The theoretical part provides foundational information on circular economy concepts, the European Union circular economy strategies, the EU monitoring framework and its support for circular economy transition. This was conducted using a descriptive method drawing from EU publications and academic literature.

The practical part builds on the theoretical foundation by presenting a case study analysis of circular economy indicators in Ireland. The research was carried out using a quantitative method via desk research of data. Key indicators for the assessment were selected based on the EU monitoring framework from Eurostat for the period 2012-2024. The analysis was conducted using secondary data and official statistical databases. Results were interpreted to identify progress, barriers and recommendations specific to Ireland's circular economy implementation.

The proposed extent of the thesis

70 – 90 pages

Keywords

Circular economy, Ireland, Circular Economy Action Plan, European Union, Environmental policy, Sustainability, Waste management, Environmental Footprint, Recycling, Circularity gap

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Thesis supervisor
Ing. Pavel Kotyza, Ph.D.

Supervising department
Department of Economics

Electronic approval: 25. 02. 2026
prof. Ing. Lukáš Čechura, Ph.D.
Head of department

Electronic approval: 26. 02. 2026
prof. Ing. Lukáš Čechura, Ph.D.
Dean

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Declaration

I declare that I have worked on my master's thesis titled "Circular Economy Transition and Prospects: Case study of Ireland" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights. Also, I also declare that I have used AI tools in accordance with the internal regulations of the university and the principles of academic integrity and ethics.

In Prague on 31.3.2026 _____

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Přechod na Oběhovou Ekonomiku a Perspektivy: Případová Studie Irska

Abstrakt

Tato diplomová práce se zabývá perspektivami přechodu na oběhové hospodářství v rámci Evropské unie, se specifickým zaměřením na Irsko a jeho úroveň cirkularity hodnocenou prostřednictvím monitorovacího rámce Evropské unie pro oběhové hospodářství. Výzkum je rozdělen do dvou hlavních částí, které zahrnují teoretickou analýzu politického rámcu a praktickou případovou studii Irska, založenou především na datech získaných z Eurostatu, doplněných o sekundární data z národních institucí, jako jsou Agentura pro ochranu životního prostředí v Irsku a Irský statistický úřad.

Výsledky výzkumu odhalují mezeru v cirkularitě v Irsku, přičemž analýza se primárně zaměřuje na období let 2012 až 2022. Toto období je charakterizováno výrazně nízkou mírou využití druhotných surovin, která zůstávala do značné míry stagnující a výrazně zaostávala za cíli EU v oblasti oběhového hospodářství. Analýza dále identifikuje řadu strukturálních slabin a naznačuje, že dosažení vyšší úrovně oběhového hospodářství v Irsku bude vyžadovat efektivnější implementaci příslušného politického rámce, zvýšenou finanční podporu podnikům a malým a středním podnikům při zavádění oběhových obchodních modelů a rozšíření zadávání zelených veřejných zakázek s cílem podpořit poptávku po druhotných surovinách.

Klíčová slova: Oběhové hospodářství, Irsko, Akční plán pro oběhové hospodářství, Evropská unie, Environmentální politika, Udržitelnost, Odpadové hospodářství, Environmentální stopa, Recyklace, Cirkulární deficit

Circular Economy Transition and Prospects: Case Study of Ireland

Abstract

This thesis explores the prospects of circular economy transition within the European Union, specifically focusing on Ireland and its circular performance assessed through the European Union Circular Economy Monitoring Framework. The research utilizes two main parts consisting of theoretical policy analysis and a practical case study of Ireland, which is based on data extracted mainly from Eurostat, supplemented with additional secondary data coming from national bodies, such as the Environmental Protection Agency and the Central Statistics Office of Ireland.

The research findings reveal a circularity gap in Ireland, with the analysis primarily focusing on the core time-period of 2012 to 2022. This period is characterized by a considerably low circular material use rate, which remained largely stagnant, falling significantly behind the EU's circular targets. The analysis further identifies other numerous structural vulnerabilities and suggests that achieving a more circular economy in Ireland will require effective implementation of its circular economy framework, increased financial support for businesses and SMEs to adopt circular business models, and the expansion of green public procurement to stimulate demand for secondary materials.

Keywords: Circular economy, Ireland, Circular Economy Action Plan, European Union, Environmental Policy, Sustainability, Waste management, Environmental Footprint, Recycling, Circularity Gap

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1 Introduction

The linear "take-make-dispose" model that has dominated industrial economies for decades, which has driven unprecedented economic growth, but it has done so at a tremendous cost to natural resources and our environment. Global demand for raw materials accelerates, and the need for an alternative economic structure becomes urgent. The circular economy has emerged as a transformative framework that is based on decoupling economic activity from resource depletion. This approach challenges conventional production and consumption patterns and aims to reduce waste, lower greenhouse gas emissions, and foster sustainable resource management — outcomes that are central to achieving long-term environmental resilience.

While the European Union has developed comprehensive strategies and monitoring frameworks, translating these ambitions into a reality at national and local levels continues to be a challenge. With its economy heavily reliant on resource-intensive sectors and waste generation above the EU average, Ireland faces both structural and institutional barriers to advancing circularity. As a result, opportunities for scaling sustainable business models and harnessing the economic and environmental benefits of circular practices remain under-realised. This thesis argues that enhancing Ireland's circular economy framework through clearer policy direction, stronger implementation mechanisms, and engagement with stakeholders across government, and industries, is essential if the country is to meet its sustainability objectives. By examining Ireland's current circular landscape, this thesis seeks to offer evidence-based recommendations that can serve as a support to propelling a more robust transition to circularity.

2 Objective and methodology

2.1 Objective

The objective of this thesis is to address the development of circular economy strategies in the European Union and analyse their practical implementation through a case study of Ireland. The need to transition from the current traditional model of "take-make-dispose" is becoming increasingly necessary due to growing pressure on natural resources and the environment. This thesis is focused on the assessment of EU-level circular economy policies to determine progress, recognize barriers and prospects of circular economy advancement. A central objective of the thesis is to evaluate the Ireland's performance in circular economy progress through key indicators aligned with the EU monitoring framework for circular economy. Through benchmarking Ireland against the European Union average and leading circular performers such as the Netherlands, this research aims to highlight the gap between Ireland's current performance and the EU's objectives to double its circular material use rate by 2030.

The analysis also takes into account specific characteristics of the Irish economic and environmental landscape, including its significant reliance on waste exports, an intensive construction sector and a dominant agri-food industry. Considering these features, the analysis addresses current barriers that continue to hinder Ireland's progress in circular economy transition, while highlighting factors that support circularity. Based on these findings, the thesis proposes recommendations to support the advancement of Ireland's circular economy transition.

2.2 Methodology

The thesis consists of two interconnected parts, combining theoretical analysis with a national-level case study of the selected country. The theoretical part provides foundational information on circular economy concepts, outlines the European Union's circular economy strategies and the supportive role of EU Circular Economy Monitoring Framework. This section is based on a descriptive analysis of official EU publications, policy documents and relevant academic literature. It includes an overview of major EU circular economy initiatives, such as the Circular Economy Action Plan and the European Green Deal, as well as key legislative instruments such as the Waste Framework Directive, the Packaging and Packaging Waste Regulation and other related legislative documents. Together, these sources provide institutional context for understanding how circular economy

principles are embedded within EU policy objectives, and the obligations they create for EU Member States, including Ireland.

The practical part builds on this theoretical foundation by presenting a case study analysis of Ireland's circular economy performance, assessing national progress using selected indicators from the EU Circular Economy Monitoring Framework. The selected indicators enable a measurable comparison with the EU average and other Member States, helping to identify key challenges that influence Ireland's performance. The analysis adopts quantitative approach based on desk research of statistical data derived from Eurostat for the core period 2012 to 2022, supplemented by more recent data where available, and complemented with additional sources from the Environmental Protection Agency and the Central Statistics Office of Ireland where necessary. The findings are used to interpret relevant recommendations to support further circular economy development within the state.

This thesis aims to answer following research questions:

1. What is the current state of circular economy in Ireland?
2. What structural barriers hinder Ireland's progress across multiple circular economy indicators compared to the EU average?
3. How effective are circular economy policies and strategies in promoting circular economy development in Ireland?
4. How can the construction and demolition sector transition towards high-quality recycling within Ireland, and what strategies could enable this shift where the sector accounts for over 50% of total waste?
5. To what extent does Ireland's municipal waste sector rely on export for treatment abroad, and how can domestic infrastructure be developed to achieve self-sufficiency?
6. What actions are necessary to accelerate the reduction of packaging waste generation within Ireland?
7. Given that the transition to a circular economy cannot occur without private sector engagement, how can Irish businesses and SMEs overcome barriers to adopt more circular business practices?

3 Literature Review

To establish a clear foundation, this chapter begins by outlining the core principles of circular economy and its theoretical framework. It examines the definition, origin, significance and key barriers associated with the transition to a circular model at the national level. The theoretical section then progresses to explore the European Union's approach to circular economy and resource efficiency, providing a broader policy context, which shapes national transitions.

3.1 Concept of Circular Economy

The concept of circular economy has emerged as a crucial paradigm in how global economies, particularly the Member States of the European Union, approach sustainable growth and resource management. A healthy, growing economy is defined as one that demonstrates consistent increases in the production of goods and services, income levels and living standards over time (Patterson, 2023). After the 1970s, the limits of natural resources have increasingly been stepping into the center of economic and environmental awareness groups. The 'Limits to growth' report written in 1972, warned that increasing industrial activity coupled with population growth would lead to detrimental consequences, given the Earth's finite resources (Meadows et al., 1972). Over time, growing environmental pressures and resource constraints have pushed for the question of transformation of the linear model to a more sustainable, circular model.

3.1.1 Definition and Origins of Circular Economy

Circular economy is a multifaceted model, composed of many variations of definitions. According to Kirchherr et al. (2017), a widely cited definition that aids in understanding of the circular economy is as follows: "*A circular economy describes an economic system that is based on business models, which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.*" (Kirchherr et al., 2017, pp. 224–225).

According to the European Commission (2020), in circular economy, the value of products, materials and resources is maintained in the economy for as long as possible, and waste and resource use is minimised.

According to the Ellen Macarthur Foundation (2019), circular economy can be characterized as a systems-level approach to economic development, which aims to decouple economic growth from the consumption of finite resources and simultaneously build economic, natural, and social capital. This model also distinguishes between biological cycles, where organic materials regenerate living systems, and technical cycles, which focus on the restoration of materials through reuse, repair, and recycling processes (Ellen Macarthur Foundation, 2019; Goldrick-Kelly, 2022)

The first idea of circularity emerged during 1940s with the concept of industrial symbiosis. In 1966, Kenneth Boulding contributed to the notion of circular thinking as he presented the idea of a closed-loop cycle of materials. After cradle to cradle concept was introduced by Stahel, a continuous product life cycle has been emphasized, focusing on designing products for longevity and reuse (Rada, 2023). Subsequently, industrial ecology gained prominence during the late 20th century, which features the principle of closing the material loop, by creating a system where waste is a valorised input, used in the next production cycle (Fet, 2023; Rada, 2023). This evolution set the foundation for current, modern circular economy, which was officially introduced by the European Union in 2015, through its first Circular Economy Action Plan (CEAP) (Baldassarre & Saveyn, 2023). This plan aimed to stimulate the circular transition, focusing on plastics, waste reduction, secondary raw materials, construction, and biomass (Baldassarre & Saveyn, 2023; De Pascale et al., 2023). The Action Plan marked a strategic commitment by the EU to lead the global transition to a circular economy, aligning economic competitiveness with environmental sustainability and resource efficiency (Baldassarre et al., 2023; De Pascale, 2023; European Commission, 2015).

Circular bioeconomy

In addition, bioeconomy can be seen as an extension of the circular economy, a concept that has gained significant prominence on the European Union's agenda since the introduction of the European Bioeconomy Strategy and Action Plan in 2012 (European Commission, 2012a). Despite the lack of uniformity in bioeconomy definitions, according to the European Commission (2025), it is based on the sustainable use of biological resources from land and sea, crops, forests, fish, animals, and micro-organisms – to produce food, materials, and energy. The EU identifies bioeconomy as a key driver for accelerating progress towards a circular and low-carbon economy. Circular bioeconomy is essentially the intersection of circular economy and bioeconomy, as it is often described as the bio-based circular carbon economy (Tan & Lamers, 2021). Circular bioeconomy is a multifaceted and evolving concept aimed at achieving sustainable development goals, yet there remains a critical need for enhanced collaboration among stakeholders to address knowledge gaps, foster innovation, and bridge research with practical implementation to fully realize its potential.

3.1.2 Foundational Principles of Circular Economy

Circular economy model drifts away from the traditional linear model, a 'take-make-dispose' pattern, which is based on leaving waste as a by-product in the environment. The linear economic model, which originated during the industrial revolution, was founded on the premise that natural resources are abundant, easily accessible, and effectively limitless. The current consumption model has proven to lead to continuous environmental degradation and resource depletion. According to the UN's Global Waste Management Outlook (2024), more than 2 billion tonnes of solid municipal waste is generated each year, and 3.8 billion tonnes will be produced by 2050.

A closed-loop system in a circular economy shows that the cumulated waste is becoming a resource itself and can be infinitely recycled and reused in the production process. The waste produced in the linear model ends up being the output, which cannot be processed and is consequently harming the environment in form of a negative externality. Obsolete material is reintroduced back into the production chain, contributing to the efficiency of all resources within the cycle (Sehnem et al., 2022). To successfully implement the circular model on a global scale, businesses, organizations, cities and governments must reorient value creation toward collaboration. The clusters of different actors sharing their knowledge, purpose, intentions and valuable practices produce an ecosystem that drives innovation, development and future research forward. The result of their work is much greater than an individual could ever produce alone (Aarikka-Stenroos et al., 2021). At its core, circular economy model is based on the 3R principles: reduce, reuse and recycle, which is an effective strategy ensuring the environmental impact is reduced to the minimum.

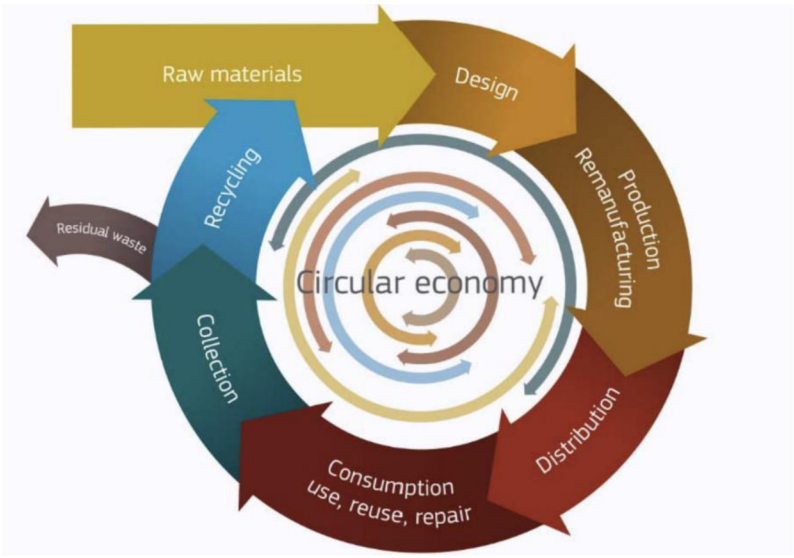

Figure 1. Circular Economy Cycle

Source: (European Commission, 2014)

The reduce principle is interlinked with a concept of resource efficiency, which promotes keeping or improving the product value, while using less harmful substances per unit of value to extend the product lifecycle and lessen the environmental impact (Ghisellini et al., 2016). The reuse principle primarily focuses on extending the life cycle of the product and using the product to its maximum capacity. Finally, the recycle principle emphasizes the need to convert waste materials into a new source of virgin materials (Heshmati, 2017). Over time, the original 3R principles evolved into an expanded 10R model to capture a broader set of circular strategies. These principles include:
refuse (avoid unnecessary production of materials), rethink (redesign for improved efficiency), repair (prolonging product's life-cycle), refurbish (restore outdated products), remanufacture (creating new components), repurpose (finding new functions), recover (extracting resources from waste products).

According to Suárez-Eiroa et al. (2019), operational principles of circular economy focus on managing resource inputs and outputs to minimize environmental impact. These principles adjust the rate of biological and technological waste to levels that natural systems can safely absorb. This approach is also connected with strategy of eco-efficiency, which aims to create more with the same amount or less of a resource, and using resources circularly (Figge & Thorpe, 2023). This strategy lies at the core of circular economy and reflects its fundamental goal. The next operating principle focuses on maintaining resource value throughout product lifecycle. This involves applying the 10R principles at different life stages. These actions thereby prevent disposal and reduce material demand. Complementary principles also include increasing transparency with consumers and stakeholders about product origins and material composition. This enhances trust and efficiency, which propels the shift to circular systems (Suárez-Eiroa et al., 2019).

Design emerges as the critical pillar in circular economy. Appropriate designs of durable products that withstand multiple life cycles are essential for sustaining circular strategies. The concept of Cradle to Cradle (C2C), which promotes designing products where materials circulate without generating waste, is closely linked to this principle. McDonough and Braungart (2002) exemplify a framework where cradle to cradle materials are given back to the earth in form of either biodegradable biological waste, or technological industrial waste that is designed to circulate from customer to producer, indefinitely. The design of these regenerative materials offers the opportunity to go beyond the conventional design of price and aesthetics, creating a healthy sustainable ecosystem (Marinova et al., 2007). Under C2C, products are specifically designed for recycling, recovery and upgrading. A prominent example is aluminium, which can be recycled indefinitely without losing its quality. Advanced recycling processes can be used to separate impurities and

restore aluminium alloys to near-virgin quality, reducing green-house gas (GHG) emissions compared to primary production (Kawajiri et al., 2025). Beyond C2C, the concept of regenerative design also embraces a closed-looped cycle by aiming not only to sustain the material value, but to restore and reuse the input energy and material (Ogunmakinde et al., 2021). Regenerative design is based on using already existing materials. This expands the C2C's strategy by prioritizing natural, fully recyclable and renewable materials that are a source of their own energy (Morseletto, 2020; Ogunmakinde et al., 2021).

3.1.3 The Importance of Circular Economy to Sustainable Development

Sustainable development: Circular economy plays an essential role in driving the sustainable development of the global economy. It is not merely a strategy to optimize resource use, but it is an effective approach to achieve sustainable development goals by addressing global environmental and societal challenges. A widely accepted definition of sustainable development presents the Brundtland Commission Report from 1987, which defines it as a development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs (Schaefer & Crane, 2005, p. 77). By reducing the use of primary virgin materials, circular economy paves the way for sustainable production and consumption of resources, which is directly in line with the Sustainable Development Goal (SDG) 12. As circular economy produces economic growth through its sustainable model based on a closed-loop cycle, it is also closely interlinked with SDG 8, which aims to support economic growth and decent work, SDG 13, which revolves around climate action, and effectively supports SDG 11, promoting sustainable cities and communities (Castillo-Díaz et al., 2024; Garcia-Saravia Ortiz-de-Montellano et al., 2023).

Economic growth: In a circular economy, sustainable economic growth makes a large contribution to creation of jobs across the European Union. Between 2012 and 2018, jobs in the circular economy rose by 5%, reaching approximately 4 million in the European Union (European Commission, 2020). Private investment into circular economy directly correlates with stronger economic performance. Cenaj & Haxhimustafa (2025) find that during the transition and adaptation phase to a circular economy, economic growth may temporarily slow down. However, with appropriate policies that improve the investment climate and make private investment more attractive, circular economy will deliver long-term benefits (Cenaj & Haxhimustafa, 2025). According to Lakshmi et al., (2025), economic growth is directly linked with job creation, which suggests that the circular economy may significantly contribute to generating employment opportunities.

Social importance: A crucial component in the circular transition will be a societal acceptance of the changes in economic activities through providing well-paid jobs in the CE sector. Therefore, the social dimension is crucial for a successful transition to circular economy, as it needs to benefit the society broadly (Lehtimäki et al., 2023). Circular economy has the potential to transform societal structures by creating employment opportunities in local sectors. Circular economy should not only strive to reduce the environmental footprint and the amount of green emissions produced, but it should also lead to a more united society and community cohesion. The social aspects of the CE transition are frequently overlooked by the primary focus on economic growth and technological advancements (Williams, 2019). This highlights the need to integrate the social dimension more into the foundational framework of circularity (Lehtimäki et al., 2023, p. 585).

3.1.4 Barriers of Circular Economy in the European Union

Despite the widespread adoption of CE strategies by the European Member States, circular economy is yet to be fully implemented in EU national economies. It is important to recognize the main barriers and the limitations to growth in order to understand how they can be addressed, to ensure clear progress towards a circular economy.

