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RESEARCH ARTICLE

Socioeconomic Impacts and Regional Disparities in Circular Economy Adoption: Insights from Europe and Beyond

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Abstract

The transition to a Circular Economy (CE) aims to decouple economic growth from resource consumption by promoting resource efficiency, sustainable industries, and regional economic resilience. CE offers environmental benefits, such as reduced resource demand and lower greenhouse gas emissions (GHG) but also introduces complex economic effects that require further research. This article examines the socioeconomic impacts of the CE, focusing on the European Union (EU), where member states have developed specific strategies to address their economic and environmental challenges, exploring employment dynamics and resource optimisation. It explores employment dynamics and resource optimization across sectors. It combines a comprehensive review of existing literature with an empirical analysis to contrast theoretical insights with current data on investment and employment trends in CE sectors. The findings highlight opportunities, such as job creation in recycling, repair, and service-based industries, as well as challenges, including job losses in manufacturing and mining. Germany and France are confirmed as leaders, with steady investments in EC and employment growth. Meanwhile, southern European countries are being addressed, underscoring the need for urgent and tailored strategies and policies that align macroeconomic goals with the principles of CE. This dual approach provides actionable insights for fostering sustainable economic growth, environmental resilience, and inclusive transitions within the EU and beyond.

Keywords Circular economy · Sustainability · Resource Efficiency · Employment Dynamics · Socioeconomic Impacts

1. Introduction

The transition to a Circular Economy (CE) seeks to decouple economic growth from resource consumption by fostering investment in resource efficiency, expanding sustainable industries, and enhancing regional economic resilience.

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While various organizations have shaped the CE framework, the Ellen MacArthur Foundation (EMF) has promoted this model, emphasizing the closing of the linear production cycle, optimizing resource use, and reducing environmental impact to enable sustainable businesses. The CE aims to address environmental changes through material reuse, repair, and recycling, while promoting sustainable economic growth. It also focuses on integrating renewable energy and eliminating toxic chemicals and waste through the innovative design of materials, products, and systems. It could drive sustainable development and economic competitiveness (EMF 2012, 2013, 2014, 2015).

From a conceptual perspective, the CE is based on cyclical flows that close material and substance cycles. These flows include a biological cycle, where materials are biodegradable and return to nature once used, and a technical cycle, where non-biodegradable materials are recovered and reintroduced into another production process. This approach preserves material value and quality, thereby avoiding the need for additional resources. The conservation of resources and the concept of industrial symbiosis are implicit in the model, wherein waste from one industry serves as a resource for another, maintaining its quality and status as resources (upcycling). Unlike other concepts, CE focuses on extending resource lifespans, creating value, and reducing environmental impact.

The CE model has three core objectives: first, to close the resource loop by minimizing the use of raw materials and maximizing recycling and secondary materials usage; second, to slow resources flow by enhancing durability through eco-design, reuse, and repair; and third, to reduce resource demand by promoting service-based economies, the sharing economy, and changes in consumers behaviour (Bibas et al., 2021).

Over the past decade, the CE has gained significant attention across political, academic, and business domains. The motivations for implementing CE strategies vary across countries. For illustrative purposes, Finland and the Netherlands aim to increase resource efficiency and reduce their dependence on imported raw materials, with the goal of doubling their material circularity rates by 2035. Spain emphasizes waste reduction, targeting a 30% decrease in domestic material consumption relative to GDP by 2030, driven by its reliance on resource-intensive industries. Germany stands out for its emphasis on innovation, fostering circular business models, and advanced recycled technologies to maintain industrial competitiveness. This focus on innovation is an inspiring aspect of the CE model. Outside Europe, Chile sees CE as a tool to generate inclusive economic growth, projecting 100.000 new green jobs by 2030. China focuses on securing supply chains and increasing the production of recycled materials to 20 million tons of non-ferrous metals annually. Through these examples, most countries shared goals, such as mitigating climate change, improving resource efficiency, and enhancing economic resilience, tailored to each country's unique economic and environmental challenges (UNIDO, 2024).

Numerous studies highlight its environmental benefits across various productive sectors, including reduced resource demand for energy and materials, as well as lower greenhouse gas emissions (EMF 2013, 2019; IRP, 2018). Beyond environmental advantages, transitioning to a CE introduces complex structural changes with socioeconomic impacts that remain difficult to quantify (Antonioli et al., 2022). These uncertainties underscore the need for further research to comprehend the drivers of the CE model and how systemic changes impact economic growth, employment dynamics, and resource efficiency across diverse contexts.

This article explicitly examines the socioeconomic impacts of CE adoption in the EU, focusing on investment trends, employment dynamics, and regional disparities. These variables were selected due to their direct implications for economic policy and sustainable development. By narrowing our scope, we aim to provide a structured analysis that offers theoretical insights and empirical evidence on how the adoption of CE varies across different economic contexts.

The article is organized as follows: Section 2 includes a literature review of the theoretical socioeconomic impacts of CE. Section 3 focuses on EU research, examining the drivers of CE and regional disparities through an empirical approach that utilizes actual data on investment and employment. Section 4 summarises the conclusions and recommendations.

2. Literature review

This study examines the economic dynamics of CE adoption, focusing on how investment in CE sectors affects employment patterns and regional economic disparities across the EU. While prior research has explored the environmental benefits of CE, fewer studies provide a structured evaluation of its economic effects, particularly regarding cross-country differences in CE investment and employment creation.

To bridge this gap, this literature review follows a mixed-methods approach, integrating a structured literature review with an empirical analysis based on the available statistical information. The review serves two main purposes: (1) to synthesize key findings on CE's economic impact, (2) to identify gaps in existing research, and (3) to establish the empirical foundations for the study's quantitative analysis. This review is not merely theoretical framing; it is an integral part of the methodology, as it identifies the economic indicators and behavioural patterns that will subsequently be contrasted with real-world data in the empirical analysis.

2.1. Methodological approach to literature review

Given the extensive body of research on CE, we apply specific selection criteria to ensure relevance to our analysis, as well as methodological rigor and transparency. The literature review was conducted following a structured protocol grounded in the principles of systematic evidence synthesis. This approach integrates the PRISMA 2020 guidelines (Page et al., 2021), the four-step sampling framework proposed by Gusenbauer & Gauster (2025), and the methodological foundations outlined by Booth et al., (2019). These frameworks emphasize the importance of comprehensiveness, reproducibility, and clarity in the identification, selection, and reporting of literature.