Institutional and regulatory fragmentation:

One of the most significant barriers is regulatory fragmentation across national economies. Each Member State operates under a distinct governance structure, and circular strategies must be carefully tailored specifically to align with key challenges and advantages of each economy. In addition, income inequality is coupled with institutional fragmentation. According to Jekria and Daud (2016), income inequality may be acting as a block to the creation of environmentally friendly technologies. Consequently, the income inequality coupled with regulatory inconsistencies creates a barrier that hinders the desired progress and perpetuates linear models.

Enforcement and limited incentives:

Circular economy initiatives at the EU level are well-designed and supported by comprehensive frameworks, but their enforcement at national level remains challenging. Lack of coordination between national agencies, different measurement methods and technical capacity may result in only partial enforcement across states (OECD, 2025b). Therefore, strengthening monitoring systems, improving transparency and consistent data systems can support implementation. This is particularly relevant in terms of extended producer responsibility, waste shipments, and eco-design, where technical inspections are important.

Labour market and skills shortages:

While economic growth leads to higher levels of municipal waste, this in turn creates jobs in the waste management sector (Neves & Marques, 2022). Von Kolpinski & Kratzer (2024) find that

circular economy sectors such as repair and reuse employment areas tend to generate more labour-intensive jobs compared to the recycling sector, where technological innovations could result in job reductions. Therefore, Von Kolpinski & Kratzer (2024) claim there is a need to create better policy measures to boost job creation and foster an encouraging environment for innovation and growth. To achieve a sustainable transition, the social aspect should go beyond the economic and environmental factors, as it often goes overlooked (Neves & Marques, 2022). Furthermore, education plays a pivotal role in facilitating the transition from the linear economic model. The absence of adequate education and know-how is a significant obstacle, highlighting the need for educators to design more relevant and targeted programs within circular economy (Tiippana-Usvasalo et al., 2023). Tiippana-Usvasalo et al. (2023) emphasize the importance of incorporating circular economy education into the curriculum for both students and representatives of small and medium-sized enterprises (SMEs).

The role of the public sector in circular economy transition

From the financial point of view, transitioning to circular economy requires high upfront investment costs that go into development of new circular technologies and infrastructure. SMEs are often found facing difficulties in affording these necessary changes, which can hinder their ability to innovate. Public funding has therefore become a necessary tool that businesses need for a successful implementation of circular practices, and public institutions carry the responsibility to provide targeted financial support. SMEs mainly drive localized innovation but frequently encounter additional barriers like complexity of regulations and directives that may be overlapping, often resulting in confusion and built-up costs.

In addition to the public funding, the integration of private sector and technological advancement is vital to achieve full realization of circular economy. In the European Union, the involvement of the private sector is a necessary factor that will develop CE infrastructure and drive innovation forward. Therefore, to complement the strain on public budgets, private investments are essential to bolster circular economy projects through instruments such as green bonds and sustainable finance mechanisms (Georgescu et al., 2025). It is noteworthy that private capital investments in the circular economy reveal disparities across European countries, with high-income countries having well-developed infrastructure, such as Germany and France, exhibiting higher private-sector engagement. In contrast to eastern and southern nations, such investments remain limited. Lower-performing countries, such as Romania and Bulgaria face high initial costs of investment and lack of modernized waste management infrastructure. Therefore, they require higher financial support to revitalize outdated technology and upgrade equipment to evolve. In conclusion, EU policies must prioritize bridging these gaps and provide better support for bolstering recycling systems – which correlate

with higher material reuse rates – to facilitate cross-border investments and sustainability initiatives (Afolabi & Islam, 2025).

Ultimately, the joint effect of targeted government support with the help of private investment capital is significantly greater than their individual contributions. Well-targeted government spending reduces the barriers and risks of private investments, by reducing uncertainty and creating favourable market conditions.

4 European Union Framework for Circular economy

The European Union is considered to be a global leader in the circular economy due to its ambitious goals and strategies aiming to reach full circularity by 2050. European's leadership is evident not only in its policies, but also in resource productivity and recycling: Europe recycles nearly half of what it produces, and extracts over twice as much value from resources as the world average (European Environment Agency, 2024b). Building on this leadership, the EU progressively developed a comprehensive framework of multi-level policies, aiming to become climate-neutral, resource-efficient circular economy, in line with the objective under the European Green Deal to achieve net-zero greenhouse gas emissions across all Member States by 2050 (Castillo-Díaz et al., 2024).

4.1 Circular Economy Strategies and Policies within the European Union

The awareness of the need of the circular transition has gradually increased after the European Commission introduced the Manifesto for a Resource-Efficient Europe in 2012 to promote green growth and increased competitiveness (European Commission, 2012b). The manifesto called for innovation and reindustrialization of Europe, reinforcing the circular economy transition as a comprehensive systemic change. This conceptualization laid the foundation for subsequent policies, including the Circular Economy Action Plan (Calisto Friant et al., 2021). The circular economy has therefore emerged as a core factor of EU environmental policies, through which the Union advances its climate neutral goals. This chapter outlines the structure of EU initiatives advancing the circular economy, starting with overarching policies such as the European Green Deal, followed by action plans (CEAPs), and circular economy packages bundled with a legal framework of specific regulations and directives that enforce compliance across Member States.

European Climate Action Policy

The European Green Deal (EGD) is the European Union's comprehensive growth strategy to create a resource-efficient economy, achieving carbon neutrality by the year of 2050 through reducing greenhouse gas emissions by at least 55% by 2030, subsequently becoming a net-zero continent (European Commission, 2019b). The European Green Deal is composed of a number of strategies and legislative measures that aim to decouple growth from resource use via integrated policies on zero pollution and sustainable development goals. This initiative aims to improve the quality of living conditions and well-being of citizens in all sectors of the economy. Under the EGD, the Commission has introduced a legislative package Fit for 55, which targets already established legislative acts to make them more effective, suggesting to create new, supplementary legislation to achieve goals of EGD, to ensure a fair, cost-effective and competitive transition (Schlacke et al., 2022).

According to the European Green Deal Barometer (2024), experts from Sweden, Poland, Czech Republic, France and Spain believe that the EGD will bring significant positive impact on a global scale and that the Green Deal's objectives will be approved to become binding legislation in the upcoming years. To foster a meaningful change, public participation is necessary to achieve the green transition. However, the public perception of the EGD is weakened due to challenges caused by external factors like uncertainty of consumers amid rising energy costs during the energy crisis due to the Ukraine conflict, contributing to a negative image of the strategy, especially in the central and eastern European countries (Nagy et al., 2025). Circular economy is seen as a core principle in the strategy, as it promotes sustainable use and manufacturing of products, which keeps the economy running in the closed-loop cycle. The concept of circular economy has gained further momentum with the adoption of the European Green Deal in 2019. It has been emphasized that circular economy is the core instrument in the EDG, which has been central in the first Circular Economy Action Plan.

Circular Economy Action Plan

The European Commission has adopted the first Circular Economy Action Plan in 2015, which encompassed actions and recommendations for increased resource efficiency, legislative proposals for improved waste management, and setting targets to reduce landfilling of municipal waste (European Commission, 2015). This strategic document formed a part of Circular Economy Package, accompanied by 4 legislative proposals to revise key waste management legislation:

- Waste Framework Directive
- Landfill Directive
- Packaging Waste Directive

- Waste Electrical and Electronic Equipment Directive

These directives are described in more detail later in this chapter. The first circular economy action plan sought to encourage all Member States to put forward their circular practices, reduce waste production and adopt circular thinking more extensively, thereby fostering innovation, optimizing material flows and making a systemic change. The package predominantly focused on recycling targets and separation of textiles and biowaste (Ellen Macarthur Foundation, 2022). As a result, the package spurred national strategies and improvements in waste management, when the European Commission intensified efforts and invested more than €10 billion in public funding to the circular economy transition (European Commission, 2019a).

The Circular Economy Action Plan 2020

The 2015 Action Plan has delivered strong results and was renewed in 2020 with updated goals and broadened ambitions. The updated 2020 plan shifted focus from linear models to full product lifecycles, emphasizing sustainable design, consumption, and resource circulation through 35 specific actions (European Commission, 2020). It introduced new indicators like material footprint and resource productivity while prioritizing product durability, repairability, and recyclability.

Key objectives of the 2020 Circular Economy Action Plan included:

- Boost recyclability to 65% of municipal waste by 2035
- Boost European economies to position the EU as a global leader in circular economy
- Embed circular practices as a norm in the broadest possible range of products for regions, communities, governments and cities
- Promote sustainable products via enhanced durability and eco-design
- Fostering sustainable products through enhanced durability

The 2022-2025 Circular Economy Implementation Package delivered CEAP 2020's 54 actions through enacted legislation, most notably the Eco-design for Sustainable Products Regulation (ESPR), which mandates companies to produce more durable and recyclable products, alongside the Digital Product Passport (DPP) requiring QR-code for batteries and textiles by 2026 (European Commission, 2026d).

Looking ahead, the new Circular Economy Act is expected to be launched in 2026, building on the second Circular Economy Action Plan, with incorporated feedback from stakeholders and businesses. Following the recommendations of the Draghi and Letta reports, one of the main aims of the Act is establishing a Circular Single Market for secondary raw materials, which would improve

the recovery of the raw materials, reshape supply chains and increase the circularity rate within the European Union (European Commission, Directorate-General for Environment, 2025). The Act will introduce binding recycling content targets for certain products and will focus in more detail on the plastic packaging sector. To prevent market fragmentation, the Commission seeks to establish uniform EU-wide end-of-waste criteria for plastics, clearly defining when plastic waste transitions from waste status to reusable secondary raw material, ensuring a stable, high-quality supply of recyclable plastics across Member States. In addition, the Commission also aims to place distinct customs codes for virgin and recycled plastics to ensure fair competition between EU-produced materials and imported goods (European Commission, 2025f).

Apart from the Circular Economy Act, the European Climate Law similarly establishes net-zero emissions by 2050 as a legally binding target, compelling European companies to conduct lifecycle assessments of their products and prioritize sourcing from recycled goods instead of virgin resources. Integrated with the revised Emissions Trading System (ETS), where linear production incurs higher costs, this makes recycled alternatives a less expensive resource. Non-compliant companies face financial penalties and Member States may face fines for not completing the 2030 targets (European Commission, 2026e). Through these mechanisms, the EU is strategically positioning circularity at the center across its policy framework, embedding it into climate governance.

Furthermore, the Clean Industrial Deal and the Critical Raw Materials Act aim to support the forthcoming Circular Economy Act. Under the Clean Industrial Deal, circularity is systematically embedded into the objectives of heavy-industrial businesses across Europe aiming to decarbonize their operations (European Commission, 2026b). To further enhance the EU's competitiveness, the Critical Raw Materials (CRM) Act seeks to enhance the Union's resilience by diversifying supply chains and strengthening trade partnerships with third countries. The CRM Act also places a strong emphasis on raising the share of recycled critical raw materials, including rare earth permanent magnets (European Commission, 2026c).

4.1.1 Legal Framework for Circular Economy

The European Union seeks to mitigate the environmental impact of waste generation through a number of legally binding directives that Member States must transpose into national law, along with regulations that aim to harmonise standards across the Union for innovation and fair competition. This chapter therefore outlines the most pivotal directives aimed at reducing waste generation across the EU. The European Union's waste legislation comprises more than 30 legally binding targets for the period 2015-2030 (Waste Recycling in Europe, 2025). However, significant challenges persist,

as in 2023 the EU generated 511 kg of municipal waste per capita, which was considerably more than other low-waste leaders like Japan's 326 kg and South Korea's 245 kg of municipal waste per capita in 2022 (Eurostat, 2025c; OECD, 2025b). This disparity stems from Europe's patterns of high consumption, large varieties of recycling rules between European countries and slow decoupling of economic growth from the generation of waste. This underscores the need for the following directives, which this chapter describes.

Waste Framework Directive (2008/98/EC)

The Waste Framework Directive established proper management of waste, while enforcing the waste hierarchy, prioritizing reuse, recycling and recovery by treating disposal as a last resort. Waste management hierarchy forms the foundation of European Union's policy on waste, as it orders actions from most to least favourable, whilst treating disposal as the stage of last resort (Directive 2008/98/EC, 2008). The directive has been revised in 2018 through Directive (EU) 2018/851, and being part of the Circular Economy Package, it introduced new binding municipal waste recycling targets of 55% by 2025, 60% by 2030, and 65% by 2035 (Directive (EU) 2018/851, 2018). The implementation of this directive has been challenging throughout recent years, with only nine countries being on track for the 2025 target.

The latest revision, Directive (EU) 2025/1892 entered into force in October 2025 and requires Member States to reduce food waste by 30% in retail and households per capita by 2030, while making clothing, shoes and textile producers pay higher fees for fast fashion, mandating sorting of textiles before export to curb illegal shipments (Directive (EU) 2025/1892, 2025).

Packaging and Packaging Waste Regulation (PPWR) (EU) 2025/40

Under the Packaging and Packaging Waste Regulation (EU) 2025/40 (PPWR), Member States across the Union are obliged to reduce packaging waste placed on the market by minimum 5% by 2030, 10% by 2035 and 15% by 2040 compared to 2018 baseline levels through implementing reusable and refillable systems, deposit-return schemes and bans on single-use packaging. The regulation places a goal of achieving a 65% packaging waste recycling target by 2025, increasing to 70% by 2030 to contribute to climate neutral Europe (Regulation (EU) 2025/40, 2024). The PPWR replaces Directive 94/62/EC on packaging and packaging waste, as regulations are directly applicable across the entire Union, ensuring uniform implementation without significant discrepancies between Member States (European Commission, 2025e).

However, the recycling target for 2025 has not been uniformly achieved, as significant disparities across member states are experienced. Frontrunners such as Belgium, the Netherlands, Italy and

Czechia have exceeded the target, while countries with lowest recycling rate such as Malta, Romania, Bulgaria, Cyprus and Greece are lagging behind as they are still relying on single-use packaging destined for landfills or illegal export of waste (Waste Recycling in Europe, 2025). As some countries lack proper recycling infrastructure and face challenging economic barriers, they require larger waste management investments to reach the desired goal.

Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU)

The Directive 2012/19/EU was implemented to tackle the rapid growth of e-waste across the European Union, which is one of the fastest growing waste stream in the EU, as it rose by 60% between 2015 and 2023 (Eurostat, 2025n). The Directive demands stronger producer responsibility and requires them to pay for electric and electronic waste in order to collect, recycle and safely dispose of old equipment, reaching a target of 85% collection by 2026 (Directive 2012/19/EU, 2012). The Union faces overconsumption of electronics, as there was more than 89% increase in sales of electrical and electronic equipment since 2012, with collection rates remaining low (Arbinolo, 2025). Large quantities of electronic waste are being illegally shipped to low-income countries where the cost of recycling is lower than in the European Union, or the electronic waste is improperly disposed of. This prompts the European Union to push producers towards prioritizing reuse and repair.

Eco-design for Sustainable Products Regulation

The Eco-design for Sustainable Products Regulation (ESPR, Regulation (EU) 2024/1781) entered into force in 2024 and expands the scope of the original Directive 2009/125/EC, which required manufacturers to develop ecologically designed products with the primary goal of reducing energy use, resource consumption and emissions. In Much More Than a Market report (2024), Enrico Letta stresses that circular product design plays a pivotal role in establishing the Circular Single Market, supported by transparent information from digital product passports. This approach drives mainstream adoption of sustainable products, enabling closed-loop systems and reinforcing product lifecycles. The ESPR mandates specific targets for product performance, including minimum recycled content levels, and introduces new requirements for durability, reparability, recyclability and carbon footprints.

Member States are obliged to enforce the regulation, under which they may impose fines and penalties on non-compliant manufacturers and producers. Companies and SMEs, however, face substantially higher costs for redesigning products and lifecycle data collection for reporting. This may create further obstacles for companies, potentially causing significant negative economic impacts and hindering innovation within circular economy.

The challenges

The efficiency and implementation are the main challenges that these directives face, with the Commission's slow response to launch infringements for missed targets. The Member States struggle with insufficient funding and investments for infrastructure that is needed for separate collection of waste. Moreover, SMEs forming the largest network of businesses in the European economy, face large administrative burdens with their limited resources and capital. The regulatory complexity and high costs for compliance create undesired conditions for innovation.

4.2 European Union Monitoring Framework for Circular Economy

In order to reach a measurable impact, precise measurement of progress and regular assessments are necessary. The European Union measures the state of circular economy of individual countries through a comprehensive set of indicators that were established to monitor the progress of transition. To progress on the goals set under the Green Deal and Circular Economy Action Plan, the EU has produced the framework as a guiding tool to track progress on its ambitions.

Prior to 2018, The European Union lacked a measurement framework, a unified system and tracking tools to derive accurate progress data on circular economy actions and resource efficiency, which hindered new policy improvements. The European Commission implemented the Circular Economy Monitoring Framework (CEMF) in 2018, which included 10 original indicators with their own subsequent categorization: production and consumption, waste management, secondary raw materials and competitiveness and innovation. The European Union has revised the framework in 2023 in response to the Circular Economy Action Plan, adding one additional dimension, as it now officially includes 11 core indicators (Castillo-Díaz et al., 2024). These indicators are used to monitor progress, guide the development of new policies, and are being used to recognize areas of improvement within circular economies in Member States. The following table describes the indicators that were developed by Eurostat and the European Commission, enabling data-driven assessments.

Dimension	Key Indicators
Production & Consumption	Material Footprint
	Resource Productivity
	Waste Generation
Waste management	Recycling rate of municipal waste and waste excluding major mineral waste
	Recycling rate for specific waste streams

Secondary raw materials	Circular material use rate
	Trade in recyclable raw materials
Competitiveness & Innovation	Private investment, jobs and gross value added related to circular economy sectors
Global Sustainability & Resilience	Consumption Footprint
	GHG emissions from production activities
	Material import dependency
	EU self-sufficiency for raw materials, aluminium

Table 1. Circular Economy Monitoring Framework.

Source: (Eurostat, 2026a)

Member States are obliged to report their performance and statistical information on an annual basis to EU authorities. Reporting relies on the Member States and for more efficient measurements, the Eurostat data is often supplemented by national statistics and surveys to address certain gaps in CEMF, which excludes areas like industrial symbiosis, education, consumer patterns and business models. It is noted here that while CEMF presents a useful and valuable tool for conducting an assessment of a circular economy in European countries, it does not provide a full, comprehensive picture as it emphasizes recycling rates and overlooks social indicators, local contexts and structural vulnerabilities unique to each Member State (OECD, 2020b). Therefore, that is why harmonized definitions and measurements across the EU remains very essential, as it prevents fragmented frameworks and different interpretations of circular economy. Due to the distinct economic situation in every country, it seems simple to have a harmonized standardized rules to measurements but coordination, collaboration and alignment is difficult when there are different mandates, perspectives and uneven definitions of CE. Available infrastructure and public acceptance of legislative changes in each country have to be taken into consideration. Circular policies should be tailored specifically with different approaches. The circular economy indicators underpin the second part of the thesis in a comparative analysis of Ireland, benchmarking its performance against other Member States.

4.3 Financial Support of Circular Economy

Time and resources are essential in achieving a successful transition to a circular economy. This requires changes to existing systems, improved waste separation, and the adoption of alternative materials and packaging, all of which must be supported by robust financial instruments. Securing funding for Member States is a crucial element in this process. Circular business models need investment from both public and private financial institutions. The European Union secures financing

for the circular economy through a multifaceted approach involving key players, such as the European Investment Bank (EIB) and national banks. The EIB, acting as the climate bank of Europe, supports the transition by providing finance opportunities for innovative projects, offering advisory services and connecting key stakeholders to accelerate progress and raise awareness (European Investment Bank, 2024). Financial and technical advisory services are mainly provided through the InvestEU Advisory Hub, which aims to support public authorities through awareness-raising for a better support in preparing circular projects (European Investment Bank, 2023). The EIB co-finances national programs focusing on improving waste management practices across the Union and helps build green infrastructure to narrow down the disparities in lower-income regions of Member States, promoting regional development. Beyond direct funding of recycling infrastructure in Member States, it offers knowledge-sharing platforms and policy dialogues, that facilitate more connections for investors and the public sector (European Investment Bank, 2023).
From 2019 to 2023, the European Investment Bank allocated €3.83 billion to co-finance 132 circular economy projects across diverse sectors. Among other significant investments, the EIB provided €40 million to Renewi to support waste-sorting facilities in Belgium and the Netherlands that convert plastics and expired food waste into high-quality secondary raw materials and biogas. It also signed a €500 million loan agreement with Sweden's Sandvik to finance research and development for industrial tools, enhancing circularity in metal cutting processes across Northern Europe (European Investment Bank, 2019). Additionally, EIB has partnered with other European Union's national banks, and in 2019 launched Joint Initiative on Circular Economy (JICE). This initiative targets EU's annual waste production of approximately 2.5 billion tonnes of waste a year, of which only 38% is recycled (European Investment Bank, 2019).

Beyond the support of the European Investment Bank, the European Union has established several funding programs specifically designed to support innovation and facilitate the transition to circular economy. European Union provides financial support for stakeholders and public authorities to carry out research, develop piloting programs, new prototypes or implement circular practices through projects under a number of funding programs, such as Horizon Europe, the LIFE program, and European Structural and Investment Funds. The projects are in alignment with the objectives of the Circular Economy Action Plan.

- Horizon Europe, the European Union's flagship program that funds innovation and research through its dedicated fund of approximately €95.5 billion, continues to support innovation in waste management, circularity and resource efficiency. The program drives innovation to advance circular designs, sustainable business models and recycling technologies in line with

EGD and CEAP. Research and innovation is mainly channelled through Cluster 6, focusing on natural resources, bioeconomy and climate (European Commission, 2025c).

- The LIFE program, the EU's primary financial instrument for environment and climate action, allocates €5.4 billion for 2021-2027 to drive circular innovations. In addition, over the 2016-2020 period, more than €100 million has been invested to more than 80 projects contributing to circular economy under the LIFE program (European Commission, 2019a). To provide an example, the project LIFE WOODMER is oriented on creating a wood-based premium biopolymers from wood pulp waste, which will reduce the amount of forestry waste generated, directly contributing to the EU Green Deal goals (European Commission, CINEA, 2026b). In Sweden, a project called LIFE RE:FOOD, focused on recycling processes of food waste to produce new food products, contributing to the goals of CEAP 2020 (European Commission, CINEA, 2026a).
- Interreg Europe and Interreg Central Europe programs primarily fund circular innovations through supporting interregional cooperation. They facilitate the exchange of best practices at both policy and SME levels (Interreg Europe, 2026). The projects under Interreg programs prioritize cross-regional collaboration, often involving multi-helix stakeholders.

Outside of Interreg funds, Cohesion policy in the European Union also makes a fundamental contribution in fortifying the circular economy by primarily the European Regional Development Fund (ERDF) and the Cohesion Fund. This support was significant during 2013-2020 programming period, but it also remains as an important financing instrument in the 2021-2027 period. European Cohesion Policy is defined by the European Union as the main investment strategy to reduce disparities between regions, striving to achieve harmonious development and a greater quality of life across all member states (European Commission, 2025a). With its €12.5 billion total investment allocation in the 2021-2027 period, the Cohesion Policy supports tangible circular projects managed by national and regional authorities, and eligible beneficiaries like municipalities, SMEs and private or public consortia partners, thereby implementing the quadruple helix model. These projects are developed based on this model, which integrates four key stakeholders: research institutions, government and public authorities, private businesses and NGOs. The quadruple helix fosters creation of solutions that are crucial for delivering tangible results, allowing to productively collaborate and to create new innovation ecosystems.

Financial Barriers in Circular Transition

While the EU public support for circular economy initiatives has surged dramatically in recent years, fragmentation still remains and budgetary constraints continue to limit the EU financial aid.

Governments have limited capacity of the things they can provide and the support from private sector is inevitably necessary.

1) **Regulatory fragmentation:** Governments alone cannot fund circular innovations alone through top-down regulations and subsidies, therefore, the circular economy transition faces a funding gap. Due to regulatory fragmentation and inconsistent national standards, companies see high risks without having the guarantee of their return on investment. To get private businesses start investing, the governments need to create favourable economic conditions and create a market demand for secondary raw materials and modern circular technology, otherwise private enterprises lack incentive to see the opportunities for growth. Moreover, the EU and national governments often fail to provide needed guidance and standardized guidelines for companies and entrepreneurs transitioning to circular economy. Financial opportunities remain undefined due to regulatory fragmentation, causing businesses to become uncertain, discouraging them from making investments.

2) **Government aid:** To accelerate the CE transition, national governments should implement mandatory public procurement targets, legally requiring public authorities to prioritize products with higher recycled content. This would motivate investors to buy recycled products to scale production, creating market demand. Complementing this approach, the public sector should introduce tax alleviations for using raw secondary materials, therefore making virgin materials more expensive, along with establishing stabilized prices or future contracts on recycled materials to create balanced supply. These measures would substantially de-risk investments from the private sector by creating predictable results and revenues, therefore would create an environment where circular economy can financially thrive (Georgescu et al., 2025). Furthermore, governments have the option to issue green bonds targeting circular economy infrastructure for waste recycling facilities. Due to lower interest rates, the risk of investors is covered by receiving stable returns, and the governments are not forced to strain national budgets to support circular initiatives (UNEP Financing Initiative, 2020). Governmental institutions have a crucial role in creating incentives for circular projects and in supporting the development of circular infrastructure. If Member States continue to subsidize fossil fuel production and fail to phase these subsidies out, all measures become counterproductive and the financial sector will have little incentive to invest in circular solutions.

3) **Investment risks:** Financial motives are still anchored in the needs of an economy that is based on a linear model, which discourages circular adoption. Companies prioritize their

investment decisions with short-term return on investment, typically three to four years. However, circular business models deliver financial returns over a longer period of time, making them less attractive. Investments into sustainable business models play a critical role in expanding circular practices, but in the initial phases, the upfront cost of the capital expenditure is much higher than in comparison with a linear investment alternative (Rizos & Behrens, 2016). Corporate investment decisions are focusing their needs on immediate returns within three to four year period, which creates a large financial barrier when revenues from circular business models are uncertain and oriented long-term. Moreover, there is a high level of scepticism from the organisations perspective, as many firms are of the opinion that circular transformation requires comprehensive departmental and organizational change (Ritzén & Sandström, 2017). This compounds the problem – extensive internal restructuring often ties with high incurred costs, while management lacks clear visibility into reliable revenue streams, further deterring from making the initial investment.

Global cooperation beyond the European borders

The strategies of the EU circular economy must gradually extend beyond its borders to initiate connections with other global leaders. France, the Netherlands and Germany are at the front of the circular economy transition, yet despite the EU's efforts, progress still lags behind the European Commission's ambitions. The EU should align its strategies with other world leading economies, which will need to allocate substantial investments and align supply chain partnerships based on harmonized standards for secondary materials. This approach would enable the EU to progressively transform national economies and fulfil its obligations, while also aligning with the UN Sustainable Development Goals. In addition, fostering connections and trade agreements with key global partners such as China, India and major African economies should include targets for recycled materials. Global alignment transforms the EU policy and economy, supporting a resilient, international, and a circular market (European Commission, 2026a).

4.4 Companies and SMEs in Circular Economy

Companies, and especially SMEs, form the economic backbone of the European economy, accounting for over 99% of businesses across the EU Member States, employing approximately two-thirds of the private sector workforce (European Commission, 2024a). The European Environment Agency highlights that achieving full CE transition involves comprehensive policies, including financing and consumer behaviour changes, but mostly business adoption of circular practices (European Environment Agency, 2024a). Firms serve as essential actors in advancing circular

economy because they design, produce, repair and reuse the everyday goods and services that give shape the consumers' patterns. Circular economy is the future of SMEs, but a fundamental shift in perception among SMEs business owners needs to take place – from viewing it as an external burden to recognizing it as an internal driver and an opportunity to improve the company's productivity. At the same time, transition to a circular model requires certain financial inputs, which for smaller scale businesses can be a challenge. The forms of these investments depend on the specific sector of the business, but it may include automatization of processes for recycling, sorting, testing, refurbishment, or it may be costs for switching to more recyclable packaging or investing into refill or repair infrastructure. Across Europe, companies usually associate circular innovation with high upfront costs and uncertainty of getting a return on their investment. These challenges are especially difficult to overcome for smaller firms, which typically do not possess a large capital and technical expertise. Therefore, SMEs need access to financial and advisory support, and public financing can play an important role in overcoming these challenges (García-Quevedo et al., 2020). These support mechanisms are provided through a range of instruments, including innovation grants, innovation vouchers, pilot funding, green public procurement measures, cluster programs and project grants. Non-financial support is equally as important, since partnerships, knowledge exchange and access to circular ecosystems help firms advance their circular practices (Arranz et al., 2024).

While also external factors also play a big role, such as regulatory complexity and limited access to funding, there is a large amount of proactive decisions that SMEs can take to initiate changes from within the company. If companies start seeing CE adoption as a strategy to reduce operational costs through measures like resource optimization and waste minimization, they will be more inclined to implement change, unlocking economic benefits. Strategic managers, who are responsible for shaping the direction of trajectories for their organizations, need to be involved in the initial phases of assessments of feasibility and efficacy during circular economy planning (Arranz et al., 2024)

It has been shown that CE implementation within SMEs typically starts with deploying gradual environmentally-friendly changes. These can include practical actions, such as proper waste separation, recycling, switching virgin materials with more sustainable alternatives, energy efficiency improvements to lower electricity costs, and conducting regular environmental audits. As this is a progressive journey, it is highlighted that management needs to acknowledge the length of the process and approach it with patience (Arranz et al., 2024). Moreover, supporting continuous learning and education is crucial, as SMEs must progressively absorb new knowledge, acquire relevant skills, and stay informed about emerging opportunities, modern technologies, and advanced equipment in their sectors.

Lastly, another barrier for CE adoption for SMEs is the lack of relatable success stories and prior examples, which leaves many SMEs uncertain about moving forward with CE implementation. Companies inspired by examples of best practices by other businesses demonstrating their experiences on cost reductions, internal restructuring for profitability and growth, material substitutions and going forward with alternative designs – these SMEs are more inclined to make a change. Peer visibility of such achievements would provide a motivational element to foster a cycle of circular innovation (Arranz et al., 2024). This underscores the importance of information dissemination to enable SMEs remain up-to-date with industry developments, and to network effectively with peers and public authorities. Knowledge exchange and information sharing workshops play a critical role in advancing circular economy forward.

4.4.1 Environmental, Social and Governance Alignment with Circular Economy

ESG (Environmental, Social and Governance) and Corporate Social Responsibility (CSR) also highlight the importance of enhanced transparency and accountability concerning large firms.
The European Commission streamlined the Corporate Sustainability Reporting Directive (CSRD), which currently concerns companies with over 500 employees or with €450 million net turnover with obligations to report their ESG impacts publicly for investors and stakeholders (Directive (EU) 2022/2464, 2022). Under the Omnibus 1 package, the Commission has simplified the rules with the intention to reduce the administrative burden for companies, and sustainability reporting will be a requirement for firms with over 1000 employees and a net annual turnover of over €450 million (European Parliament, 2025). Under the same package, the European Parliament approved the revised Corporate Sustainability Due Diligence Directive (CSDDD) with thresholds of more than 5,000 employees and more than €1.5 billion net worldwide turnover, amending Directive (EU) 2024/1760, which originally applied to companies exceeding 500 employees and €150M turnover (Directive (EU) 2024/176, 2024). These large organizations are therefore obliged to report their due diligence to identify, prevent, and mitigate adverse human rights and environmental impacts across their operations and supply chains. The European Commission introduced a push for these directives to foster ethical and sustainable behaviour and reduce environmental impacts across global supply chains. Moreover, making circular economy a central part of businesses' ESG strategy provides numerous benefits. Creating synergies with ESG strategies and circular activities directly supports company's environmental performance through reduced production of GHG emissions and reduced waste production. Besides the environmental benefit, Hassan (2025) recognizes key benefits of CE and ESG alignment:

- **Cost savings & Regulatory compliance**: Companies prioritizing environmentally responsible suppliers are more likely to achieve reduced operational costs through sustainable supply chain practices, such as waste minimization (Hassan, 2025). Implementing circular practices further helps with maintaining regulatory compliance, enabling firms produce sustainably under the EU directives, such as the Waste Framework Directive (2008/98/EC, as amended) and also the revised Energy Efficiency Directive (EU/2023/1791), which mandates enhanced energy efficiency and energy audits – industrial symbiosis measures that companies implement through circular practices (European Commission, 2020).
- **Investor attraction**: The focus of investors is increasingly being shifted towards sustainability commitments of a given organization (Hassan, 2025). In terms of large corporations, sustainability-oriented investors prioritize long-term financial returns from circular business models over short-term gains from linear businesses, as evidenced by the rapid expansion of the EU sustainable finance market, where EU taxonomy aligned capital expenditure reached €250 billion in 2023 (Platform on Sustainable Finance, 2025). The European Commission estimates that to reach the goals set under the Fit for 55 package and achieve climate neutrality, approximately €700 billion in additional capital investments will be needed annually until 2030, compared to the previous decade (European Commission, 2024b). Given these large investment requirements, firms demonstrating verifiable circular practices displaying full compliance with ESG and CSR obligations have a significant competitive advantage. Corporations with strong credentials will indicate reliability and long-term viability to investors.
- **Improved brand value**: Businesses cooperating with certified ISO 14001 suppliers and organizations affiliated with sustainability assessment platforms like EcoVadis often have elevated brand image and higher customer loyalty. These partnerships and certifications are credible signals of robust corporate social responsibility commitments that help organizations gain trust of their consumers, which in a competitive market is becoming increasingly essential.

As CE is gaining momentum, businesses will need to recognize the need for integrating circular economy principles into their ESG strategies to move forward in their journeys, and to ensure full compliance with ESG standards and the forthcoming Circular Economy Act coming in the second part of 2026. To reach meaningful progress, companies are required to invest in education campaigns and R&D to allocate resources to circular economy practices (Banu Z & Dr. Vimala, 2024). Even if numerous leading companies often do not fail to highlight their circular practices in ESG reports,

reporting may remain too aspirational, vague and not fully verifiable, which presents a risk. Non-verifiable disclosures undermine the trust of investors and the company's reputation. Moreover, if a reputable company is exposed for falsifying its circular practices, it can negatively damage its reputation, setting a detrimental precedent.

5 Analytical part

This part of the thesis focuses on the assessment of the current state of circular economy in Ireland with comparison to other selected European Union Member States. Following the direction of the European Union, Ireland has introduced a number of measures and strategies to improve its position on circularity. In order to identify the areas of improvement, this chapter centers on a comparative analysis to create robust recommendations for Ireland, as it currently tails the EU average in circular economy performance among other Member States. For the descriptions of each indicator, the analysis primarily aims to address the core time-period of 2012 to 2022, which was selected to ensure consistency. Where more recent and reliable data were available for 2023 and 2024, these were incorporated to provide more up-to-date developments. However, in cases where data were not available through Eurostat, the analysis was supplemented with reliable information from official sources, such as the Environmental Protection Agency (EPA) and the Central Statistics Office of Ireland (CSO).

5.1 Circular Economy in Ireland

Ireland identifies circular economy as a strategic mechanism to improve the performance of its waste management sector and reduce environmental emissions in line with the EU's climate objectives. Despite this recognition, the current ways of using resources and generating waste in Ireland remains heavily unsustainable. Ireland's Circularity Gap Report (2024) shows the country is lagging behind in circular progress in comparison to other states with a circular material use rate (CMUR) of only 2% in 2024. Nevertheless, Ireland acknowledged its significant potential to transform: to embrace reuse, repair and remanufacturing principles and embed it into the center of its economy (OECD, 2022).

Circular Economy Strategies:

From the perspective of strategies, Ireland has introduced two main strategies:

a) The Whole of Government Circular Economy Strategy 2022-2023: Living More, Using Less
b) The Whole of Government Circular Economy Strategy 2026-2028: Accelerating Action

The Whole of Government Circular Economy Strategy 2022-2023 was Ireland's first national strategy on circular economy, aiming to progress on a path to reduce green-house gas emissions and reach the net-zero target by 2050. Under this strategy, the Irish government set out to measure up with its CE rates till 2030 to reach the EU average, reduce the Ireland's circularity gap and increase awareness of CE in households and businesses. The strategy established Ireland's first policy

framework for circularity, complementing the Circular Economy and Miscellaneous Provisions Act 2022, which provided the first statutory definition of circular economy in Irish law and introduced a legal basis for circular economy measures (Circular Economy and Miscellaneous Provisions Act, 2022, s. 6, 2022). The strategy also firstly defined the ambition to raise Ireland's circularity rate to EU's average by 2030 (Department of the Environment, Climate and Communications, 2021).

The Second Whole of Government Circular Economy Strategy 2026-2028 builds on the foundation of the first strategy's vision. This follow-up strategy aims to target and improve Ireland's low circular material use rate by two percentage points each year, aiming to reach 12% by 2030 (Department of Climate, Energy and the Environment, 2026b). Ireland's second circular economy strategy also includes the social aspect, emphasizing social equity and acceptance of circular economy in wider communities. The strategy places digitalisation at the centre, positioning it as a key enabler of the circular economy while also setting targets for priority sectors such as construction and agriculture. In this context, Ireland could achieve emission reductions of up to 32% through widespread adoption of circular measures in sectors such as construction and the bioeconomy (Circle Economy, 2024). The strategy also responds to the Circularity Gap Report's evaluation that Ireland achieves low circular material use rate, far below the EU's average of 12,2 % in 2024. As the EU strives to double the rate to 24% by 2030 under the Circular Economy Act, Ireland must accelerate its progress to align regional policies with national circular targets, which also the Circular Economy and Miscellaneous Provisions Act strives for (European Environment Agency, 2025e).

On the level of waste management planning, Ireland has followed the waste plans:

a) Waste Action Plan for a Circular Economy (WAPCE) 2020-2025
b) National Waste Management Plan for a Circular Economy 2024-2030

Since 2004, the National Waste Prevention Programme (NWPP) managed by the Environmental Protection Agency (EPA), fostered the evolution of waste management policy in Ireland and significantly improved the awareness on waste prevention (OECD, 2022). Since 2020, Ireland's circular economy initiatives have become more structured, as the country's approach became aligned with the EU Green Deal and EU Circular Economy Package. The Irish government has since published a number of policy guidelines, with the first significant milestone being the Waste Action Plan for a Circular Economy (WAPCE) 2020-2025. The policy document focused on broadening the concept of waste management to circularity and produced more than 200 measures across various areas, including municipal waste, consumer protection, plastics, textiles and green public procurement. Among other measures, it included bin standardization, halving food waste by 2030

from 2012 baseline levels and bans on specific single-use plastics. The WAPCE was superseded by National Waste Management Plan 2024-2030, which intends to put more emphasis on the production of single-use plastics, and aims to integrate regional waste initiatives to align it with the national circular programme (OECD, 2022).

On the legislation level, the Circular Economy Act and Miscellaneous Provisions Act also created the Circular Economy Fund, which provided funding for later initiatives, such as the Anti-dumping initiative, Food Circle Project and the Circular Economy Innovation Grants Scheme (CEIGS) (Department of Climate, Energy and the Environment, 2025b).

Circular Economy Programme 2021 - 2027

From the perspective of implementation level, programs and funding play a crucial role in translating Ireland's circular economy strategies and legislation into practical action, providing targeted financial support. EPA Circular Economy Programme 2021 – 2027 is a statutory programme under the Circular Economy Act, which is to support implementation of the Circular Economy Strategy to improve coherence and alignment. The programme is based on four main pillars: advocacy, innovation and demonstration, delivering through partnerships and regulation for circularity. The programme is based on knowledge sharing and puts great emphasis on engaging with the public sector, social enterprises, product designers and other stakeholders to raise awareness and change linear patterns in a society. Through this economic model, the Programme aims to be the driving force for Ireland's path to circularity (Environmental Protection Agency, 2021).

5.1.1 Ireland's Economy

Ireland, a small island nation, transformed its agriculturally-focused economy to a leading European technology hub with its heart in Dublin. Ireland's economic structure plays a decisive role in shaping the circular strategies to be effective. The economy is strongly export-oriented, thriving on trade connections with the United Kingdom, United States and European partners, sustaining low unemployment with highly skilled, young workforce. There are opportunities that stem from challenges hindering CE development in Ireland that are worth noting.

Economic structure and material dependence: A large share of Ireland's GDP is generated by foreign-owned multinational companies, whose global supply chains can limit the government's direct influence on waste reduction practices. At the same time, SMEs are central for scaling circular economy activities across the country. The implications of this economic structure are examined in more detail in subsequent sections of the analysis.

Regional disparities and infrastructure gap: Agriculture occupies approximately two-thirds of Ireland's territory, while Dublin's urban concentration is 40% (Circle Economy, 2024). As rural areas lack necessary infrastructure, SMEs often face with struggling the scaling circular practices. In addition, wide distances lead to increased logistics costs, which may be troublesome and off-putting for businesses to adopt circular operations. Rural regions often lack necessary infrastructure, repair shops and secondary material marketplaces.

Job Market: This also ties with the job market, as only 5.5% of jobs are contributing to circular economy and the vast majority of employers are still contributing to the market in jobs that are based on the linear pattern (Circle Economy, 2024). However, Ireland benefits from highly skilled and relatively young workforce, with over half of adults aged 25-34 holding tertiary education, which presents a strong potential for reskilling into high-value circular roles. The labour market therefore holds strong potential for CE transition by scaling sustainable practices among SMEs that will be increasingly offering more reuse, repair and recycling services in response to rising consumer demand (Circle Economy, 2024).