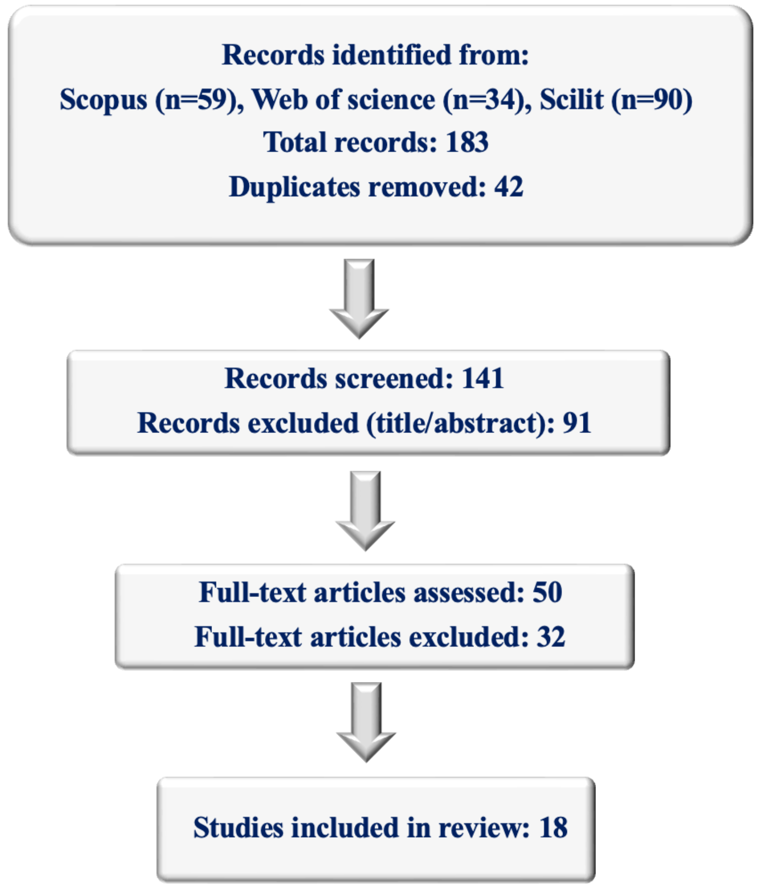
The review commences with a scoping phase designed to refine the research question and define the conceptual boundaries of the study. This phase involves exploratory reading, the identification of key terms and constructs, and the formulation of inclusion and exclusion criteria. The focus is on peer-reviewed literature that addresses the relationship between CE, employment, and investment within the European context. To ensure relevance and currency, the temporal scope is limited to publications from 2015 to 2024, a period marked by the consolidation of CE strategies in EU policy frameworks.

The search strategy is designed to maximize both sensitivity and precision. A Boolean query—"circular economy" AND "employment" AND "investment"—was applied across three bibliographic databases selected for their disciplinary relevance and technical suitability for systematic reviews: Scopus, Web of Science (WoS), and Scilit. These databases were chosen based on their high absolute and relative coverage of management and sustainability literature, as well as their support for advanced search functionalities (Gusenbauer & Haddaway, 2020; Gusenbauer & Gauster, 2025).

After the initial search, duplicate records were removed, and the remaining articles were imported into a reference management system and screened in two stages: first by title and abstract, and subsequently by full text. A screening process was conducted following predefined eligibility criteria. Thus, studies were included if they addressed CE-related employment or investment, provided empirical or theoretical insights relevant to the EU context, and were published in peer-reviewed journals or recognized scientific outlets. Exclusion criteria encompassed studies focused exclusively on environmental impacts, those unrelated to socioeconomic dimensions, and non-European case studies unless they offered comparative relevance. This dual-stage screening process was conducted manually and documented in accordance with PRISMA 2020 standards, ensuring transparency and replicability.

The identification, screening, and inclusion of studies have been documented using a PRISMA 2020 flow diagram, which provides a visual summary of the systematic review process and supports the methodological rigor of the study. As shown in Figure 1, a total of 183 records were initially identified through structured searches in three bibliographic databases: Scopus (n = 59), WoS (n = 34), and Scilit (n = 90). After removing 42 duplicate records, 141 unique records were screened based on titles and abstracts; of these, 91 were excluded because they did not meet the predefined inclusion criteria. The remaining 50 full-text articles were assessed for eligibility. Following a detailed evaluation, 32 articles were excluded due to lack of relevance, insufficient methodological quality, or absence of socioeconomic focus. Ultimately, 18 scientific journal articles were included in the final synthesis.

Figure 1. PRISMA 2020 flow diagram of the literature selection process (Source: Own elaboration.)



Therefore, the search strategy has been validated using two quality checks: the ability of the search string to retrieve key studies identified during the scoping process, and the number needed to read (NNR) to identify relevant studies, in line with Gusenbauer & Gauster (2025). These checks ensured that the search was neither overly narrow nor excessively broad, striking a balance between comprehensiveness and efficiency.

Google Scholar was deliberately excluded from the search strategy despite its broad coverage. As noted by Gusenbauer & Gauster (2025), Google Scholar lacks essential functionalities for systematic searching, such as reliable Boolean logic, reproducible search results, and transparent indexing. Its limitations in query formulation, result filtering, and export capabilities compromise both the precision and reproducibility of systematic reviews. Booth et al. (2019) similarly caution against the use of search engines that do not allow for controlled, replicable searches, emphasizing that transparency and auditability are fundamental to systematic review methodology. Moreover, PRISMA 2020 underscores the importance of reporting complete and replicable search strategies, which is not feasible with Google Scholar due to its opaque algorithms and dynamic indexing (Page et al., 2021). Therefore, its use was deemed incompatible with the methodological standards adopted in this study.

In addition to peer-reviewed literature, the review incorporated selected grey literature from authoritative institutional sources, including reports and strategic documents published by the European Commission (EC), the Ellen MacArthur Foundation (EMF), the International Labour Organization (ILO), and the OECD. These documents were included due to their empirical richness, policy relevance, and conceptual contributions to the understanding of CE-related employment and investment dynamics. As Booth et al. (2019) and Adams et al.