Housing and Construction as an opportunity: Due to Ireland's housing shortage problem, the Housing for All lists that more than 300,000 new homes will need to be built by 2030 to cover the growing demands of a rising population (Department of Housing, Local Government and Heritage, 2021). This presents a pivotal opportunity for Ireland to embed circularity into the construction sector from a design stage. This can shift reliance from virgin resources to recycled, second-hand materials like gravel and cement, which would enhance resource efficiency. The construction sector is heavily linearly dominant, which is evidenced by 9 million tons of construction and demolition waste produced in 2023 alone (Environmental Protection Agency, 2025b). Most of the waste consists of crushed concrete and soil, discarded to landfills. Designing for future disassembly enables modular use, while contractors also increasingly adopt dedicated waste management plans driven by sustainability commitments, to respond to rising market demands. Some construction waste is unavoidable, due to hazardous materials, poor quality items or custom designs, rendering the product not recyclable. However, private developers are seeking access to green funding with lower interest rates, for which waste management plans are needed, so they are trying to realign their operations with EU taxonomy. As construction waste from building and demolition of buildings and road infrastructure presents the largest waste stream in Ireland, it accounts for approximately half of all waste generated. Therefore, there is a growing need for innovative practices for Irish businesses to adopt modular designs for disassembly and to use digital platforms to trade reusable materials – a secondary materials market which remains underdeveloped in Ireland, leaving raw materials cheaper and more accessible. Scaling these solutions remains vital to boost Ireland's circular productivity (Environmental Protection Agency, 2024b).

Textile industry: Ireland's textile industry heavily relies on 'take-make-waste' model, consuming roughly 53 kg of new textiles per person a year, which is more than double the EU average of 16 kg per person in 2022 (European Environment Agency, 2025c). In Ireland, around 65% of the textile waste is discarded through residual bins, making it difficult to separate and recycle, and so large quantities of textiles are being sent to thermal recovery plants or are incinerated. Ireland discards estimated 164,000 tonnes of textiles annually - among the highest per capita in the EU (Department of Environment, Climate and Communications, 2024). Under the newly revised Waste Framework Directive (EU 2025/1892), Ireland is required to implement separate waste collection systems for post-consumer textiles for recycling or reuse, as it will also be required to implement Extended Producer Responsibility (EPR) scheme for textiles, making producers financially responsible directly (Directive (EU) 2025/1892, 2025).

5.2 Analysis of Circular Economy Indicators in Ireland

The following indicators were selected to establish a clear, structured, and comprehensible evaluation of circular economy within Ireland. This assessment is grounded in the circular economy indicators defined within the EU Circular Economy Monitoring Framework, which provide a harmonised basis for evaluating progress, performance, and structural differences across Member States. The analysis draws on the following circular economy indicators:

- Material Footprint
- Resource Productivity
- Total Waste Generation
- Generation of municipal waste per capita
- Food Waste
- Generation of packaging waste per capita
- Generation of plastic packaging waste per capita
- Circular Material Use Rate
- Private Investments and Persons Employed in CE
- Consumption Footprint and Material Import Dependency

5.2.1 Material Footprint

Material footprint is defined as the total amount of raw materials extracted both domestically and globally to meet a country's final demand for goods and services. Material footprint concerns four key material extractions: biomass, fossil fuels, metal ores and non-metallic minerals. (Eurostat,

2024a). The indicator reveals significant challenges in advancing circular practices in Ireland, as the analysis shows consumption for one Irish person is substantially high.

Ireland's material footprint clearly signals substantial room for improvement in its circular economy. The country's per capita footprint reached 18.9 tonnes per person in 2023, which is 38 % above the EU average. Domestic extraction stood at approximately 80 million tonnes in 2020 and is dominated by non-metallic minerals, such as gravel, sand and limestone, primarily used in construction (Circle Economy, 2024). The 2024 levels show higher numbers compared to EU's average of 13 tonnes per person, underscoring Ireland's 97% reliance on virgin materials. The Circularity Gap Report (2024) indicates that 30 million tonnes of material are consumed domestically, with approximately 50 million tonnes exported abroad, predominantly non-metallic resources and biomass exports, including meat and livestock products. Ireland's material footprint is substantially amplified through large amounts of agri-food exports, such as beef and dairy.

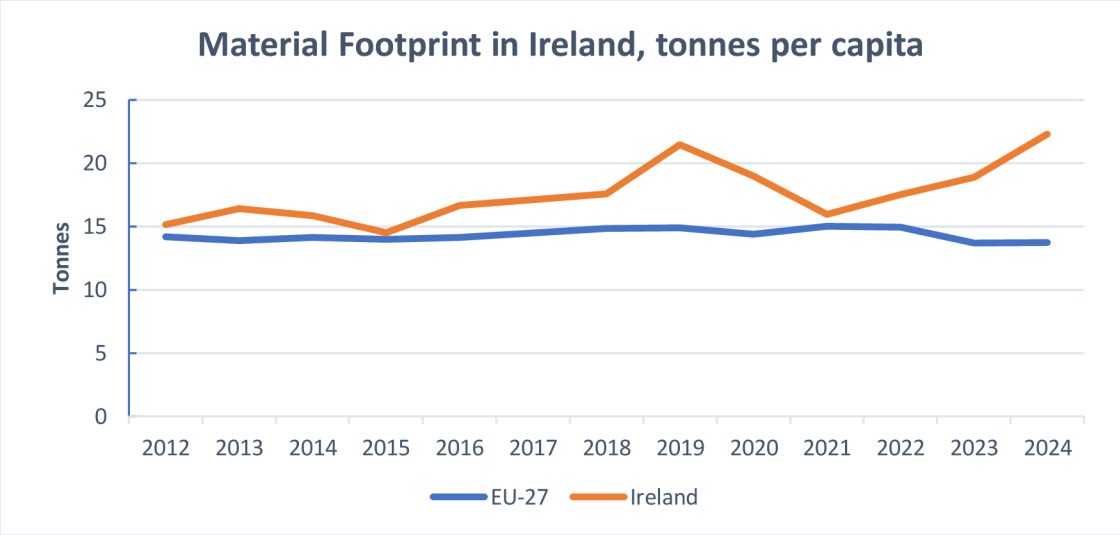

Figure 2. Material Footprint in Ireland.

Source: Own elaboration based on Eurostat (2025f).

This underperformance stems from relying heavily on linear practices in the construction sector, limited recycling infrastructure in rural areas of Ireland and insufficient reuse measures. The material footprint spiked to 21.4 tonnes per capita in 2019, primarily due to a construction boom that increased consumption of non-metallic minerals like sand, gravel and limestone, as housing demand and economic growth demanded more building projects (Goldrick-Kelly, 2022). Overall, Ireland's elevated levels of material footprint are also based on its high dependence on imported fossil fuels. In 2024, 81.3% of all energy supply came from fossil fuels, with 48.9% consisting of oil and 29.6%

of natural gas (Sustainable Energy Authority Ireland, 2025). As the nation does not produce its own oil and gas, renewable energy will become vital in the future. In other words, Ireland's energy import dependency was 79.7% in 2024, however, renewable energy shows steady growth, contributing 14.1% of total energy in the same year. Wind energy constitutes the majority of Ireland's renewable production (Environmental Protection Agency, 2024d). Despite this progress, overall reliance on oil and natural gas prevails, and from the perspective of circular economy, replacing fossil inputs with renewables and circular materials will be crucial.

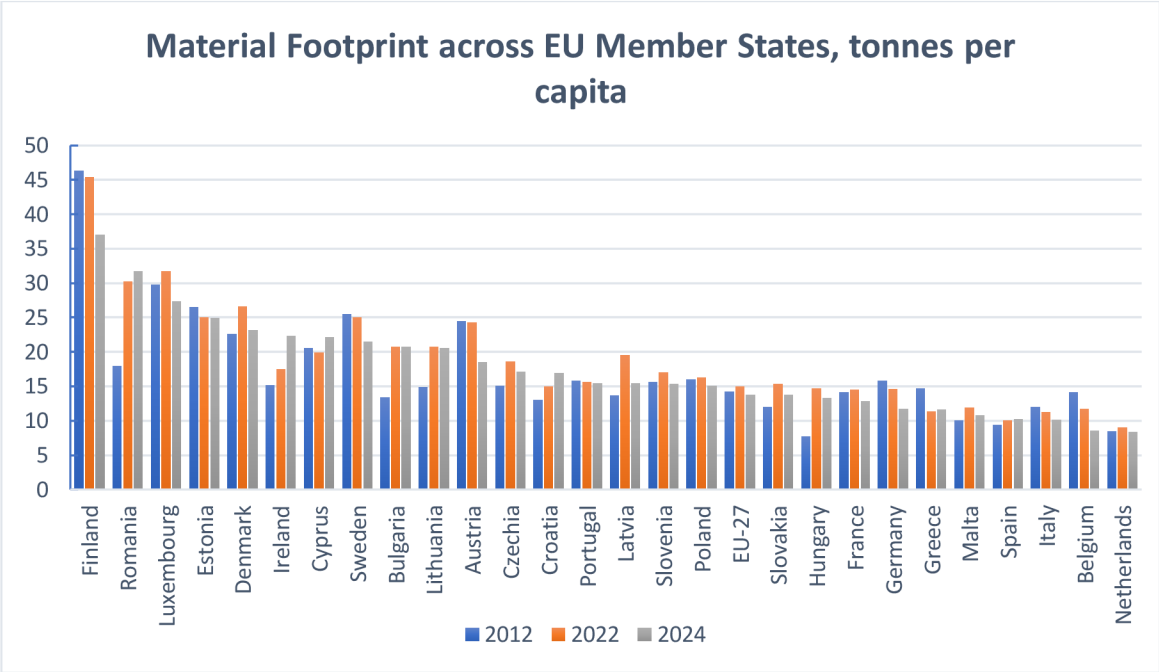

Figure 3. Material Footprint across EU Member States.

Source: Own elaboration based on Eurostat (2025f).

The Netherlands exhibit the lowest levels of material footprint achieved through implementation of strong circular policies embedded across numerous sectors. Leading the way with material footprint of 8.3 tonnes per capita in 2024, the Dutch government established high recycling rates for construction materials, set a national objective to reduce the use of primary raw materials by 50% by 2030, and promote product design for reassembly and recycling (Government of the Netherlands, 2019). Ireland could significantly reduce its material footprint in the built environment by strengthening landfill taxation, mandating the reuse of demolition materials, increasing recycling of construction waste and expanding green public procurement of refurbished materials.

5.2.2 Resource Productivity

The next indicator of the analysis is resource productivity, defined as the country's gross domestic product (GDP) divided by its domestic material consumption (DMC). This indicator shows how much economic activity is produced for every kilogram of material consumed as an input. An increasing trend of resource productivity over time means the country's economy is growing without additional consumption of resources, which suggests that material use is more efficient (European Environment Agency, 2025b). Decoupled economic growth from higher resource use is linked to the economy making efficiency improvements as a result of innovation or shifting extraction abroad. Resource productivity within the European Union increased by approximately 52% since 2000. Resource productivity in Ireland has been increasing steadily in recent years, and since 2000 it has more than doubled, exceeding the EU average. Despite the Covid-19 pandemic, the levels have steadily risen as Ireland's GDP did not contract as sharply, the imports of pharmaceutical products increased, and the DMC of materials did not grow (Eurostat, 2024b).

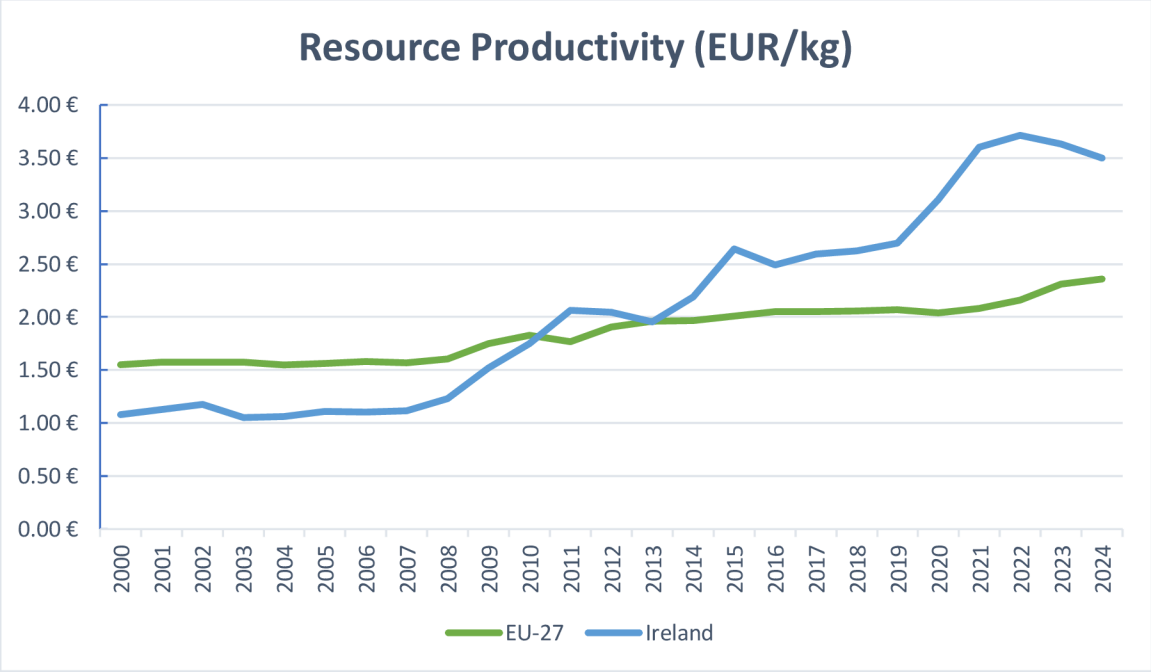

Figure 4. Ireland's Resource Productivity.

Source: Own elaboration based on Eurostat (2025m).

Ireland is a particular situation to analyse, as it has one of the highest GDP among European countries. Ireland's resource productivity reaches high levels due to its economic growth coming from high-value services and returns of foreign multinational corporations yielding high profits, without heavy use of physical resources. Combined with information technology and the

pharmaceutical industry, these transactions inflate Ireland's GDP and the real domestic consumption of biomass, non-metallic minerals, ores and fossil fuels remains minimal. Ireland's gross domestic product has seen steady growth over the recent years, reaching €562.8 billion in 2024, a large increase by approximately 2.6% from the previous year due to growing exports and consumer spending (Central Statistics Office, 2025b). Additionally, according to the Central Statistics Office (2024a) and OECD (2020a), the Irish population is expected to increase to approximately 7 million people by 2057, along with a proportional rise in demand for materials, energy, infrastructure and food. For a further analysis, the following graph depicts the distribution of GDP per sector.

Figure 5. Sectoral GDP in Ireland.

Source: Own elaboration based on Central Statistics Office (2025b).

The Figure 5 highlights that much of the apparent high resource productivity is not linked with an efficient use of domestic resources, but with a different structure of the economy. Ireland's GDP by sector reflects the value added through economic activities within each area. In the Irish context, although the category of industry including manufacturing accounts for a large share of the GDP, this reflects the pharmaceutical activities and ICT manufacturing, as well as the effects of multinational organizations relocating their intellectual property to Ireland. Being the 7th largest exporter of pharmaceutical products worldwide, this sector is one of the areas where the imports are the highest (Central Statistics Office, 2025b). These activities do not require much of physical domestic material, which causes an elevated picture of resource productivity. In addition, the activities of multinational companies are also reflected in the Information & Communication and

Administrative Services categories. A substantial share of the profits generated is often repatriated to parent companies abroad, indicating that a large share of GDP does not remain in the Irish economy. In conclusion, these activities also contribute to the overestimation of Ireland's resource productivity, resulting in elevated indicator values.

Policies to encourage resource productivity levels

In order to improve resource efficiency, the Irish government implemented the National Waste Prevention Plan (NWPP) in 2004, which embodied the vision of 'Towards a Resource Efficient Ireland', with an objective to decouple economic growth from environmental impact. The NWPP is mainly targeted reductions in waste generation and promoted efficiency improvement, for example the Sustainable Energy Authority of Ireland (SEAI) has overseen energy efficiency management through policy support and funding schemes. While these sector-specific efforts did make contributions, the programme lacked clear focus on improving material use efficiency and resource productivity.

To improve resource productivity levels, Ireland could draw policy lessons from Germany and Netherlands, who evidence the best performance concerning this indicator. In the German context, the German Resource Efficiency Programme (ProgRess), firstly adopted in 2012, established a framework taking into consideration the full life-cycle of a product, and integrating circular criteria into public procurement to increase efficiency. Between 2010 and 2012, Germany saw improvements in raw material productivity by 27% due to targeted policy interventions (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016).

Similarly, the Dutch government introduced the Dutch National Circular Economy Programme 2023-2030, which established circular measures that promoted secondary material markets, circular public procurement and industrial symbiosis. In addition, the Netherlands enhanced its resource productivity levels through initiatives like CIRCO, which assist businesses in designing products that are repairable, reusable and recyclable. This is important, as research shows that over 80% of a product's environmental impacts are determined at the design stage (Government of the Netherlands, 2023)

Therefore, the Irish government could strengthen its resource productivity performance by implementing stricter measures to publicly procure more secondary products to stimulate markets for recycled materials. Additionally, the government encouraging Irish businesses to integrate circular designs of their products, more circular products would be produced and consumed domestically.

5.2.3 Total Waste Generation per capita

The Circular Economy Action Plan (2020) aims to significantly reduce total waste generation across the EU by 2030, but as EU-27 GDP growth is predicted to increase in the future, it remains unlikely these targets will be met. Although the volume of recyclable waste almost doubled between 2010 and 2022 in the EU, construction and demolition waste increased by 100 kg per capita (European Environment Agency, 2025a). Ireland annually generates over 14 million tonnes of waste in total and the volume is progressively rising due to the construction and demolition activities and economic growth (Environmental Protection Agency, 2024b). Waste generation is a key indicator of circular economy, showing how much material is discarded and not kept in circulation. Waste generation is closely linked with circular material use rate, which will be analyzed as an individual indicator. According to the Directive 2008/98/EC, waste is defined as any substance or object which the holder discards or intends or is required to discard (Directive 2008/98/EC, 2008). The latest data that Eurostat reports on total waste management comes to 2022, when 2,233 million tonnes of waste were generated by all economic activities and households (Eurostat, 2024c). The following graph presents an overview of total waste generated by economic activities and households, including major mineral waste such as construction and demolition materials, other mineral wastes, soils, and dredging spoils (European Commission, 2023).

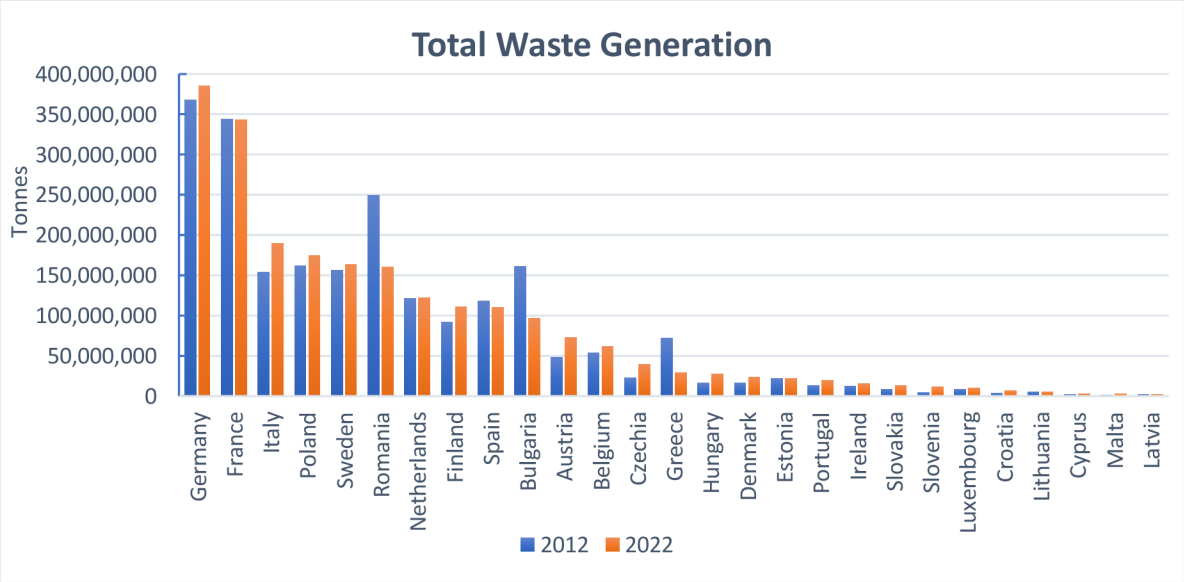

Figure 6. Total Waste Generation.

Source: Own elaboration based on Eurostat (2025e).

Germany ranked the first, with generation of 385 million tonnes of waste, while Ireland ranked 19th among other states. Despite the aforementioned EU's ambitions to reduce waste, Ireland continues

to produce large volumes of waste. Although Ireland's total waste generation is lower in absolute values compared to larger economies, it is significantly high relative to its population size and economy. For a more accurate comparison of total waste production across EU Member States, the following graph presents total waste generation in kilograms per capita.

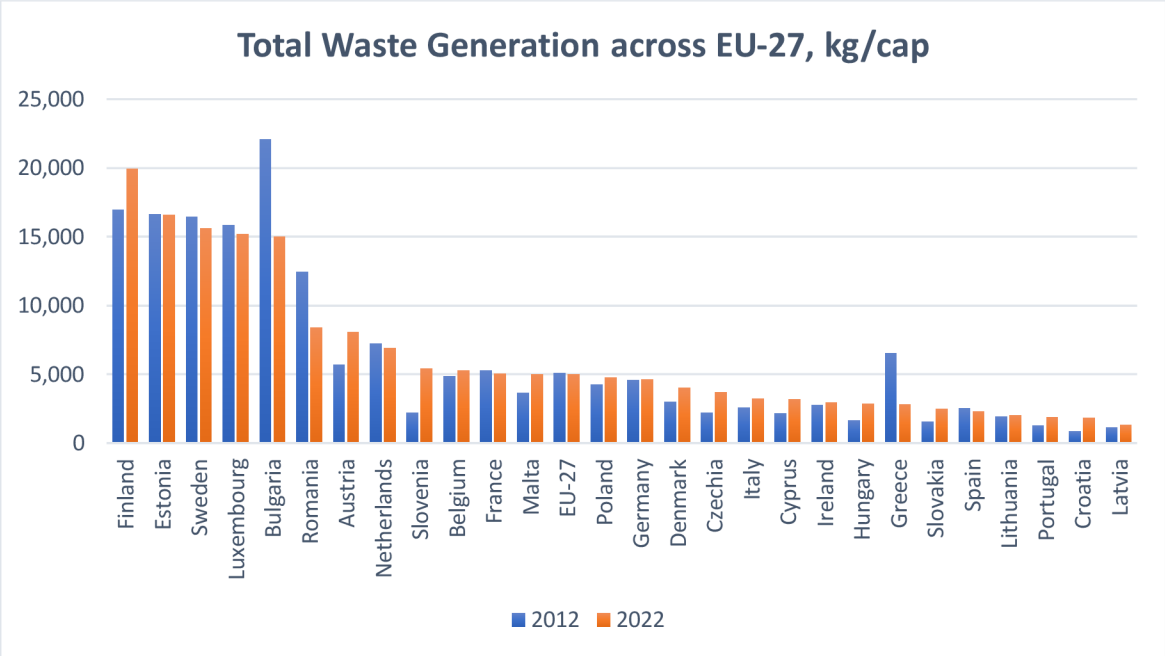

Figure 7. Total Waste generation across EU-27.

Source: Own elaboration based on Eurostat (2025e).

In 2022, the average EU citizen generated approximately 5 tonnes of total waste per capita, a figure that has remained relatively stable over the past decade. Between 2010 and 2022, total waste generation per capita decreased by only 26 kg, indicating a stalled progress in reducing overall waste volumes produced. A temporary decline occurred during the COVID-19 in 2020, however, waste volumes increased again by 2022. This also highlights the close link with waste generation and economic growth, as waste production rises with increasing GDP (European Environment Agency, 2024d). Figure 7 illustrates significant differences in individual economies. Finland records the highest waste generation in the EU, reaching almost 20 tonnes per capita, followed by countries such as Estonia and Sweden. It is noted that these values are explained due to a large share of major mineral waste produced due to heavy mining and construction activities within these countries. In contrast, Ireland ranks around the middle of the European states, as it reflects a considerably lower production of major mineral waste.

This also ties to the Irish national statistics. In 2022, 15.7 million tonnes of waste were generated in Ireland, with construction and demolition waste being the largest stream. While Ireland records lower

values of total waste generated per person than the EU average, this measurement is strongly influenced by particularly low levels of mining, quarrying and heavy industry operations. However, Ireland records high volumes of municipal waste per capita, which the analysis will reveal at a later stage.

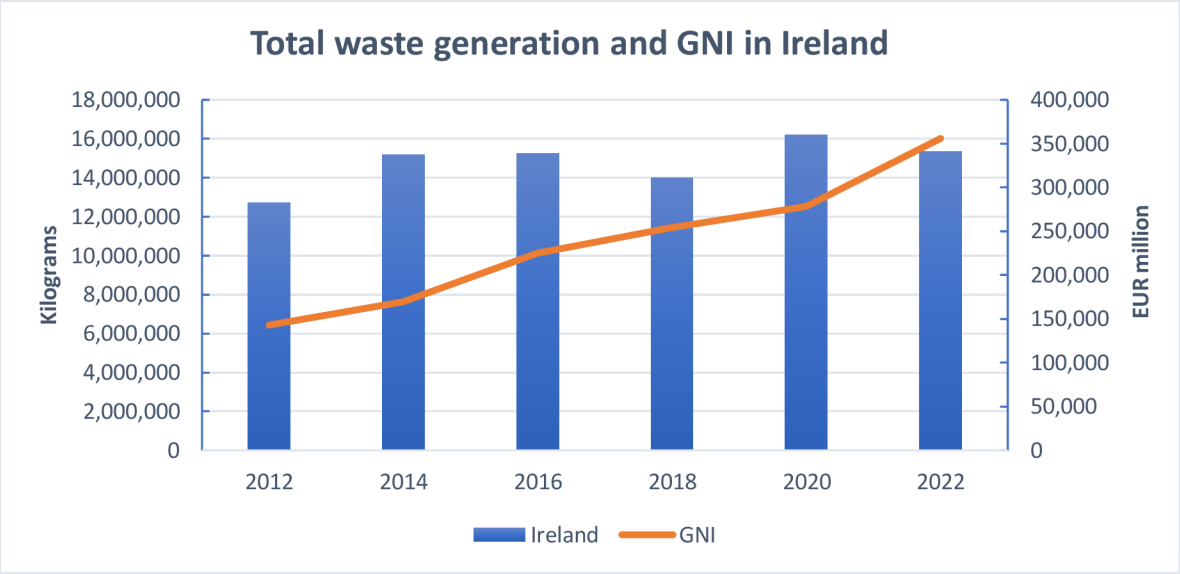

Figure 8. Total Waste Generation and GNI in Ireland.

Source: Own elaboration based on Eurostat (2025d) and CSO (2025a).

Figure 8 compares total waste generation in Ireland and Gross National Income (GNI) for the years 2012 to 2022, as comprehensive data were unavailable for the intervening years. It should be noted here that data regarding GNI were obtained from the Central Statistics Office of Ireland, as they were unavailable in Eurostat. The figure 8 illustrates a clear positive correlation between rising GNI and total waste generation in Ireland. As GNI increased over the period shown, domestic consumption of Irish stakeholders rises with increasing waste generation. This suggests that higher income levels of consumers foster a rebound effect, spurring greater consumption, resulting in greater volumes of waste generated. These patterns show that implementing more secondary materials circulating within the economy is crucial to decouple economic growth from waste production.

Waste Streams in Ireland

Furthermore, as waste generation rises across all main streams in Ireland, it is important to highlight that the most impactful and largest stream of waste is construction and demolition waste (C&D). The construction waste represents over 50% of total waste generated. All in all, total waste generation

has increased by 20% from 12.7 million tonnes in 2012, to over 17 million tonnes in 2021. This surge calls for a substantial improvement needed for a circular economy transition.

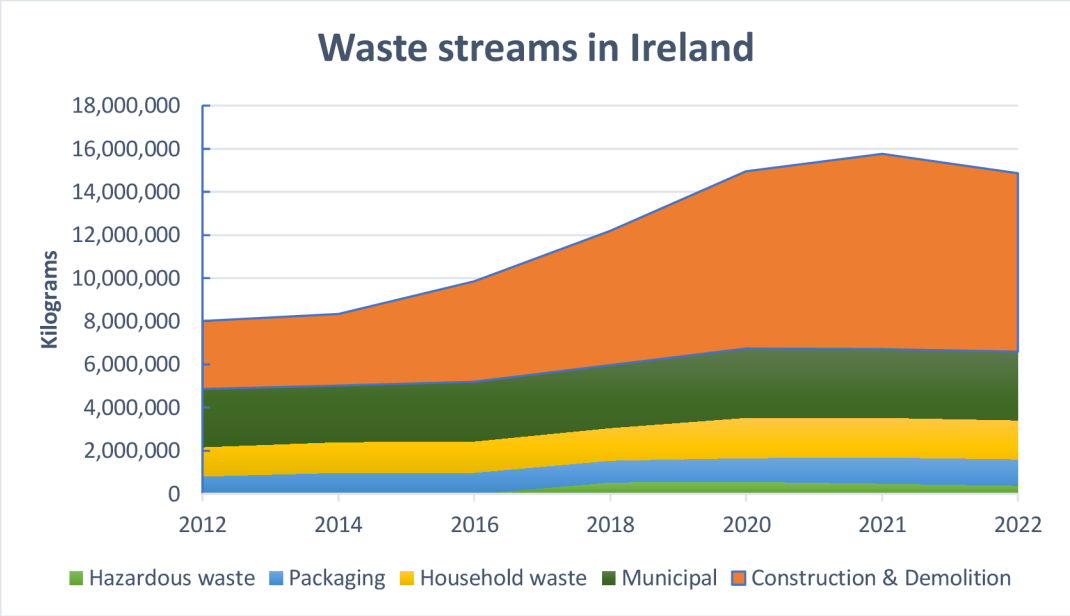

Figure 9. Waste Streams in Ireland.

Source: Own elaboration based on EPA (2025e).

Construction & Demolition Waste

In 2022, Ireland generated nearly 8.3 million tonnes of C&D waste. This figure rose to over 9 million tonnes in 2023. Of the total waste generated in 2023, only 11% was recycled, while approximately 75%, more than 6 million tonnes, was treated through backfilling. However, more than 80% of construction waste was composed of soil and stone, materials that can be reused in further construction (Environmental Protection Agency, 2025a). As the majority of this material is used for backfilling, it reveals missed opportunities to turn these materials into new products or landscaping. This presents a gap for Ireland in the built environment where more strategic use of soil and stone could have a significant reduction effect on waste production.

***Practical example*:**

The Environmental Protection Agency (2025b) lists three main challenges that are encountered in circular economy concerning construction and demolition materials in Ireland:

1) Lack of secondary materials markets. The availability of secondary markets offering recycled materials remain constrained, and limited supply hinders the opportunity for growth.

2) No confidence in secondary material markets. Cost savings are the highest priority during contracting and building. Virgin materials, often inexpensive and readily available locally, are typically preferred. Using recycled materials can also incur additional costs from testing and certifications. This reflects the current linear model in Irish construction space.
3) Circular designs are not yet common occurrence. Product designers focus on the user having the best experience, not prioritizing future disassembly or reuse (Environmental Protection Agency, 2025b).

National Criteria to support construction waste recycling:

The Environmental Protection Agency therefore enacted regulatory responses in form of national decisions to establish safe markets for secondary materials. This includes the National End-of-Waste Criteria, under which waste authorised facilities turn recycled C&D waste into non-waste products if they pass quality tests and are afterwards reintroduced into the economy as valid resources (Environmental Protection Agency, 2024c). Furthermore, the National By-Product Criteria (by-product regulation 27) aim to minimize extraction of virgin materials by classifying excavated materials (greenfield soil, stone, shredded asphalt) as by-products after safety checks – enabling direct reuse as secondary resources in construction, rather than landfilling or low-value backfilling (Environmental Protection Agency, 2024a).

A practical example of these challenges can also be seen in a LIFE project '*Recovering and recycling construction and demolition waste*' (DemCon 20/20), which demonstrated that even high-quality recyclates can be difficult to reuse, because the secondary material markets are underdeveloped and contractors are hesitant about their quality, leading to builders purchasing cheaper, raw primary materials (European Climate, Infrastructure and Environment Executive Agency, 2002) As these challenges still persist today, the Irish government introduced a waste recovery levy in 2024, imposing a €10 charge per tonne of municipal waste sent to waste-to-energy and incineration plants (Government of Ireland, 2024). The recovery levy also applied to construction and demolition waste from the 1st of January 2025. Through the introduction of this regulation, the Irish government sought to incentivize contractors to sort C&D waste on-site rather than sending mixed C&D waste for incineration, thereby increasing recycling and supporting secondary material markets.

5.2.4 Municipal Waste

According to the Directive 2008/98/EG and Directive (EU)2018/851, municipal waste is defined as mixed waste and separately collected waste from households and from other sources, such as retail, administration, education, health services, accommodation and food services, which is similar in

nature and composition to waste from households, excluding waste from production, agriculture, forestry, fishing, end-of-life vehicles or construction and demolition waste (Directive 2008/98/EC, 2008; Directive (EU) 2018/851, 2018). The following graph includes data obtained from the Environmental Protection Agency, as for certain time periods data from Eurostat were unavailable and incomplete.

Figure 10. Total Municipal Waste generated in Ireland.

Source: Own elaboration based on EPA (2025e).

Between 2016 and 2023, municipal waste in Ireland increased from 2.7 million to 3.13 million tonnes, averaging approximately 3 million tonnes since 2019 (Environmental Protection Agency, 2025e). According to EPA, 45% of municipal waste generated in 2023 was exported for treatment, while further 43% was incinerated. Although the data for the most recent years are not yet available, EPA concludes that under the current waste generation patters, Ireland is unlikely to meet the EU municipal recycling targets of 55% by 2025 (Environmental Protection Agency, 2025d).

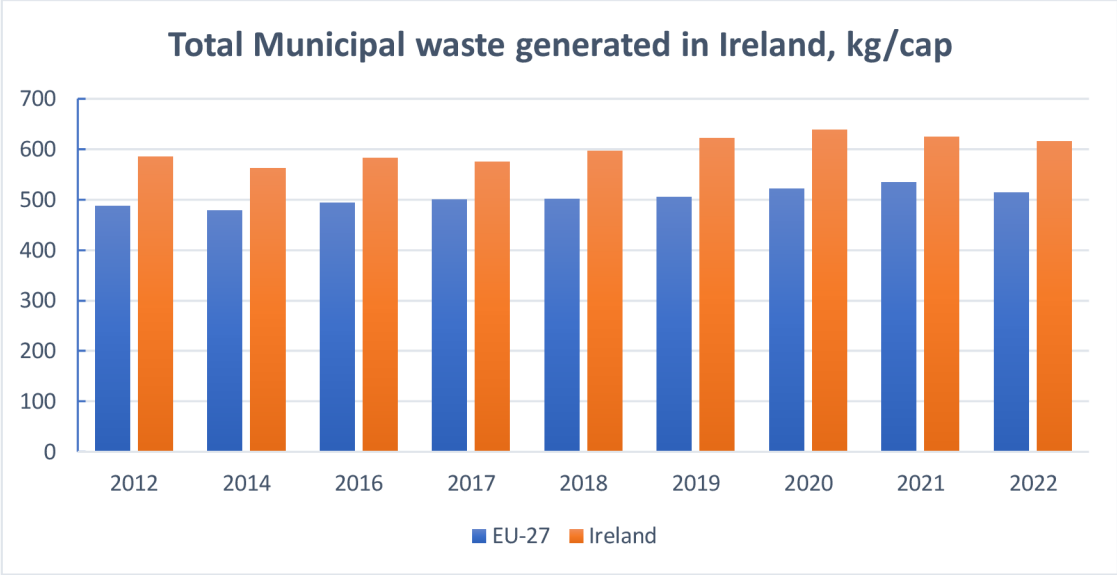

Figure 11. Total Municipal Waste generated in Ireland, kg/cap.

Source: Own elaboration based on Eurostat (2025h) and EPA (2025e).

In the Figure 11, the municipal waste generation shows an increasing trend with a significant increase in 2020 driven primarily due to accumulated waste production from households during Covid-19 isolation. The per capita rate in 2020 rose to 638 kg, which is 22,5% above the EU average of 521 kg (Eurostat, 2025i). This difference translates to approximately 600,000 extra tonnes generated nationwide, based on the rough estimate of Ireland's population of 5 million people in the same year. In 2022, Ireland generated almost 3.2 million tonnes of municipal waste, of which 55% came from households and 45% came from commercial and public service sources, resulting into 8kg per person a day. Only 1.3 million tonnes of this amount – 41% of the total – was recycled in 2022, confirming a significant shortfall to meet the EU recycling target of 55% by 2025 (Environmental Protection Agency, 2025f). Ireland consistently records higher rate of municipal waste generation per person than EU average. While the volumes of waste are increasing, the recycling rates experience a long-term stagnation with no change in the last 10 years. Recycling rate of municipal waste is further elaborated in the chapter on circular material use rate.

Comparison with EU member states

For an accurate comparison of Ireland, the following graph compares Ireland's municipal waste generation per capita across EU member states to provide an international context. However, it is acknowledged that Eurostat does not report on data of municipal waste generation per capita for Ireland in 2021, 2022 and 2023. Consequently, Ireland's data for 2022 was derived from a national dataset published by the Environmental Protection Agency (Environmental Protection Agency,

2025e). The year 2022 was selected for analysis as it represents the most recent year for which comparable data are available.

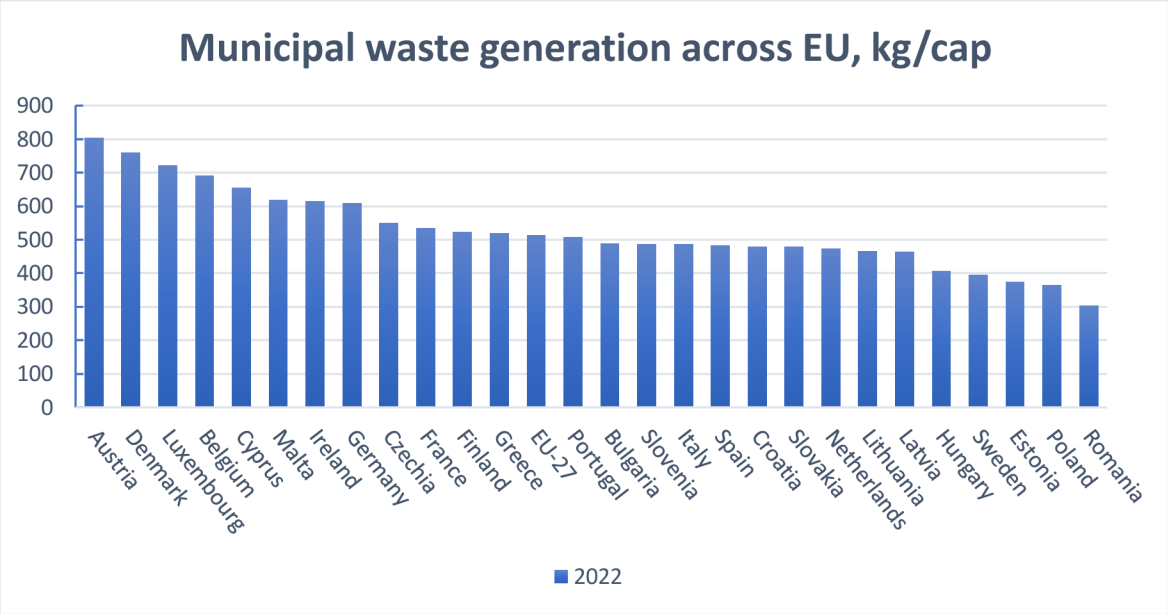

Figure 12. Municipal Waste generated across EU-27.

Source: Own elaboration based on Eurostat (2025h) and EPA (2025e).

For 2022, the EU average of municipal waste generation per person was 514 kg, while there are substantial variations across the states depending on their economic growth and consumption patterns. Austria, Denmark, Luxembourg and Belgium record the highest volumes of municipal waste not only due to higher income levels and fast economic growth, but also due to higher household consumption. Ireland's seventh place with 615 kg of waste produced sits above the EU average, which underscores the necessity for reduction of waste generated. On the other side of the spectrum, lower levels of waste generation were reported in several eastern European countries, which mainly reflects their different economic structures and lower household consumption. This may also be influenced by a different approach of municipal waste collection systems and the classification of waste streams, also having an effect on final reporting of the amounts (Eurostat, 2025i). It is important to note that some countries collect and manage waste with different methods, and may cover a broader set of waste streams, while other countries may exclude certain categories, which may have a slight influence on the resulting figures.