(2017) argue, grey literature is particularly valuable in emerging or policy-driven fields, where academic research may lag institutional developments. Furthermore, the use of grey literature is aligned with the PRISMA 2020 methodological recommendations, which recognise the importance of including non-conventional sources when relevant to answering the research question (Page et al., 2021). In addition, Gusenbauer & Gauster (2025) emphasize that excluding grey literature can introduce publication bias and limit the representativeness of the evidence base. The selected documents were chosen based on their thematic alignment with the research objectives, their institutional credibility, and their influence on CE policy discourse in Europe. Other grey literature sources were excluded when they lacked methodological transparency, regional relevance, or conceptual depth.

We consider that integrating these protocols into the literature review of this work ensures that the evidence base is both representative of the current state of knowledge and aligned with the academic standards of the social sciences.

2.2. General context of CE and its socioeconomic dimensions

The transition to a CE is often framed as an economic paradigm shift, promoting sustainable growth while reducing dependency on finite resources. Ghisellini et al. (2016) and Kirchherr et al. (2017) argue that minimizing resource input and increasing recycling enhances economic resilience. However, their studies do not quantify CE's direct effects on investment growth or employment trends. This gap in economic modelling leads to uncertainties regarding CE's actual contribution to gross domestic product (GDP) and labour market structures.

Transitioning to a CE requires economic restructuring, promoting new business models, and offering financial incentives to support sustainable industries. The European Green Deal emphasizes sustainability, cost reduction, and innovation through eco-design, industrial symbiosis, and green infrastructure. While these elements are crucial for long-term CE adoption, this study focuses on their socioeconomic impacts rather than their technological or environmental dimensions. In this sense, CE not only fosters sustainable growth but also opens new markets and creates jobs in promising sectors, such as renewable energy and waste management, as well as in labour-intensive sectors like repair, reuse, and recycling.

Estimating the economic and environmental impacts of the CE has led to the development of various modelling approaches. Among these, macroeconomic models are particularly relevant to our study, as they provide insights into the relationships between CE policies, investment flows, and labour market effects. The literature identifies four key macroeconomic modelling approaches: (1) Input-output accounting models, which estimate changes in intersectoral activity, GDP, employment, and trade. (2) Static input-output models with environmental extensions, which integrate sector-specific links between environmental and economic outcomes; (3) Macroeconometric models, which analyse year-by-year macroeconomic changes under policy scenarios; (4) General equilibrium models, which evaluate economic balance using social accounting frameworks.

Regarding the economic implications of CE transition and their influence on GDP, the research of McCarthy et al. (2018) is relevant, concluding that CE scenarios could lead to changes ranging from 0% to 15% in GDP by 2030 compared to a baseline scenario. However, introducing taxation on raw materials and implementing recycling measures resulted in a small positive impact on GDP.

Other studies conducted by Dubois (2015), Rizos et al. (2020), McCarthy et al. (2018), Fernández-Herrero & Duro (2019), Bongers and Casas (2022), or Kostakis & Tsagarakis (2022) concluded that, in the long term, the effects may prove beneficial for the GDP, showing a positive correlation between the level of circularity in an economy and its growth. Nevertheless, the results vary depending on the initial assumptions and the role of policy-driven incentives in accelerating private sector investment. The European Commission (2022) report suggest that public funding is crucial in kickstarting CE adoption, but long-term sustainability depends on private sector engagement. However, empirical studies rarely quantify the degree to which investment distribution correlates with CE policy implementation, further reinforcing the need for structured data analysis.

In this context, it is pertinent to note the research conducted by Bourdin & Torre (2024) and Pinyol (2022) for the European case.

Each estimation method provides complementary results with varying levels of complexity and data requirements. However, many discrepancies exist in CE impact estimations, often due to differences in initial assumptions, policy scope, and fiscal incentives promoting resource efficiency (Appendix 1). These variations underscore the need for an empirical analysis to validate and contextualize these findings. In the following section, we contrast the trends in the literature related to investment and employment dynamics across EU regions, ensuring that our study builds upon existing knowledge while providing new empirical insights.

2.3. Empirical evidence on CE Investment Growth and Regional Disparities

Investment in CE sectors and sectoral dynamics are determinants in the transition from a linear to a circular model, yet their regional distribution and financial impact remain understudied. The shift to a CE demands significant new investments in key areas, such as secondary materials production, repair and remanufacturing, and shared services, as highlighted by McCarthy et al. (2018).

Several studies have assessed the determinants of CE investment trends across Europe, highlighting the role of industrial specialization, financial constraints, and policy incentives. D'Amato et al. (2017) provide a comparative analysis of the sustainability pathways in the green, circular, and bioeconomy, emphasizing the industrial and policy challenges linked to CE transitions. According to their analysis, countries with strong industrial eco-innovation frameworks (Germany, the Netherlands or Sweden) demonstrate higher CE integration. In contrast, economies reliant on extractive industries (Poland, Romania, or Bulgaria) face structural barriers to CE transitions.

Additionally, Zoboli's reports (2019, 2020) under the Fondazione Eni Enrico Mattei (FEEM) framework provide key insights into sectoral CE investment trends and the role of policy alignment in fostering industrial transformation. Despite increasing CE investments, these reports confirm that Italy and Spain experience inefficiencies in circular material flows and policy implementation, contributing to lower-than-expected circularity rates (Eurostat, 2024), partly due to policy inconsistencies.

Furthermore, Horbach (2016) and Cainelli et al. (2020) discuss innovation diffusion in CE, emphasizing how eco-innovation frameworks drive sectoral transformations. The Eco-Innovation Scoreboard (European Commission, 2023) also provides comparative performance metrics, showing disparities in CE adoption across European regions. These findings underscore that financial commitment alone does not determine CE progress but must be complemented by regulatory effectiveness, sectoral adaptability, and innovation diffusion.

Investments in CE sectors contribute to increasing industrial-added value, particularly in labour-intensive industries and high-value recycling processes. The Eco-Innovation ScoreBoard (EC, 2023) highlights the role of R&D investment in accelerating CE adoption, particularly in Northern Europe, where policy incentives support technology-driven circular transformations. Conversely, lower R&D intensity in Southern and Eastern Europe correlates with slower CE employment growth and lower recycling rates. These findings underscore the need for targeted policy interventions that consider industrial composition and regional innovation capacities.