Ireland's reliance on waste exports

Being an island nation, the persistent higher rates of waste generation are also linked to heavy dependency on landfilling and export of waste. Ireland faces significant gap in waste infrastructure as the local waste treatment facilities are unable to handle the waste volume and therefore the country experiences a lack of self-sufficiency. In 2022, approximately 1.2 million tonnes of municipal waste and 220,000 tonnes of hazardous waste was exported to other European countries, which was a sharp increase by 39% from the previous year (Environmental Protection Agency, 2024b). This is 45% of all municipal waste generated in the country going abroad to be recycled. Roughly 49% of this amount was recycled by other states, 36% of waste was exported for energy generation through incineration to heat for other states' households and businesses, and 11% went for composting (Environmental Protection Agency, 2025f). To provide a more accurate picture of the impact of these exports, 222,150 tonnes of plastic packaging was incinerated, creating almost 600,000 tonnes of CO2 emissions (Environmental Protection Agency, 2024b). In this context, it should be noted that according to the State of the Environment Report by the Environmental Protection Agency, Ireland operates three residual waste landfills for disposal and recovery, and two municipal waste-to-energy facilities, with no landfill or incinerator for hazardous waste. As these facilities have insufficient capacities to handle the volume of waste generated, continued waste generation will exacerbate these weaknesses (Environmental Protection Agency, 2024d).

In conclusion, in a high-income country, such continued reliance on waste exports remains unsustainable and the absence of universal segregation systems across the country significantly constrains effective recycling. This presents a high risk in case of unforeseen events, natural disasters and market shocks. Well-functioning waste collection infrastructure and improved packaging design of plastics firstly require targeted government investment, which is essential to integrate more of reusable and recyclable materials to the supply chain (Climate Change Advisory Council, 2025).

5.2.5 Food Waste

According to the Waste Framework Directive 2018/851, the European Commission defines food waste as any food or substance, raw or cooked, that is discarded or intended to be discarded (Directive (EU) 2018/851, 2018). The generation of food waste imposes a significant environmental burden through consumption of natural resources and the emissions generated from the production and transportation of food that is ultimately discarded. Food waste in Ireland also causes a significant issue, as the Environmental Protection Agency estimates that 700,000 tonnes were generated in 2022, equivalent to 145kg per capita, exceeding the EU average of 130 kg per capita in the same year. (Environmental Protection Agency, 2024b). Data for 2023 suggest a further escalation, as food waste

generation in 2023 increased to 835,000 tonnes, of which Irish households discarded 221,000 tonnes at an average annual cost of €700 per household. This resulted in a national cost of €1.29 billion.

Ireland has taken targeted action steps to curb food waste through the National Food Waste Prevention Roadmap 2023-2025, aiming for a 50% reduction by 2030 (Department of Climate, Energy and the Environment, 2022). At the beginning of 2024, Ireland implemented a nationwide roll out of brown bins for collecting organic waste to household and commercial properties. However, the figures above indicate significant room for improvement, as a large proportion of organic waste continues to be placed in mixed waste bins. In addition, after the 2025 amendment of the Waste Framework Directive introduced a new binding targets of 10% reduction of food waste in manufacturing and a 30% per capita reduction at retail and consumption, Ireland is obliged to adapt, which strengthens its Roadmap efforts to align with this requirement (Directive (EU) 2025/1892, 2025).

5.2.6 Packaging and Plastic Packaging Waste

Under the new Packaging and Packaging Waste Regulation (Regulation (EU) 2025/40, 2025), packaging includes sales packaging, grouped packaging and transport packaging, and it covers materials like plastics, paper, glass, metals, wood and composites. All packaging becomes waste when it is discarded or intended for disposal, in line with the definition set out in the Directive 2008/98/EC (Directive 2008/98/EC, 2008). Packaging waste remains as one of the largest growing waste streams in Europe. As a result, European Commission under the Packaging Waste Directive 2025 established new binding targets for all Member States to follow and reach by 2030:

- 70% of all packaging waste to be recycled
- 85% of paper and carboard
- 75% of glass
- 60% of aluminium
- 55% of plastic
- 30% of wood

Despite of having a common legislative framework, significant differences occur across the EU states with different consumption behaviours. To assess Ireland's performance in a broader European context, the following graph shows its position to better identify its areas of improvement.

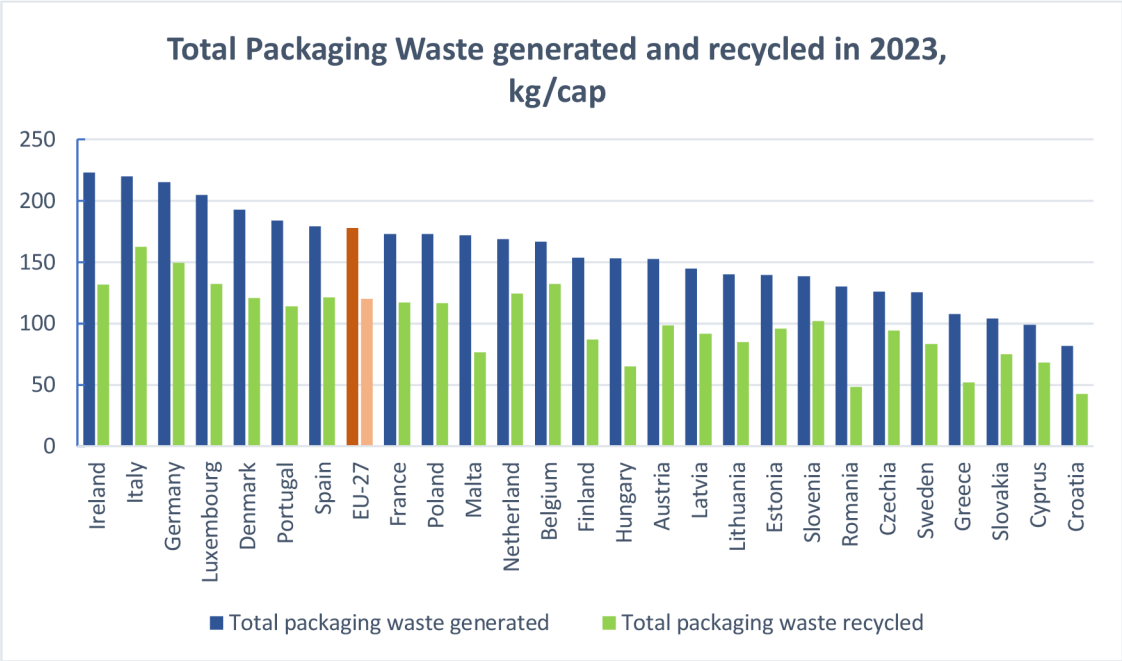

Figure 13. Total Packaging Waste generated and recycled in 2023.

Source: Own elaboration based on Eurostat (2025j).

In 2023, the European Union generated 79.7 million tonnes of packaging waste, equivalent to 177.8 kg per capita. In the same year, Ireland produced approximately 1.2 million tonnes of packaging waste, corresponding to 223.1 kg per capita. This positioned Ireland as one of the highest per capita generators of packaging waste, highlighting the high consumption of packaging and the need for improvement compared to the EU average. Several Member States achieved the 70% recycling target in 2023, including Belgium, the Netherlands, Italy, Czechia, Slovenia and Slovakia, all of which reported recycling rates above this threshold. In Ireland, 131.6 kg of packaging waste per capita was recycled out of the 223.1 kg packaging waste produced. However, the recycling rate reached only 59%, which is below the EU average. The Environmental Protection Agency reports that Ireland's packaging waste recycling rate stood at 67% in 2016 but with generation levels rising by 20% since then, reaching the desired target for 2030 seems highly unlikely (Environmental Protection Agency, 2025g).

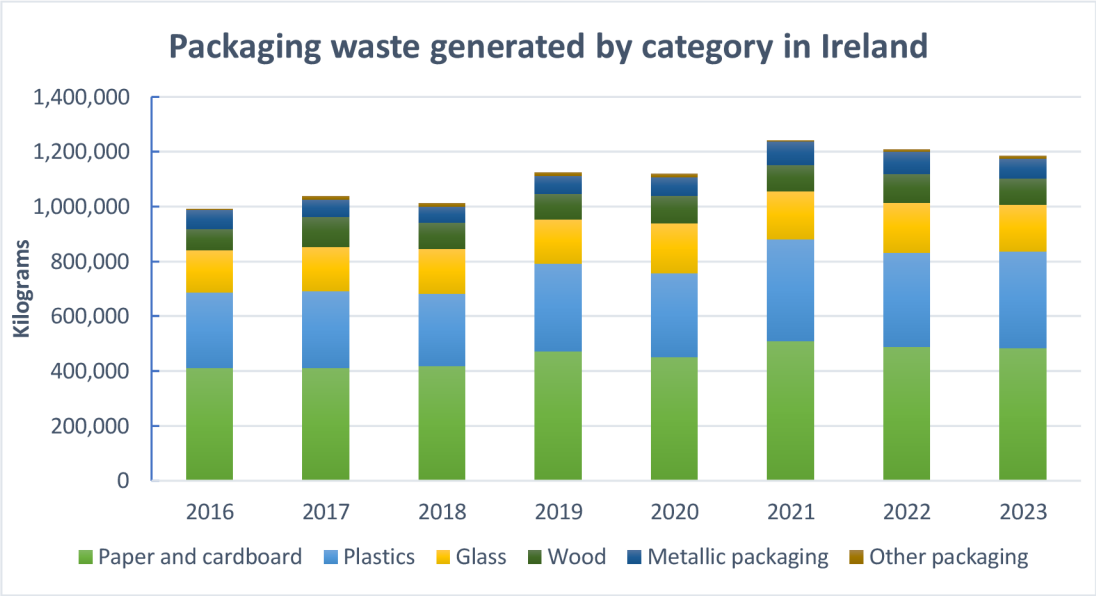

Figure 14. Packaging Waste generated by category in Ireland.

Source: Own elaboration based on EPA (2025g).

It is important to note that Ireland has successfully met the 2030 recycling targets set by Regulation (EU) 2025/40, achieving 83% for glass packaging compared to the required 80% and 50% for wood packaging against the mandated 30% by 2030. (Environmental Protection Agency, 2025g).

Plastic waste

Ireland's circular performance is predominantly constrained by plastic packaging waste. Plastic packaging waste includes all plastic materials, particularly single-use plastics that are discarded after one use. European Commission defines single-use plastics as any packaging that is designed to be used only once and is not reusable again (Directive (EU) 2019/904, 2019). Under the Directive (EU) 2019/904, Ireland cannot place certain single-use plastic products on the market, such as cotton bud sticks, cutlery, plates, stirrers, balloon sticks and straws on the market. The following graph illustrates the stagnation of recycling rates of plastic packaging waste in the period of 2021-2023. Despite of the Deposit-Return Scheme implemented by the Irish government, these rates reflect the dominant reliance on incineration for energy recovery and insufficient waste separation infrastructure, which reduces the capacity to recycle plastics in mixed waste.

Figure 15. Plastic Packaging in Ireland.

Source: Own elaboration based on EPA (2025g).

The Environmental Protection Agency lists that 98% of all packaging placed on the Irish market consisted of single-use packaging – equivalent to approximately 1,186,000 tonnes, while reusable packaging accounted for less than 2% (Environmental Protection Agency, 2025g).

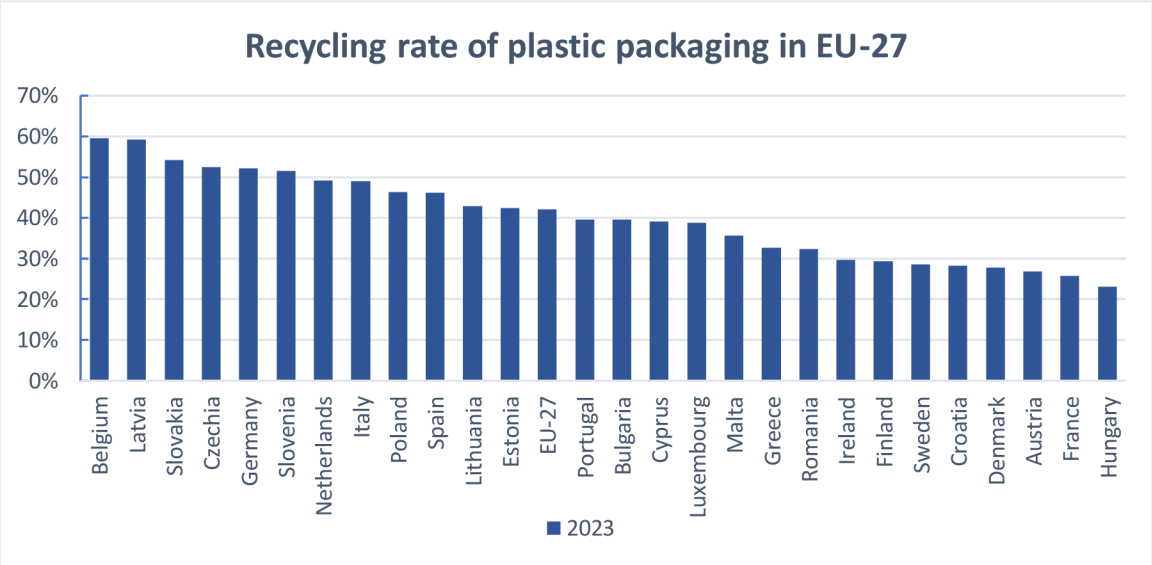

Figure 16. Recycling Rate of Plastic Packaging Waste in EU-27.

Source: Own elaboration based on Eurostat (2025j).

In order to effectively analyse Ireland's position, its insufficient performance in recycling rate of plastic packaging waste is compared to other European countries. In 2023, the recycling rate reached

29.6%, placing the nation eighth from the bottom among EU Member States. These figures highlight how rising waste generation effectively offsets recycling rates in Ireland.

Challenges in Plastic Packaging

High generation of plastic packaging waste in Ireland is also due to high dependence on packaged imported products and low public awareness of what is recyclable. An EPA research report (2022a) indicates that 21% of consumers rarely or never wash plastic packaging before disposal, which causes contamination of recyclable materials, rendering them unsuitable for recycling and directing them to incineration instead. Although consumers claim they are willing to pay slightly more for a sustainably packaged product, their purchasing decisions are affected by confusing sustainability labels and a lack of comprehension of recycled contents.

On the production side, it is clear that companies see the shift to circular economy as a more strategic direction in the future, while accepting that sales performance and consumer acceptance is the priority. Producers list that uncertainty, lack of recycling facilities and a lack of clear guidance on how to incorporate recyclates into their packaging are the main barriers. Nevertheless, as fees are expected to rise under the new Packaging and Packaging Waste Directive and the Single-Use Plastics Directive, the financial pressure to redesign packaging to be more recyclable will increase. In this context, producers and waste processing operators need to establish a stronger cooperation, fostering better communication. Therefore, public awareness campaigns on the benefits of recycling and composting should be strengthened and conducted more frequently. The degree of recyclability of packaging should also be communicated more transparently. Improved guidance documents should be developed to help producers design recyclable packaging. Lastly, the national governments should organize more conferences, workshops, and webinars to connect packaging providers, producers, waste processors, and policymakers in their respective states (Environmental Protection Agency, 2022a).

5.2.7 Circular Material Use Rate

Circular material use rate (CMUR) is defined as a share of recycled materials fed back into the economy and is calculated as the ratio of circular use of materials to the overall material use (European Commission, 2018). CMUR is the headline indicator of the EU's Monitoring Framework, as it captures recycling flows of an economy, but it needs to combined with other critical aspects such as GHG's emissions production and resource productivity. Therefore, the CMUR should be evaluated with this awareness and in conjunction with other factors and metrics (McCarthy et al., 2024).

As outlined in the Circular Economy Action Plan, the EU aims to double its CMUR to around 22.4% by 2030, combining ambitions from the Clean Industrial Deal, Critical Raw Materials Act and the forthcoming Circular Economy Act. From 2010 to 2024, the EU average of CMUR increased by 1.5 percentage points to 12.2%, marking a slight improvement, but this indicates that EU is off-track to meet its circular ambitions. Meeting this target would require a 1.7% annual increase, which exceeds the progress achieved over the twelve-year period from 2012 and 2024 (European Environmental Agency, 2025b). However, the Commission acknowledges that significant financial investments in further circular innovations are needed, and seeks to accelerate progress through the upcoming 2026 Circular Economy Act, by harmonising end-of-waste criteria, stimulating a higher supply of recyclates in the economy and expanding producer responsibility (European Commission, 2025b). For the purpose of a critical assessment, it is important to highlight that increasing recycling rates alone will not be sufficient to reach EU's targets, as material demand is projected to rise. This necessitates a paradigm shift toward reducing primary extraction, while at the same time scaling circularity throughout supply chains.

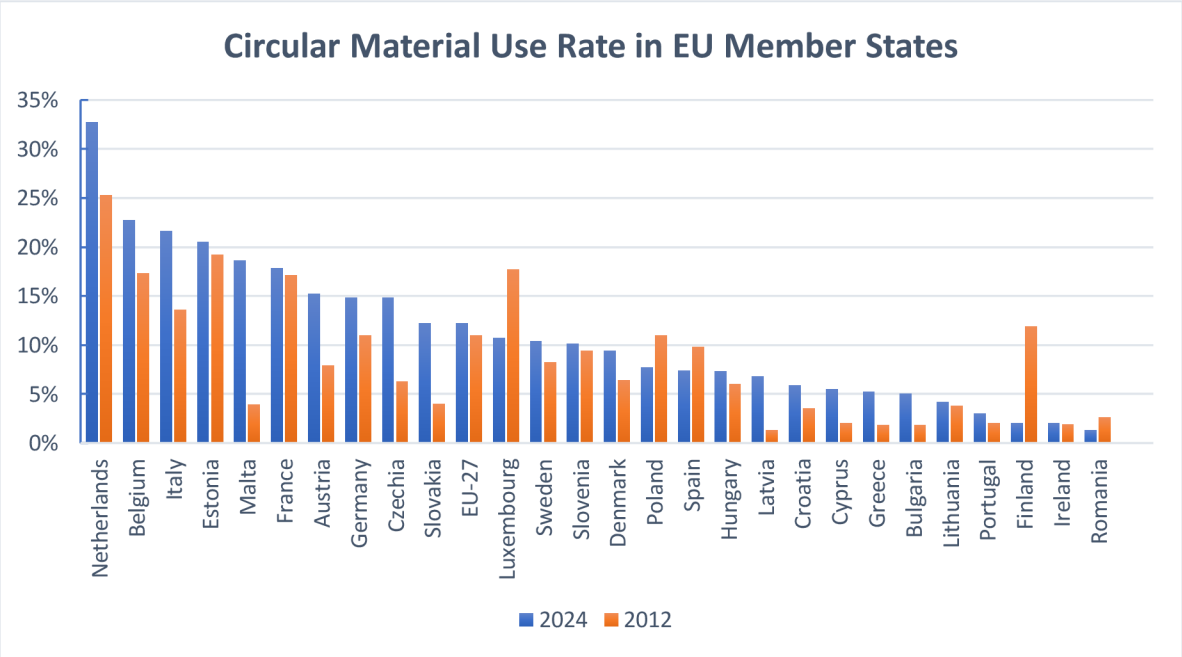

Figure 17. Circular Material Use Rate in EU Member States.

Source: Own elaboration based on Eurostat (2025a).

The comparison of circular material use rates across EU Member States reveals considerable structural varieties. The Netherlands with 32.7% and Belgium with 22.7% CMUR demonstrate that the EU targets are attainable through having robust policy frameworks in place, with implementation of supportive legislation towards circular economy and a well-developed infrastructure for recycling

and for circular practices for private enterprises. In contrast, Luxembourg and Finland record decreases in CMUR, which can be attributed to high primary material extraction and limited secondary materials usage. In comparison with other countries, Ireland scores poorly in this context, achieving a circularity rate of only 2% in 2024.