Thus, investment alone does not guarantee a successful CE transition; it must be strategically allocated to foster innovation ecosystems, support industrial transformation, and enhance material efficiency within supply chains (Kasztelan, 2020). CE adoption varies significantly across European economies due to industrial specialization, financial constraints, and policy incentives. These investments are crucial for resource-intensive industries, such as electronics, information and communication technologies (ICTs), batteries, vehicles, packaging, textiles, and construction. Designing products with longer lifespans and optimizing waste management in these sectors is projected to save materials across value chains, generate added value, and unlock new economic opportunities, as underscored by Robaina et al. (2020) and Bianchi et al. (2021). This also fosters entrepreneurship and supports the growth of SMEs, thereby promoting broader economic development (European Commission, 2020).

2.4. The Role of CE in Employment Creation

These investments drive job creation by expanding labour-intensive industries and fostering demand for both skilled and unskilled workers, particularly in recycling, waste management, and repair sectors.

Regarding the effects of the labour market, CE is expected to generate employment in circular industries. However, the overall impact remains a subject of debate. Existing studies indicate that the shift to a CE could lead to a net increase in employment, subject to variations across sectors and regions (Larsson & Lindfred, 2019). Chateau & Mavroeidi (2020) identified several factors influencing employment creation, including shifts in production methods, changes in demand, macroeconomic conditions, and trade specialization and competitiveness. New sectors, such as secondary raw materials, recycling, maintenance, repair, and shared services, are projected to generate approximately 350.000 jobs in OECD countries by 2040.

These investments drive job creation by expanding labour-intensive industries and stimulating demand for both skilled and unskilled workers, particularly in the recycling, waste management, and repair sectors. Nevertheless, the transition process is not without its challenges. While sectors like recycling and reuse show employment growth, industries dependent on raw material extraction – such as mining – are expected to experience job losses (Chateau & Mavroeidi, 2020). Using the OECD's ENV-Linkages general equilibrium model for 2018–2040, their study indicated that countries with large extractive industries, such as Australia, New Zealand, and the ASEAN nations, may encounter more job destruction than creation. This reinforces findings from the 2019 and 2020 FEEM Reports, which highlight that employment shifts depend heavily on sectoral transformations and the adaptability of labour markets to CE principles.

The review by Laubinger et al. (2020) also indicated the complex labour market implications of transitioning to a CE. It concluded that the employment impacts differ across sectors and regions. Green sectors, such as recycling and reuse, are expected to create jobs. At the same time, material-intensive industries may face job losses. It also emphasized that skill transferability and labour mobility are critical for managing these transitions. Ferranti and Germani (2020) highlight the role of CE employment in fostering economic resilience, particularly in labour-intensive sectors such as recycling, repair, and reuse. Their findings suggest that CE adoption can create significant employment opportunities, especially in regions transitioning from traditional industries.

Other authors, such as Donati et al. (2020), using input-output tables expanded with environmental variables, estimated global reductions of 6,3% in added value and 5,3% in employment. The estimations exclude potential fiscal stimuli, new investments, or price adjustments. Therefore, the results must be interpreted cautiously. Niang et al. (2023) analysed a database on CE job creation and companies between 2008 and 2015, showing that employment growth in CE outpaced overall employment growth during this period.

The International Labour Organization (ILO) projects that by 2030, employment in CE-related industries could create jobs globally, whereas traditional industries (manufacturing and mining) may shrink. The ILO forecasts an annual 5% increase in employment in recycling activities, replacing the extraction of primary resources, and a 1% annual growth in the services sector through activities such as rental, repair, reduced ownership, and goods replacement. Therefore, CE is expected to generate between 7 and 8 million jobs globally by 2030, primarily in the recycling and remanufacturing sectors (ILO, 2018, 2019). This initial estimate by the ILO differs from the one provided by the OECD, which projected employment growth of 1,8 million jobs by 2040 (OECD 2020). However, CE employment structures vary across regions. While in the EU, CE jobs are generally integrated into the formal economy, ensuring adequate labour policies and skill adaptation programs remain crucial to maximizing socioeconomic benefits (ILO, 2023).

An interesting aspect of the analysis is related to employment quality, as CE demands a diverse workforce. Skilled workers are often found in design and technology-related processes, while lower-skilled roles are concentrated in waste recovery and reuse activities. This diversification promotes employment growth and holds promise for alleviating poverty and achieving economic equity.

3. Understanding the key drivers of the circular economy in Europe

Europe leads globally in developing CE roadmaps, accounting for 70% of all global strategies. These roadmaps prioritize resource efficiency, waste management, and sustainable industry development. Countries like Spain and Finland have set ambitious goals, such as reducing domestic material consumption by 30% relative to GDP by 2030 and doubling material circularity rates by 2035. The key to their success lies in robust policy design, where 88% of strategies integrate comprehensive governance mechanisms, providing a solid foundation for their effectiveness. Eighty percent utilize fiscal instruments, such as green taxes and subsidies. Economic opportunities for CE policies are significant, exemplified by Austria's 50% target by 2030 and Spain's projection to create 100.000 green jobs by the same year (UNIDO, 2024).

However, there are still challenges to be faced. Many circular economy roadmaps require an integrated government approach, additional funding, and a focus on avoiding voluntary goals or unilateral actions that undermine implementation efforts. Despite these barriers, European roadmaps serve as a global benchmark for driving sustainable economic transformation.

3.1. Regional motivations and perspectives

The implementation of CE in Europe is driven by various reasons, which reflect regional disparities in factors such as economic conditions, environmental challenges, infrastructure, governance, institutional capacities, and policy priorities. These disparities underscore the need for tailored strategies and collaboration to ensure equitable progress across the EU (Bourdin & Torre, 2024).

Western Europe, guided by countries such as Germany, Denmark, Sweden, and the Netherlands, excels in innovation and waste management. Due to its high GDP per capita and robust infrastructure, it achieves recycling rates of up to 67.2%. Furthermore, substantial investment in CE sectors leads to resource efficiency and a reduction in environmental degradation (Lehmann et al., 2022; Pinyol, 2022). Southern Europe is implementing the CE model to address unemployment and improve waste management efficiency. Spain, for instance, has allocated € 1.5 billion to CE initiatives to stimulate local economies. Eastern Europe, encompassing lagging regions such as Romania, Bulgaria, and Malta, faces weaker policies, lower education levels, and insufficient infrastructure. For these countries, CE provides a pathway to modernize infrastructure, reduce reliance on imports, and benefit from EU funding despite an average circular material use rate of just 8,8% (Skrinjarić, 2020; Lehmann et al., 2022; Castillo-Díaz et al., 2024). Greece continues to face significant challenges in CE adoption, with one of the lowest circularity rates in the EU (5.2% in 2023), indicating structural inefficiencies in waste management and the integration of secondary raw materials. Poland's circularity rate (7,5%) remains below the EU average, suggesting moderate barriers to CE progress, including policy inconsistencies.

However, these low-performing countries have the highest potential to benefit from CE measures, as improved circularity can yield significant socio-economic advantages, including reduced environmental impact and increased resource productivity. In contrast, Italy ranks among the CE leaders in Europe, particularly in recycling efficiency and circular material flows (Zoboli, 2019, 2020). However, regional disparities persist, with Southern Italy exhibiting lower CE performance due to policy inconsistencies and infrastructural gaps compared to the more advanced Northern regions (Eurostat, 2024).

Exploring these regional dynamics is crucial for understanding the different ways of progressing in implementing CE practices across Europe and the challenges that have been extensively explored in the academic literature. For example, Skrinjarić (2020) noted a correlation between regional economic development and the success of CE. Countries like Germany lead the process with higher GDP per capita, efficient administration, and resilient infrastructure. Conversely, corruption and lower education hinder progress in lagging regions, such as Romania and Bulgaria. Barbero et al. (2024) analysed CE fund distribution across 231 European regions, revealing that less developed regions receive the highest share of total CE funds

(15.45%) but allocate a smaller proportion to R&D (16.19%). In contrast, more developed regions, leveraging their stronger institutions and higher education levels, allocate more to R&D (40,03%), which provides a deeper understanding of their role. Transition regions fall in between, with 10,42% of total funds and 35,51% allocated to R&D, highlighting disparities in fund absorption and utilization.

Kolpinski and Kratzer (2024) examined growth trends in CE sectors (recycling, repair, and reuse sectors) with annual increases in gross value added (4.48%), private investments (7.59%), and employment (1.76%). They also emphasized regional disparities, with Central and Eastern Europe showing significant growth, while Greece lags. The study also noted slower job growth in recycling due to automation, while repair and reuse sectors offer more labour-intensive opportunities. Castillo-Díaz et al. (2024) analyse the implementation of CE practices in the 27 member states of the EU using a composite indicator framework that evaluates production and consumption, waste management, competitiveness and innovation, by-product utilization, and global sustainability. The study reveals significant variability in CE implementation across member states between 2012 and 2021. Germany, Italy, France, and Belgium lead in CE practices, while Malta, Luxembourg, and Cyprus lag. Germany excels in competitiveness and innovation, while Belgium and the Netherlands lead in waste management. In contrast, countries like Malta and Cyprus show weaknesses in by-product utilization. Cluster analysis reveals four groups of countries, ranging from "Vanguard" nations with advanced CE strategies to "Immobilist" countries lacking concrete implementation.

It is essential to explore the key drivers influencing the implementation and socio-economic impacts of the CE across different contexts, drawing from the literature's findings. Several factors shape the relationship between CE drivers and their socio-economic impacts (Figure 2). High-quality infrastructure and advanced technologies significantly enhance CE's contribution to GDP growth and job quality, as evidenced by countries like Italy, which benefit from well-developed recycling systems (Beccarello & Di Foggia, 2018). Innovation also serves as a key driver, with industrial modernization and reprocessing activities boosting CE adoption, particularly in Eastern Europe, where these activities have led to significant GDP growth. In contrast, Western Europe, dominated by service-oriented economies, achieves more modest economic gains but realizes higher environmental benefits, demonstrating the varied regional outcomes of CE policies (Bonnman et al., 2023). Policies and regulations, such as the EU's Circular Economy Action Plan, provide a critical framework for promoting economic growth and resource efficiency (Kolpinski & Kratzer, 2024). Education and skills development are also essential, with sector-specific skills proving more impactful than general education levels. Higher tertiary education levels are primarily associated with better absorption of CE funds and greater innovation capacity (Barbero et al., 2024; Lehmann et al., 2022).

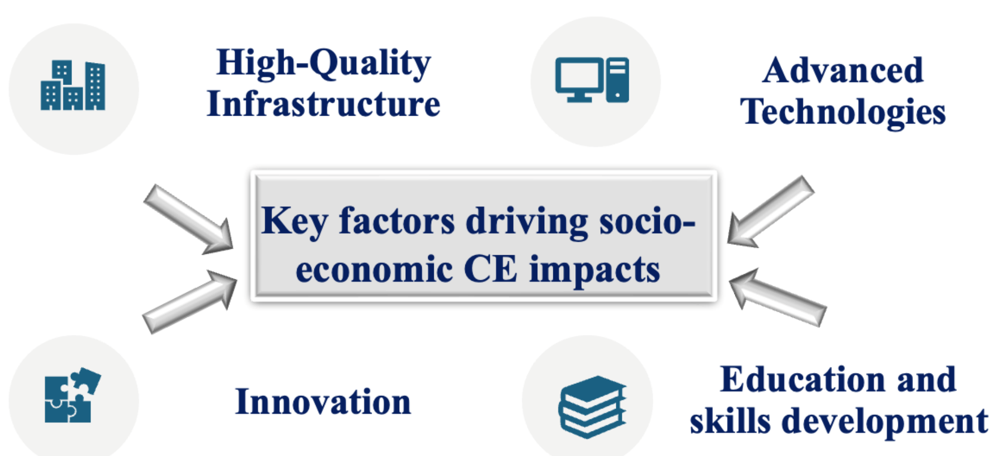


Figure 2. Main drivers of the socio-economic impacts of the Circular Economy (Source: Own elaboration.)