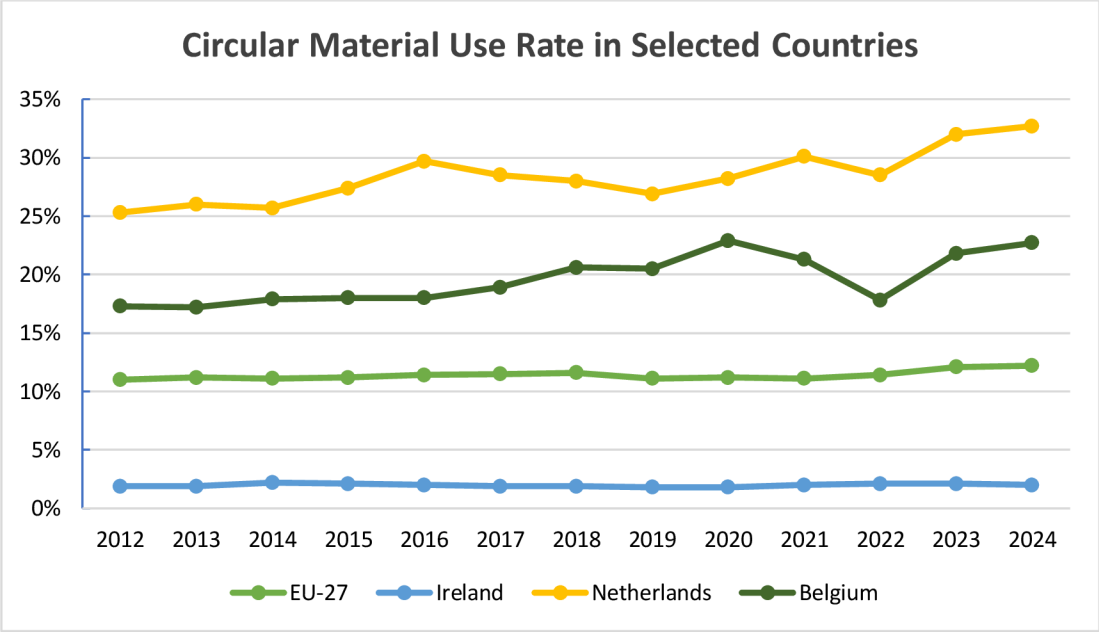

Figure 18. Circular Material Use Rate in Selected EU Member States.

Source: Own elaboration based on Eurostat (2025a).

From Figure 18, we can see that Ireland shows no significant change in CMUR over the period 2012 to 2024, remaining consistently below EU average. This performance is exacerbated due to waste generation outpacing the recycling capacity and inadequate waste management infrastructure. Without proper waste separation and collection systems in place, no improvements can be done. For a more meaningful comparison, the Netherlands and Belgium were selected for comparison in Figure 18, as both represent relatively small, high-income economies with dense construction activity, high DMC and strong trade connections, making them a comparable example to Ireland. Despite these similarities, Netherlands and Belgium have the highest rates of CMUR in Europe. This is largely due to a very well developed recycling infrastructure, strict landfill restrictions and strong markets for secondary materials (Government of the Netherlands, 2016).

The decline observed in the 2020 time period is primarily attributed to Covid-19 pandemic, due to widespread disruptions in the Member States economies and the construction sector, effecting industrial productivity and trade flows. International material flows were restricted, therefore the amount of recycled materials in circulation was reduced, leading to a reduction of CMUR in this

period. Ireland's CMUR in 2020 stayed relatively the same, which reflects the already high dominance on primary materials.

Figure 19. Ireland's Municipal waste generated and recycled.

Source: Own elaboration based on EPA (2025e).

In the context of circular material use rate, it is noteworthy to include recycling rates of municipal waste in Ireland. Ireland's recycling rate of municipal waste records stagnation at approximately 41% from 2012 to 2023 as depicted in Figure 19, which underscores its underperformance relative to other EU countries. The Environmental Protection Agency also assesses that Ireland is highly unlikely to reach EU circular targets, as it would require 400,000 additional tonnes of waste recycled every year (Environmental Protection Agency, 2025e). Compounding this, Ireland is among the countries with the lowest circularity rate also due to its high domestic consumption per capita, particularly in the biomass sector. The Critical Analysis of Ireland's Circular Material Use Rate (2024) produced following recommendations to reach a higher score in CMUR, where Ireland can take advantage of its missed economic opportunity:

- **Development of biomethane infrastructure**

  As 69% of terrestrial area of Ireland is used for agricultural activities, this sector accounted for 6.1% of total employment in 2024 and 33% of GHG emissions. As the agri-food sector generates approximately 40 million tonnes of manure annually, the home-grown biomethane industry has a great potential to reduce GHG emissions and heat thousands of homes in the

country (Brennan et al., 2015). Significant financial investment into establishment of bio-refining infrastructure across Ireland would also have a positive effect on Ireland's circularity rate. Using biomethane as an energy source would increase the CMUR score, given that expansion of regional gas infrastructure would be required for a successful injection into the gas network. (McCarthy et al., 2024).

- **Policy interventions in construction and demolition projects**
  Introduction of stricter requirements to separate materials in C&D sector for further recycling is needed. This should be coupled with establishment of a digital marketplace for secondary materials, which is necessary to foster confidence in recyclates and set regulatory clarity. Making recycled materials financially attractive is essential, while a skilled workforce is required to support design-phase planning for waste prevention (McCarthy et al., 2024)

Ireland's efforts in increasing CMUR

Despite its persistently low scores of circularity rate, Ireland has undertaken targeted initiatives to advance circularity:

- **Green Public Procurement Strategy and Action Plan 2024-2027**
  Under this outlined plan, Ireland's government strives to embed circular practices in green public procurement to procure sustainable goods and materials that can be reused within the economy to achieve a reduced environmental impact. (Department of the Environment, Climate and Communications, 2024). As an example, the government invested in a transition to more energy-efficient LED lightning system in the Environmental Protection Agency headquarters, which resulted in total financial savings of approximately €339,282 over 18 years, helping the state avoid an estimated €570,940 in future maintenance and replacement expenses (Environmental Protection Agency, 2025c).
- **Circular Economy Innovation Grant Scheme (CEIGS)**
  The government-led scheme initiated by the Ireland's Department of Climate, Energy and the Environment (DECC) in 2021 provides financial support to community groups, SMEs and social enterprises to fund circular innovation projects in various areas, such as food waste, textiles, single-use plastics, packaging and construction. These financial grants are coming from the national budget and are managed by the DECC. Since 2021, 50 projects received funding in total amount of €2.44 million (Department of Climate, Energy and the Environment, 2026a).

- **National Deposit and Return Scheme**

  The money-back scheme for plastic bottles and aluminium cans was introduced in 2024 to boost recycling rates. By February 2026, 2.4 billion plastic containers have been returned, supporting recycling efforts like in other European countries, such as Slovakia, Germany, the Netherlands, Denmark etc. (Department of Climate, Energy and the Environment, 2024).

5.2.8 Competitiveness and Innovation

The dimension of competitiveness and innovation measures how circular activities contribute to innovation, value creation and investment, using relevant economic indicators. By including this dimension in the framework, policymakers are better equipped to make more informed decisions by understanding barriers and opportunities within their circular economy policies (Eurostat, 2026b).

Private investments and gross value added

This indicator tracks the total gross investment in tangible assets made by businesses operating in circular economy sectors – recycling, repair and reuse, rental and leasing. This does not include investments in intangible assets or financial assets. This indicator shows the financial commitment of the EU to circular economy. The European Union recognizes that in order to successfully transition to circular economy, it will require a significant amount of private capital invested into the circular solutions that are widely scalable across all Member States. From a broader perspective, the European Environmental Agency lists that to achieve EU's circular economy objectives, approximately €170 billion per year will be the required investment. Based on this estimation, the EEA identifies an investment shortfall of around €29 billion in 2024, given an estimated financing baseline of €141 billion for the year (European Environment Agency, 2025d). The following graph shows the gross value added and investments made into recycling, repair and reuse sector in percentages. For a meaningful comparison, percentage of gross domestic product (GDP) is preferred to account for different sizes of certain economies within the Union.

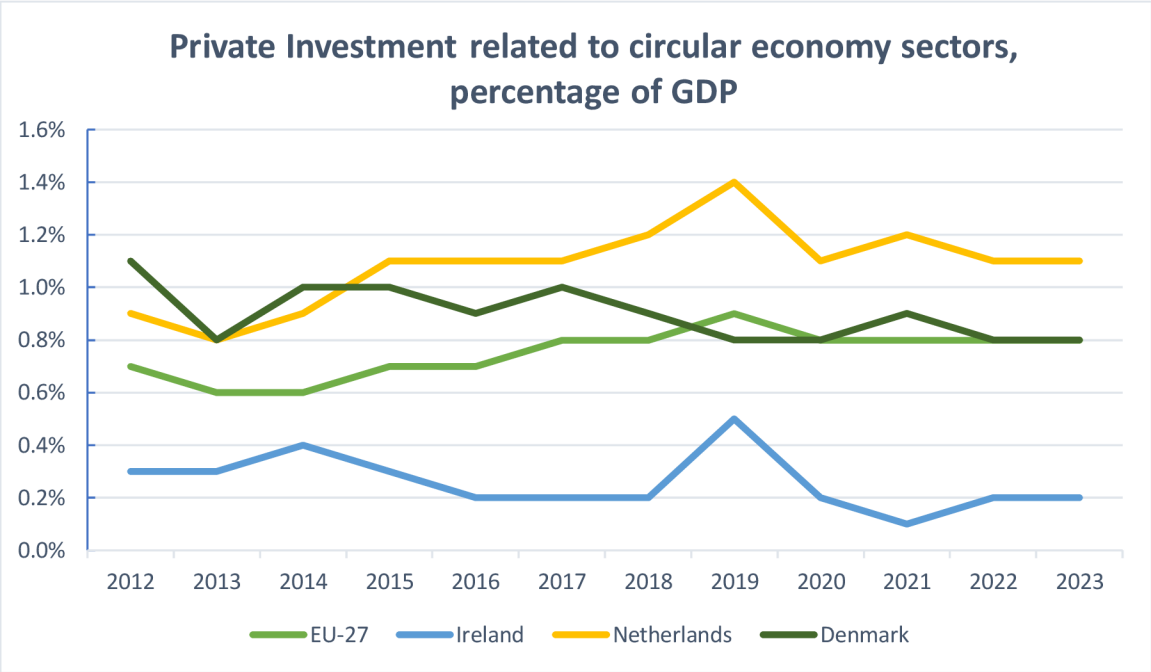

Figure 20. Private Investment related to Circular Economy Sectors.

Source: Own elaboration based on Eurostat (2025l).

Figure 20 shows Ireland's gross investment compared to the EU average, Denmark and the Netherlands. The Netherlands is included as a leading circular economy performer and acts as a best-practice reference, while Denmark was selected due to its similarly structured economy with high income levels and a strong service sector. From figure 20, it can be observed that Ireland's share of investment going into circular economy sector is below EU average, which is consistent with previous findings that domestic recycling and recycling infrastructure within the country is underdeveloped. Overall, gross investments in circular economy sector are very low between 2012 and 2023. However, it is noted that a significant share of Irish GDP is primarily generated by multinational companies, therefore, circular investment measured relative to GDP is low because it is not linked to domestic material use, waste generation and recycling. The observed spike in 2019 when Ireland's investments reached 0.5% of GDP is linked to an increased generation of policies targeting circular economy. According to the Environmental Protection Agency, Ireland's circular economy gained investments mainly due to National Waste Prevention Programme (NWPP), as it invested more than €1.5 million into circular practices and projects, directly supporting CE development (Environmental Protection Agency, 2020). Higher investment levels in Netherlands and Denmark may reflect the fact that both countries introduced circular economy strategies earlier and developed broader policy frameworks for waste prevention, recycling and on development of waste infrastructure than Ireland.

Ireland's financial support initiatives to support gross investments in circular economy

As discussed in the theoretical section, the transition to a circular economy depends not only on the establishment of the regulatory framework but also on targeted financial support that helps firms and SMEs overcome the high costs associated with circular investments. An EPA research (2022b) reveals that Irish SMEs face substantial difficulties with being uncertain of the financial benefits of circular activities and low expected returns on investment. However, the research points to a high levels of consumer interest in circular business models, with a strong willingness to engage in take-back schemes, repair services and the purchase of refurbished goods. The EPA study also highlights considerable differences across sectors in the context of companies transitioning to circular business models (Environmental Protection Agency, 2022b).

In Ireland, despite evidence indicating that the share of gross investment in circular economy activities is low relative to GDP, a range of financial mechanisms within Ireland are established to support circular models:

- **Enterprise Ireland:**

  Enterprise Ireland is the government's business development agency helping Irish companies with scaling their enterprises and growing their operations through R&D support, capital grants and funding. Within Enterprise Ireland, the Green Transition Fund and Environmental Aid Scheme serve as funding mechanisms that directly support Irish businesses to become more sustainable and resource efficient (Enterprise Ireland, 2024a). Since 2022, Enterprise Ireland invested approximately €55 million to support decarbonisation, waste reduction and sustainable production (Enterprise Ireland, 2024b).
- **IDA Ireland:**

  Industrial Development Authority (IDA) Ireland acts as the primary state agency bringing direct investment into Ireland. Increasing FDI has a positive correlation to creation of new jobs, which stimulates private investment, raising gross value added as firms increase production and become more circular. For example, Zimmer Bionet's introduced its Zero Waste to Landfill program, aiming to eliminate landfill waste, and invested in a digitalisation system replacing paper, which saves approximately 6,600,000 pages every year (IDA Ireland, 2024).
- **Circular Economy Fund:**

  The Circular Economy fund was officially established under the Circular Economy and Miscellaneous Provisions Act 2022 and is financed by the environmental levies on plastic bags, waste recovery and landfill fees. In 2025, €27 million was allocated towards the CE

transition, directly funding organisations and local authorities to use circular practices in their operations, such as smarter waste reduction strategies, increased recycling and more efficient material use (Department of Climate, Energy and the Environment, 2025a). These investments not only encourage circular models, but have a wider impact. By implementing more innovative circular solutions, the companies reduce their costs, allowing them to invest in more efficient production, which may result into hiring additional staff to manage circular supply chains or develop new circular products. Therefore, these activities have a direct positive effect on gross value added while attracting investors looking to fund businesses that are leveraging their sustainability goals to scale.

- **Circuléire*:***
  Circuléire is a public-private partnership led by Irish Manufacturing Research (IMR), and co-created by DECC, EPA, Climate KIC and 25 founding business partners. Circuléire provides funding for innovative circular projects, while the partnership also established a key ecosystem for the circular economy in Ireland, engaging stakeholders across industry, government and research organizations. Between 2020 and 2022, it invested €1.5 million to fund 10 large-scale projects, enabling enterprises to implement circular solutions within operations (Circuléire, 2022).

Employment within circular economy

The following indicator shows the number of people employed in the recycling sector, repair, reuse, rental and leasing sector. European Environment Agency estimates that in 2021, there was a total of 4,284,745 people employed in circular economy across the EU Member States, which represented 2.1% of total EU employment (European Environment Agency, 2024c). The Circular Economy Action Plan estimates that by 2030, circular economy has the potential to create approximately 700,000 jobs (European Commission, 2020). The following graph shows a number of persons employed full time, measured as a percentage of total national employment. The available Eurostat data cover the period from 2014 to 2023, which is the timeframe represented in the graph.

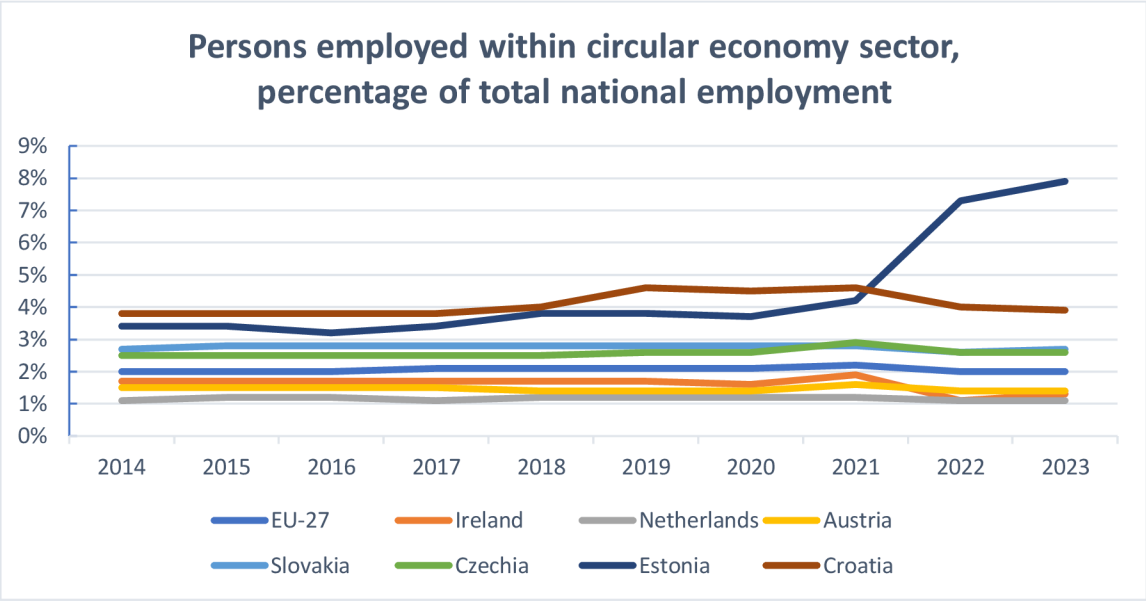

Figure 21. Persons employed within Circular Economy Sector.

Source: Own elaboration based on Eurostat (2025k).

A notable variation is evident in the share of employment accounted by circular economy sector across EU Member States. The EU average provides a useful benchmark and remains relatively stable at around 2% throughout the observed period. Ireland records a similarly stable trend, at around 1.7%, indicating a below EU average contribution to circular economy compared to national employment. Ireland's levels are comparable to Netherlands and Austria, showing a similar contribution as the composition of these economies are relatively similar. By contrast, Slovakia and Czechia rates are approximately one percentage point higher, stabilizing at around 2.6% throughout the entire period. This is due to Slovak and Czech economies being strongly oriented towards manufacturing and heavy industry sectors, such as the automotive sector, which creates a demand on the job market for metal recycling and industrial waste processing. However, on the other end of the spectrum, Estonia and Croatia display the highest shares of circular economy employment across all the selected European states. Highest point of circular economy employment in Estonia reached 7.9% in 2023. This can be linked to both countries' increased investment into waste management infrastructure. In comparison, Ireland's economy is more service-oriented with less dominance on heavy industries. Consequently, the share of people employed in the circular sector is not that high as it accounts for a smaller proportion of total employment. In addition, previously mentioned Ireland's funding initiatives also contribute positively to employment in the Irish CE sector, as financial support creates more jobs and expands work opportunities.

5.2.9 Global Sustainability and Resilience

The last thematic area is the global sustainability and resilience dimension, which consists of four indicators:

- Consumption footprint
- GHG emissions from production activities
- Material import dependency
- EU self-sufficiency for raw materials, aluminium

This chapter will focus on consumption footprint and material import dependency of Ireland as it is the most relevant for this analysis. GHG emissions from production activities and EU self-sufficiency for aluminium are excluded for two main reasons. Firstly, GHG emissions from production activities are excluded because this indicator is less informative in the Irish context. As already mentioned, Ireland's economy is not heavily industry oriented. The major emission sources in Ireland are mainly driven by the agriculture sector, road transport and energy use. High production of methane emissions reflect the large scale of dairy and meat production, and industrial production accounts for a comparatively smaller share (OECD, 2025a). Secondly, EU self-sufficiency for aluminium does not provide a meaningful country-specific comparison for Ireland, whose domestic aluminium production is very limited and whose performance in this area is largely influenced at the EU level.

Consumption footprint

The consumption footprint measures the overall environmental impact of what households consume in a given country and it covers five main areas of consumption: food, mobility, housing, appliances, and household goods (Eurostat, 2025b). As the consumption footprint is based on the life-cycle assessment, it accounts for their life-cycle from the extraction to their end-of-life, and it also includes impacts of the goods irrespective of where they were produced (European Environmental Agency, 2025a). The consumption footprint therefore also captures emissions and resource use of imported goods and services, which offers a broader look of Ireland's environmental impact. The following graph presents the consumption footprint per capita, expressed as a single weighted score. The composite indicator does not capture physical units, rather it shows a synthetic score that enables a cross-country comparison of environmental pressure driven by consumption footprint over time.