Inadequate education and specialized training hinder progress in lagging regions such as Romania and Bulgaria, underscoring the need for targeted skill-building initiatives (Skrinjarić, 2020). Therefore, specific skills are needed to fully leverage these opportunities and close the gap between environmental leaders and laggards (Ferranti & Germani, 2020). Economic integration and EU funding further enhance CE activities in underperforming regions, enabling higher GDP growth and job creation. Barbero et al. (2024) revealed that while less developed regions receive the largest share of CE funds, they allocate a smaller proportion to research and development (R&D) due to institutional quality and human capital challenges. More developed regions, by contrast, direct a significant portion of their funds to R&D, leveraging their stronger institutions and education levels to drive innovation. Castillo-Díaz et al. (2024) suggest that other drivers, such as by-product exports, technological patents, and recycling rates, also play a role. However, high GHG and excessive waste generation hinder progress.

The transition to CE presents both challenges and opportunities for Europe. It is a critical pathway toward sustainability, enhances global competitiveness, and strengthens geopolitical influence (Pinyol, 2022). Although short-term transition costs present challenges, the long-term benefits of investing in CE sectors—such as sustained economic growth, environmental improvements, and job creation—outweigh these difficulties.

3.2. Economic and sectoral impacts

While CE offers significant socio-economic benefits, significant regional disparities highlight the need for tailored strategies and collaboration to ensure equitable progress across the EU. In this sense, the EU Circular Economy Action Plan (CEAP) serves as a unifying framework for addressing structural barriers. However, it requires expanding knowledge about its macroeconomic, environmental, and social dimensions.

The Ellen MacArthur Foundation (EMF) played a pivotal role in analysing the European case. They were among the first to consider how integrating new mobility, food systems, and construction technologies into the CE model could significantly enhance resource productivity. Their projections estimate that, under a transition scenario by 2025, net material cost savings could amount to $380 billion, increasing to $630 billion in an advanced scenario. This translates to a reduction in input costs ranging from 19% to 23% (EMF, 2013, 2014; EMF et al., 2015), which, in turn, would drive GDP growth.

EMF conducted a pilot study in Denmark, which provides a notable example. This study focused on sectors representing 25% of the Danish economy and concluded that the CE model would foster a more innovative, resilient, and productive economy. The estimates indicated that by 2035, the CE could contribute between 0.8% and 1.4% of additional GDP growth, create between 7,000 and 13,000 new jobs, and deliver significant environmental benefits, such as a 5% to 50% reduction in the consumption of virgin resources (EMF, 2015). Estimates for countries such as Finland, France, the Netherlands, Spain, and Sweden suggest that the number of jobs could increase due to enhanced resource efficiency and the substitution of 50% of raw materials with recycled materials. For Finland and Sweden, an estimated 50,000 jobs would be created; more than 100,000 in the Netherlands; and for Spain, greater resource efficiency could lead to the creation of up to 200,000 new jobs, rising to 300,000 in the case of France (Wijkman & Skånberg, 2017). In Spain, the Circular Economy Strategy, published in 2020, estimates that 120,000 quality jobs will be created related to recycling and reusing raw materials, waste, or water (Government of Spain, 2020).

An approach that also focuses on aggregate economic impacts rather than specific sectoral dynamics is the research by Best et al. (2018), which assesses an overall contribution to GDP between 6% and 7% and job creation (0.1%-1%) compared to a baseline scenario for 2030. Also, Hysa et al. (2020) provide a complementary perspective. Employing fixed effects and generalized methods of moments (GMM) models, the research demonstrates that environmental taxes, recycling rates, and innovation in the CE have a positive influence on GDP per capita. It emphasizes the transformative role of sustainability and innovation in economic development, inspiring the need for policies that integrate environmental, social, and economic dimensions. Their work makes a significant contribution to understanding the impact of CE indicators on economic growth within the EU.

The European Commission's Circular Economic Action Plan, published in 2015, adopted a more specific and policy-driven approach, projecting 170,000 jobs in direct employment within the waste management sector by 2035 (European Commission, 2015). In contrast, for the same year, Morgan & Mitchell (2015) estimate 3.4 million jobs for the EU, including direct, indirect, and induced employment in reuse, repair, recycling, and servitization activities, where manufacturing companies shift from solely selling products to offering tailored supplementary services. Additionally, these authors considered the systemic effects of circular strategies, such as the rise of service-based economies and a reduction in unemployment by 520,000 people.

It is crucial to expand on these insights and explore specific sectoral strategies that can drive the practical implementation of circular economy principles and maximize their economic, social, and environmental benefits. Key sectors, such as recycling, construction, and repair, play pivotal roles in CE-driven growth. Building on this initial framework, the European Commission (2018) report analyses how transitioning to a circular and resource-efficient economy will affect labour markets across EU Member States. The study focuses on five critical sectors of the CE: food and beverages, construction, motor vehicles, electronics and electrical equipment, and waste management. Using the E3ME model, which integrates energy, environmental, and economic aspects, the study assesses direct job gains and losses, as well as indirect, induced, and rebound effects resulting from this transition. Key findings indicate that the net employment effect is expected to be positive. Advancing toward a CE could boost the EU's GDP by nearly 0,5% by 2030 compared to a baseline scenario. Additionally, the report projects a net creation of approximately 700,000 new jobs, driven by increased labour demand in recycling facilities and repair services, as well as consumption rebounds due to savings generated by collaborative actions.

On the other hand, the circular transition could also benefit other sectors, including services and electricity. In contrast, sectors producing and processing raw materials—such as construction, non-metallic minerals, electronics, and motor vehicles—are expected to experience job losses (Figure 3). The projections are included in the New Circular Economy Action Plan for a cleaner and more competitive Europe (European Commission 2020).

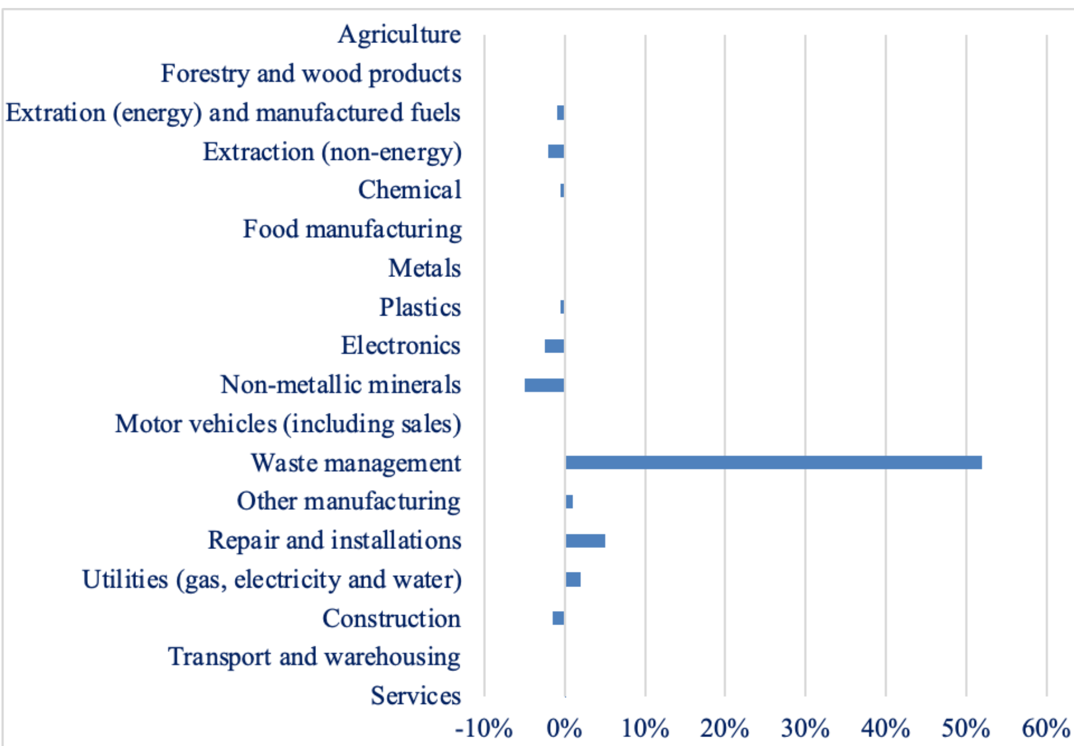


Figure 3. Circular Economy transition: EU28 employment impacts by sector by 2030 (Ambitious scenario % from base) (Source: European Commission (2018).)

The same conclusion was pointed out by Beccarello & Di Foggia (2018). Their research employs a macroeconomic model using input-output analysis to evaluate the effects of Italy's packaging waste management on job creation, production, and value-added. By 2020, higher targets resulted in an additional €196,5 million in production, the creation of 584 new jobs, and €32 million in added value compared to the baseline scenario. These outcomes are driven by direct effects, such as the expansion of recycling activities, and indirect effects, including the stimulation of supply chains that support recycling processes.

Regarding labour skills, the European Commission (2018) suggests that the CE transition will not have a transformational effect on labour market skill requirements, even in ambitious scenarios. However, there is an anticipated trend toward higher demand for transversal skills, such as problem-solving and communication, emphasizing the importance of adaptive competencies in future labour markets. The EU's Circular Economy Action Plans have also emphasized targeted policies for sectoral transformations and skill shifts.

4. Data sources and methodology

While prior studies provide valuable insights into CE investment and employment trends, significant research gaps remain. First, most studies rely on theoretical projections rather than empirical assessments of CE's actual financial and labour market impacts; second, regional disparities in CE adoption remain understudied, particularly regarding country-specific differences in investment flows and employment creation; third, existing research rarely quantifies how CE employment patterns evolve, limiting the ability to forecast long-term labour market shifts.

To address these gaps, this article conducts a quantitative analysis using standardized economic indicators to assess CE investment trends, employment distribution, and regional disparities across European countries. The analysis follows a descriptive statistical approach, using trend and comparative assessments to examine regional disparities and sectoral variations.

The data used in the empirical analysis come from official and standardized datasets to ensure accuracy and comparability. The primary sources include:

- Eurostat's "Gross Investment in Tangible Goods" dataset provides data on private investments in CE sectors across EU member states.
- Eurostat's Full-Time Equivalent (FTE) Employment Statistics cover employment trends in the recycling, repair, and reuse sectors.
- OECD Macroeconomic Indicators, including GDP growth rates and sectoral contributions.
- European Commission Reports, which provide qualitative insights into CE policy impacts.

These data were sourced from Eurostat's Circular Economy Monitor Framework, which covers investment and employment figures from 2015 onwards, coinciding with the implementation of the EU Circular Economy Action Plan. Normalization techniques were applied to adjust for country size differences, ensuring robustness and comparability, and allowing for consistent cross-country comparisons of CE adoption.

The empirical analysis employs descriptive statistics and comparative assessments to examine trends in CE investment and employment (available in Appendix 2). The key statistical techniques include:

(a) *Analytical methods*: Normalized metrics and trend analysis are commonly used in comparative studies and the evaluation of public or economic policies. These techniques are crucial for ensuring that cross-country comparisons are accurate and that temporal dynamics are accurately captured.
Normalized indicators, such as investment in the circular economy (CE) as a percentage of GDP or employment in the CE as a share of total employment, enable comparisons that adjust for differences in economic size or labour market structures. As Davis et al. (2012) explain, indicators are "a named collection of rank-ordered data that purports to represent the past or projected performance of different units." They are used to compare entities synchronically or over time, evaluating their performance against one or more standards (te Lintelo et al., 2020).

The use of such indicators has become central to policy evaluation, particularly in the context of increasing demands for transparency and accountability. Wong (2014) highlights that economic and social indicators have evolved to capture both the state and the dynamics of socioeconomic development and are now integral to policy frameworks that aim to integrate economic, social, and environmental dimensions.

Meanwhile, trend analysis, particularly through annual growth rates, complements normalized indicators by providing insight into the direction and sustainability of policy impacts over time. This temporal dimension is crucial for understanding the evolution of macroeconomic indicators and for assessing the long-term effectiveness of policy interventions.

(b) *Scatterplot analysis*: To explore the potential association between CE investment and employment across European countries, we employ a bivariate scatterplot analysis. Scatterplots are a foundational tool in exploratory data analysis (EDA), widely used across disciplines such as economics, business, and the social sciences due to their intuitive visual format and capacity to reveal underlying patterns in data distributions (Sainani, 2016; Bergstrom & West, 2018).

In a two-dimensional scatterplot, each observation is represented as a point defined by its values on the horizontal (x) and vertical (y) axes. This graphical representation enables researchers to visually assess the nature and strength of the relationship between two continuous variables, particularly in cross-sectional datasets where only one observation per variable is available for each unit of analysis—in this case, each country.