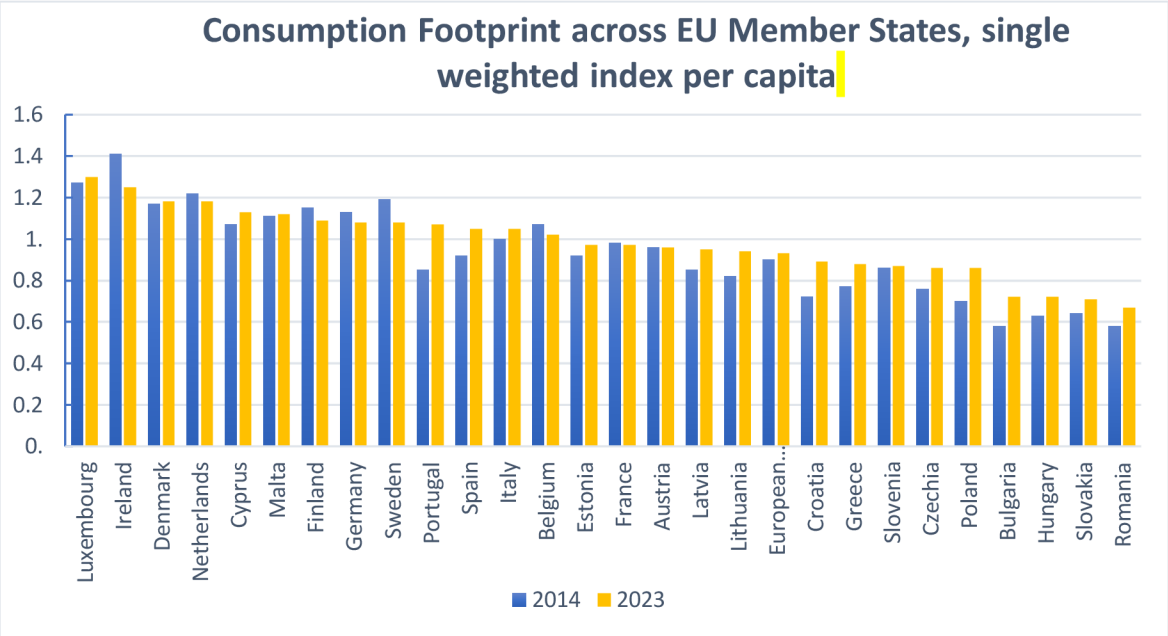

Figure 22. Consumption Footprint across EU Member States.

Source: Own elaboration based on Eurostat (2025c).

Figure 22 compares consumption footprint per capita across EU Member States in the period of 2012 and 2023. The EU average has increased over time, reaching 0.93 points on this metric and the European Environment Agency indicates that consumption of EU's citizens is considered too high, as it increased by 5% between 2020 and 2023, exceeding its share of planetary boundaries (European Environmental Agency, 2025a). With Luxembourg recording the highest share of consumption footprint, Ireland also stands out with one of the largest per-capita footprints, at 1.25 points in 2023. Ireland ranked higher than Denmark, Netherlands and Germany, which are EU countries with high levels of disposable income. This serves as a confirmation that Irish consumption patterns and material consumption is impact-intensive. The previous analysis showed that Ireland produced 615 kg of municipal waste per capita in 2022, significantly above the EU average. The analysis also revealed that substantial amount of waste is incinerated or exported with having only three active landfills in the country. The high consumption footprint therefore complements these figures, which underscores the need to improve waste prevention strategies in Ireland.

Material Import Dependency

Material import dependency is the last indicator of this analysis, which shows how much of the materials used in the economy come from abroad compared with materials extracted domestically. The indicator is measured in percentages, showing the extent, to which the economy is dependent on imports to meet its material needs. These include categories of biomass, mineral ores, non-metallic

minerals and fossil fuels. Higher values mean the country relies more on imports, whereas lower percentages indicate larger domestic extraction of resources.

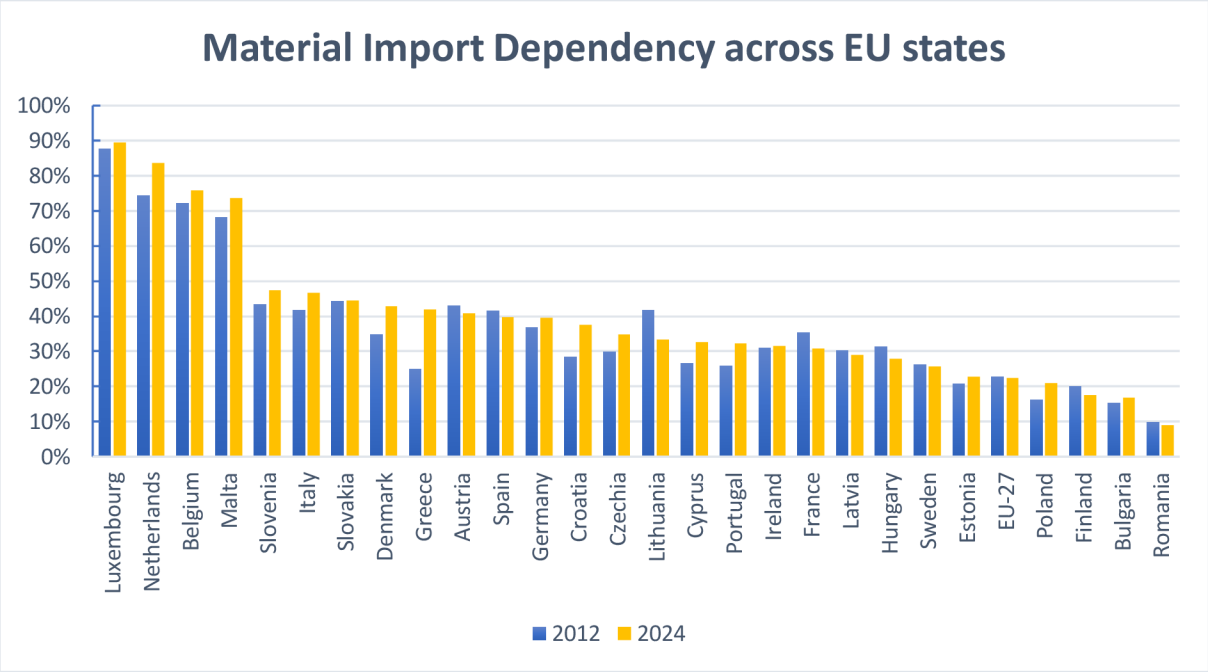

Figure 23. Material Import Dependency across EU Member States.

Source: Own elaboration based on Eurostat (2025g).

Luxembourg, Netherlands and Belgium exhibit the highest values, which indicates their strong dependency on EU supply chains. As these countries heavily rely on raw materials imports, this shows their economic vulnerabilities. In the case of global supply chains disruptions, these countries do not have a sustainable way to secure their materials. In case of Ireland, it occupies a mid-range position with approximately 31%. This value remained relatively stable between 2012 and 2024.

Ireland demonstrates a considerable reliance on imported materials, most notably on machinery, transport equipment, chemicals and certain foods (Central Statistics Office, 2024b). However, this dependency is offset by its domestic material production, particularly in the agriculture sector with high levels of dairy and meat production, which results into moderating its level of material import dependency.

Geographical barriers and industrial capacities are closely linked to material import dependency, and individual countries' national circular policies should focus on supply chain diversification and intensifying recycling opportunities. However, it is noted that without a robust secondary raw materials market, a well-developed recycling infrastructure will not derive successful results in a significant reduction of consuming primary raw materials (Pariso & Marino, 2025).

6 Discussion and Recommendations

This chapter discusses the key findings of the analysis in relation to the previously outlined research questions and the wider context of circular economy development. It also incorporates targeted recommendations to address the identified problems, which are structured in alignment with the research questions.

In relation to the first research question, the analysis revealed that Ireland's circular economy remains still at an early stage. Despite the increasing efforts by the Irish government and national public bodies to promote the development of CE in Ireland, evidenced by the publication of the Second Circular Economy Strategy, Ireland faces a large circularity gap compared to its EU counterparts. Over the analyzed period of time, the progress of its circular material use rate stagnates around 2%. While frontrunners like the Netherlands or Belgium demonstrate a significantly more integrated and advanced approach to circular economy, Ireland has a significant potential for improvement. Organizations on both international and national level also point to the increasing waste generation within Ireland, which highlights the need to transform the linear model of production and consumption to a circular one. Leaning on the EU monitoring framework for circular economy, Ireland lags behind in many of the indicators, but it is important to acknowledge Ireland's efforts to improve its policy strategies to move in the direction of sustainable circular producing and sourcing of materials.

A key aspect of this analysis is the identification of main structural barriers the nation faces, which also directly relates to the second research question. Achieving a systematic and sustained progress requires a clear understanding of the underlying causes of these challenges. The primary structural barriers are summarised as follows:

- One of the key barriers is the lack of markets for secondary materials that can be used as a new resource for the development of economy. Ireland does not generate enough high-quality recyclable materials that could increase incentives for businesses to purchase them and integrate it as inputs for their daily operations. Therefore, the government should create economic incentives in form of taxes or subsidies for companies to purchase secondary materials.
- Ireland's heavy reliance on virgin materials and other imported sources reflects the high number of being 97% dependent on imports of fossil fuels. This raises a significant concern in terms of Ireland's future resource security. As a recommended measure to improve

material self-sufficiency, incentivizing industrial symbiosis to use other firms' waste as an input would increase the prospects of independence.

- Ireland lacks the self-sufficiency to handle its own waste production due to insufficient domestic waste infrastructure. The analysis revealed that approximately 45% of municipal waste is annually being exported for waste treatment abroad. This reliance not only speaks to the loss of potential secondary materials that could be used within the economy, but makes the economy vulnerable to market disruptions. Moreover, rural regions lack access to sorting facilities and refurbishment centers, which reinforces linear consumption patterns. To address this, governments should prioritize investments in repair and refurbishment shops will provide essential support to make a meaningful progress in circular economy. While over €30 million was allocated for circular activities from the Circular Economy Fund in 2025, further investments will be needed to fund repair hubs (Department of Climate, Energy and the Environment, 2026b).

In line with the third research question focusing on circular economy implementation of circular policies and strategies, it is evident the gap persists between policy ambition and practical results. From the policy perspective, the Whole of Government Circular Economy Strategy, the Circular Economy Act 2022 and the Waste Action Plan for a Circular Economy (2020-2025) collectively provide a solid framework in setting the direction of the nation towards circular economy. However, after analysing the results, it can be concluded that Ireland does not record positive values and in terms of circular economy it is lagging behind other European states, meaning that the policy instruments and strategies are not providing a sufficient stimulus for companies to change their practices. From the perspective of some of the consumers, these policies are seen as only a strategic tool to fulfil the obligations of the EU's direction, and the policies have showed limited effectiveness so far, evidenced by the low engagement of the private sector in circular economy investments and innovation. Currently, the challenge for Ireland is to reverse the prevailing linear trend. In this context, it is important to emphasize the new Whole of Government Circular Economy Strategy 2026-2028, which represents a step forward in these measures. With its emphasis on investing more in repair and refurbishment activities to lower the cost of product repairs, as well as the introduction of digital product passports, the government is beginning to address key gaps in the practical implementation of circular economy policies.

The next research question targets the construction and demolition sector, which represents a significant opportunity for the nation to double its circularity rate by 2030. Accounting for approximately half of Ireland's total waste production, increased recycling rates within this waste

stream could have a substantial effect on national circular objectives, as only 11% was recycled in 2023. Drawing on the results from the analysis, several targeted recommendations are proposed in alignment with the supporting literature:

- The conducted analysis has shown that introducing tax breaks for the use of secondary materials would be highly beneficial. In addition, integrating recycled construction materials into procurement guidelines could further stimulate circular construction in Ireland. These findings are also aligned with the EPA research on aggregate materials, which lists that consumers are interested in purchasing recycled aggregates, particularly in the Dublin region. However, the findings also highlight that high gate fees and certification costs make these materials less attractive, as most of these fees are retained by waste operators, while potential buyers are deterred by the overall costs (Environmental Protection Agency, 2023).
- Furthermore, increasing awareness among stakeholders to understand circular operations on a deeper level, through targeted campaigns and case studies that are able to shift mindsets of both producers and consumers. Fostering collaboration between different projects to match C&D material demand and supply is also seen as essential. In addition, industrial symbiosis is an emerging concept that fosters these ideas and technology innovations (Environmental Protection Agency, 2025b).
- Leveraging digitalisation and technology innovations to improve waste tracking and faster development of more sustainable materials is crucial to advance circularity in Ireland's C&D sector. In order to keep construction materials in use for as long as possible, real-time traceability records of waste materials are necessary for responsible handling, monitoring of reuse, recycling, landfilling, and material flows, while also simplifying audits and regulatory reporting. In context of the ongoing housing crises, mandating the use of secondary materials combined with leveraging digitalisation in the built sector is a critical opportunity to increase the housing supply and advance circularity simultaneously.

In relation to the fifth research question, Ireland's high reliance on municipal waste exports presents a significant risk, exposing the country to international market shocks and transport disruptions. Ireland relies on waste shipments primarily to the United Kingdom, Germany, Sweden and Netherlands. Ireland's capacity to treat and manage waste with only three active landfill sites and two waste-to-energy facilities is limited. The analysis revealed that stagnation of municipal recycling rate at 41% underscores the lack of sorting facilities across counties. Due to insufficient separation of waste, over 20% of materials in kerbside bins are contaminated, which makes a large portion of recyclable plastic and paper to be sent to incineration or export.

To improve self-sufficiency, the linear model has to shift towards the circular one:

- Investment into domestic recycling facilities is essential in order to lift reliance on exporting of waste. The analysis mentioned biomethane infrastructure, having a significant potential in an agriculturally-oriented economy such as Ireland. Fast-tracking biomethane infrastructure such as the Kildare plant through the National Waste Management Plan for a Circular Economy 2024-2030 would enhance circular use of resources.
- Expanding recycling hubs across all Ireland's counties is seen as equally important, drawing inspiration from the Sweden's Site Zero plastic recycling facility, which required approximately €100 million investment (Interreg Europe, 2025). In Ireland's case, long-term investments into advanced recycling plants would significantly improve its performance.
- Furthermore, investing in AI-powered automated sorting bins could significantly reduce contamination rates and prevent recyclable plastic and paper materials being classified as unrecyclable.

The sixth research question focusing on packaging waste in Ireland is interconnected with municipal waste. The analysis revealed that Ireland stands as one of the largest generators of packaging waste in the EU, generating 223.1 kg of packaging waste per capita in 2023. This is driven by the single-use trends in imported plastic packaging. The main barriers are identified below, with corresponding recommendations to improve Ireland's position.

- Lack of reuse infrastructure within Ireland and its rural areas presents a challenge. However, this could be better addressed if Ireland adopts similar models like Belgium's FostPlus matchmaking platform, which connects businesses to help exchange reusable packaging materials. Similar tools deployed nationwide require a significant investment and government support, which is essential to reach progress (Fost Plus, 2026).
- The introduction of the Packaging and Packaging Waste Regulation (PPWR) coming into force in August 2026 brings numerous challenges for businesses from scaling reuse infrastructure and redesigning packaging, to meeting recycling content targets. Ireland's Deposit Return Scheme and Extended Producer Responsibility schemes with eco-modulation fees are government initiatives that are effective to curb packaging waste, but under the new PPWR, these initiatives must accelerate to reach the outlined targets that the regulation mandates. Enhanced funding for collection and sorting infrastructure, along with clear recyclability guidelines for producers are suggested as effective measures to ensure successful implementation.
- High contamination rates of Ireland's kerbside bins render a substantial amount of plastic and paper materials unrecyclable, underscoring a missed opportunity for higher recycling rates. This stems from consumer confusion over mixed streams and inadequate

infrastructure, which is evidenced by EPA audits. Under the incoming PPWR, the recycling content will be mandated to increase, which may create a challenge as many producers still use mixed materials for packaging their products. Recyclability scoring tackles this challenge by making packaging clearer and easier to sort, as simple labels remove consumers' confusion. As producers switch to single material designs, less contamination will lead to higher recycling rates (Department of Climate, Energy and the Environment, 2026b).

- Lastly, biodegradable plastic packaging represents an emerging opportunity for Ireland. While there are no recycling and treatment facilities in Ireland for biodegradable plastics, creating this infrastructure is essential to make progress. Evidence from the BioPOST project highlights, that biodegradable plastics can be effectively integrated into Ireland's existing waste infrastructure if proper segregation is secured. While the concept of biodegradable plastic packaging is new, its growing attention highlights the opportunity for improving Ireland's rates of plastic packaging waste generation (Environmental Protection Agency, 2026).

Furthermore, given that the transition to circular economy cannot take place without businesses directly transforming their operations, Irish businesses and SMEs can undertake such transformations if market demand for secondary materials and products will be sufficiently robust.

- Poor product design accounts for a substantial barrier among Irish SMEs in the adoption of circular practices, because majority of products are not designed for disassembly or easy repair. Consumers and producers prefer low-cost materials and brand-new products, at the expense of durability. EPA's research report (2022b) on Irish SMEs within circular economy is aligned with the findings of the analysis, confirming that businesses in Ireland are open to explore and engage with circular solutions and circular business models, but are either unaware of available opportunities or are uncertain of the financial benefits. This highlights the need for targeted policy interventions, where it is recommended that the government expands its financial support in form of CEIGS and Enterprise Ireland's Green Plus and Green Start schemes, while it also invests more in development of databases and platforms that SMEs can use free of charge (Environmental Protection Agency, 2022b).
- The second obstacle relates to a lack of economic drivers for SMEs to change their attitudes towards circularity. Implementing different design for packaging of their products or optimizing their ways to be more circular may be costly. Innovation and financial schemes such as the Green Enterprise Fund or CEIGS exist to support innovation, but the SMEs often lack administrative capacities, time and resources to apply successfully. Moreover, as noted

by the OECD (2022), limited expertise and skills in scaling circular solutions among SMEs are essential to access financing and scale. Therefore, tailored training programmes and building networks are crucial to support SMEs in becoming more circular. The government must also clearly and effectively communicate available opportunities for financing, along with the economic benefits of circularity for Irish business owners.

- As the final point, circular transition cannot take place without digitalization of operations, particularly through real-time digital marketplaces and platforms that track material flows and provide information on availability and quality, meeting the EU requirements, including digital product passports – a priority positioned at the centre of Ireland's Circular Economy Strategy 2026-2028.

These recommendations are directly aligned with the analytical findings of this thesis, which reveal a circularity gap within Ireland, where investments in circular economy remain insufficient to meet EU and national circular targets. Ultimately, these concluding results serve to show that without substantial increase in targeted financial and non-financial support to de-risk circular business models, Ireland will continue to function in a wasteful linear economy.

Conclusion

While the European Union positioned itself as a global leader in transitioning to circular economy with ambitious strategies such as the Circular Economy Action Plan and the European Green Deal, this thesis reveals that a systemic change remains highly complex. Progress on the policy level in the European Union is evident, particularly in advancing regulatory and legal frameworks, setting stricter requirements for recycling rates of products and waste management, but there are significant disparities among EU Member States that have to be addressed with a tailored approach by the national governments. Countries such as Netherlands or Belgium serve as positive examples that higher levels of circularity are achievable through strong policy coordination coupled with high level investments into waste recycling infrastructure.

In terms of the case study, the analysis showed that Ireland continues to lag behind its European counterparts across several key indicators. Ireland's circular material use rate of approximately 2% indicates a high reliance on consumption of virgin materials with very limited recirculation of resources. Levels of waste generation, particularly in the Irish construction sector and in packaging, remain among the highest in the European Union. This highlights the need for structural changes across multiple sectors if Ireland is to achieve its target of increasing the circular material use rate to 12% by 2030. The analysis also identified the Netherlands as one of the leading performers in circular economy implementation among the EU Member States, suggesting that Ireland could benefit from adopting similar approaches and best practices.

Building on these findings, accelerating Ireland's circular transition will require a stronger focus on practical implementation of national policies and strategies, collaboration between multiple stakeholders across government, local communities and industry, combined with stronger private sector engagement. Current progress is constrained by limited scaling of circular business models and insufficient investment. In consequence, Ireland can narrow down its circularity gap to build more resilient, sustainable and thriving economy.

7 Reference list

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Table 1. Circular Economy Monitoring Framework. 28

8.3 List of Abbreviations

C&D	Construction and Demolition
C2C	Cradle to Cradle
CE	Circular Economy
CEAP	Circular Economy Action Plan
CEIGS	Circular Economy Innovation Grant Scheme
CEMF	Circular Economy Monitoring Framework
CMUR	Circular Material Use Rate
CRM	Critical Raw Materials
CSDD	Corporate Sustainability Due Diligence Directive
CSO	Central Statistics Office
CSR	Corporate Social Responsibility
DECC	Department of Climate, Energy and the Environment
DMC	Domestic Material Consumption
DPP	Digital Product Passports
EGD	European Green Deal
EIB	European Investment Bank
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
ERDF	European Regional Development Fund
ESPR	Eco-design for Sustainable Products Regulation
ETS	Emissions Trading System
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNI	Gross National Income
IDA	Industrial Development Authority
IMR	Irish Manufacturing Research
JICE	Joint Initiative on Circular Economy
NWPP	National Waste Prevention Programme
PPWR	Packaging and Packaging Waste Regulation
R&D	Research and Development
SDG	Sustainable Development Goals
SEAI	Sustainable Energy Authority Ireland

SMEs	Small and Medium-sized Enterprises
UK	United Kingdom
US	United States of America
WAPCE	Waste Action Plan for a Circular Economy
WEEE	Waste Electrical and Electronic Equipment