One of the key advantages of scatterplots lies in their ability to detect linear and nonlinear trends, clusters, and outliers that may not be evident through summary statistics alone (Yeager et al., 2007). When a discernible pattern emerges—such as a diagonal alignment of points—it may suggest a correlation between the variables. To complement the visual analysis, it is possible to compute correlation coefficients to quantify the strength and direction of the observed relationships, such as the Pearson correlation coefficient (PCC), which assesses linear associations.

While scatterplots are potent tools for visualizing associations, it is important to acknowledge their limitations. They do not imply causality, and their interpretive power is constrained to two variables at a time (Altman & Krzywinski, 2015). Nonetheless, we believe that in the context of this study, the use of scatterplots is both methodologically sound and analytically appropriate. As Cleveland (1993) emphasized, graphical methods are not merely illustrative but are essential tools for discovering structure in data and generating hypotheses. Scatterplots allow researchers to visually assess the form, direction, and strength of relationships between two continuous variables, such as CE investment and employment rates. This is particularly useful in cross-country analyses, where heterogeneity in economic structure, policy implementation, and data quality can obscure patterns detectable through visual inspection.

(c) *Graphical convergence analysis*: The concept of economic convergence has been widely used in growth theory to assess whether less developed economies tend to catch up with more advanced ones over time. According to Barro and Sala-i-Martin (1990, 1992), convergence implies that countries with lower initial levels of income per capita should exhibit higher growth rates than richer countries, leading to a progressive reduction in income disparities. This idea is formalized through two complementary notions: β-convergence, which refers to the negative relationship between initial income levels and subsequent growth rates, and σ-convergence, which captures the declining dispersion of income levels across economies over time (Barro, 1991).

In this study, we extend the convergence framework to the domain of CE performance by examining whether countries with initially lower levels of CE-related investment and employment have experienced faster growth in these indicators. This approach enables us to assess whether lagging regions are catching up with more advanced ones in terms of CE adoption, a key objective of EU cohesion and sustainability policies.

To explore this phenomenon, we employ graphical convergence analysis. This method involves plotting the average annual growth rate of a given variable (e.g., CE investment or employment) on the vertical axis against its initial level on the horizontal axis, typically in logarithmic form. If convergence is present, we expect to observe a downward-sloping trend, where countries starting from lower initial levels exhibit higher growth rates, indicating a catch-up process. This visual approach, while intuitive, is grounded in the same logic as formal econometric tests of β-convergence and has been widely used in empirical growth literature (Sala-i-Martin, 1996; Islam, 2003).

In our case, the graphical analysis is applied to CE investment and employment data across EU member states. By examining the slope and dispersion of the scatter plots, we can infer whether convergence dynamics are present in these key dimensions of the circular transition. This method complements the cluster analysis and provides additional insights into the spatial and temporal dynamics of CE development.

(d) *Cluster analysis*: To explore patterns of CE performance across EU member states, we employed a cluster analysis based on key socioeconomic indicators related to CE investment and employment. Cluster analysis is a widely used unsupervised learning technique that allows for the identification of homogeneous groups within heterogeneous datasets, facilitating comparative analysis and policy interpretation (Hair et al., 2014; Ketchen & Shook, 1996).

We selected the k-means clustering algorithm due to its efficiency, interpretability, and suitability for large-scale, continuous data. K-means is particularly appropriate when the objective is to partition observations into non-overlapping groups that minimize within-cluster variance (Jain, 2010). Prior to clustering, all variables were standardized to ensure comparability and to prevent scale-driven distortions in the distance calculations (Milligan & Cooper, 1988).

The optimal number of clusters (k) was determined using a combination of the elbow method and theoretical interpretability. The elbow method involves plotting the total within-cluster sum of squares (WCSS) against increasing values of k and identifying the point at which the marginal gain in explained variance diminishes significantly (Thorndike, 1953). In our case, the elbow plot indicated a clear inflection point at $k = 3$, suggesting that three clusters provide a parsimonious yet meaningful segmentation of the data.

This choice was further supported by the interpretability of the resulting clusters, which revealed distinct profiles of CE performance across countries. These profiles align with known regional disparities in CE policy implementation and industrial structure, thereby enhancing the external validity of the clustering solution (Ketchen & Shook, 1996; Heshmati, 2015). By combining statistical rigor with theoretical relevance, the use of k-means clustering with three groups offers a robust analytical framework for understanding the heterogeneity of CE transitions across the EU.

These methods were selected to ensure a structured, unbiased, and economically meaningful comparison of CE adoption across regional and national contexts. Investment, as a percentage of GDP, allows for cross-country comparability; employment as a percentage of total employment contextualizes CE's labour market impact; and annual growth rates provide insight into long-term trends. Cluster analysis identifies structural patterns and disparities in the adoption of CE.

The empirical findings aim to contrast theoretical claims made in the literature. Prior research highlights that Western European countries lead the adoption of CE due to their strong institutional frameworks and investment strategies (Bourdin and Torre, 2024; Pinyol, 2022), whereas Eastern European countries lag due to financial constraints and weak governance (Skrinjarić, 2020). By analysing actual investment and employment data, this study empirically assesses whether these assumptions hold, identifying potential deviations or emerging trends that may not be fully captured in the previous literature.

5. Results and discussion

The results reflect varying levels of integration and commitment to CE practices. Germany and France emerged as clear leaders, with Germany showing substantial investment growth from €16.201 in 2021, reflecting an average annual growth rate of 11.7%. This growth was driven by solid governance, advanced infrastructure, and a capacity for innovation. Similarly, France maintains consistently high investments, averaging over €20.000M annually. However, it has not undergone significant changes in levels over the analysed period, exhibiting an average annual growth rate of 0.4%. Despite this, France remains an advanced CE player (Figure 4a).

The regional disparities in CE adoption are not solely a function of financial investment but are closely tied to industrial structure, technological diffusion, and economic specialization (D'Amato, et al, 2017; Cainelli, et al., 2020). Countries with strong manufacturing bases, such as Germany and the Netherlands, exhibit higher CE investment intensity, leveraging advanced technological infrastructures. By contrast, economies with lower R&D intensity, such as Poland and Bulgaria, display slower innovation diffusion and adoption of CE principles. The Eco-Innovation Scoreboard (2023) confirms these patterns, ranking countries based on CE-related R&D spending and innovation-driven transitions. This underscores the need for tailored policies that align CE investment with industrial capabilities and regional economic profiles.

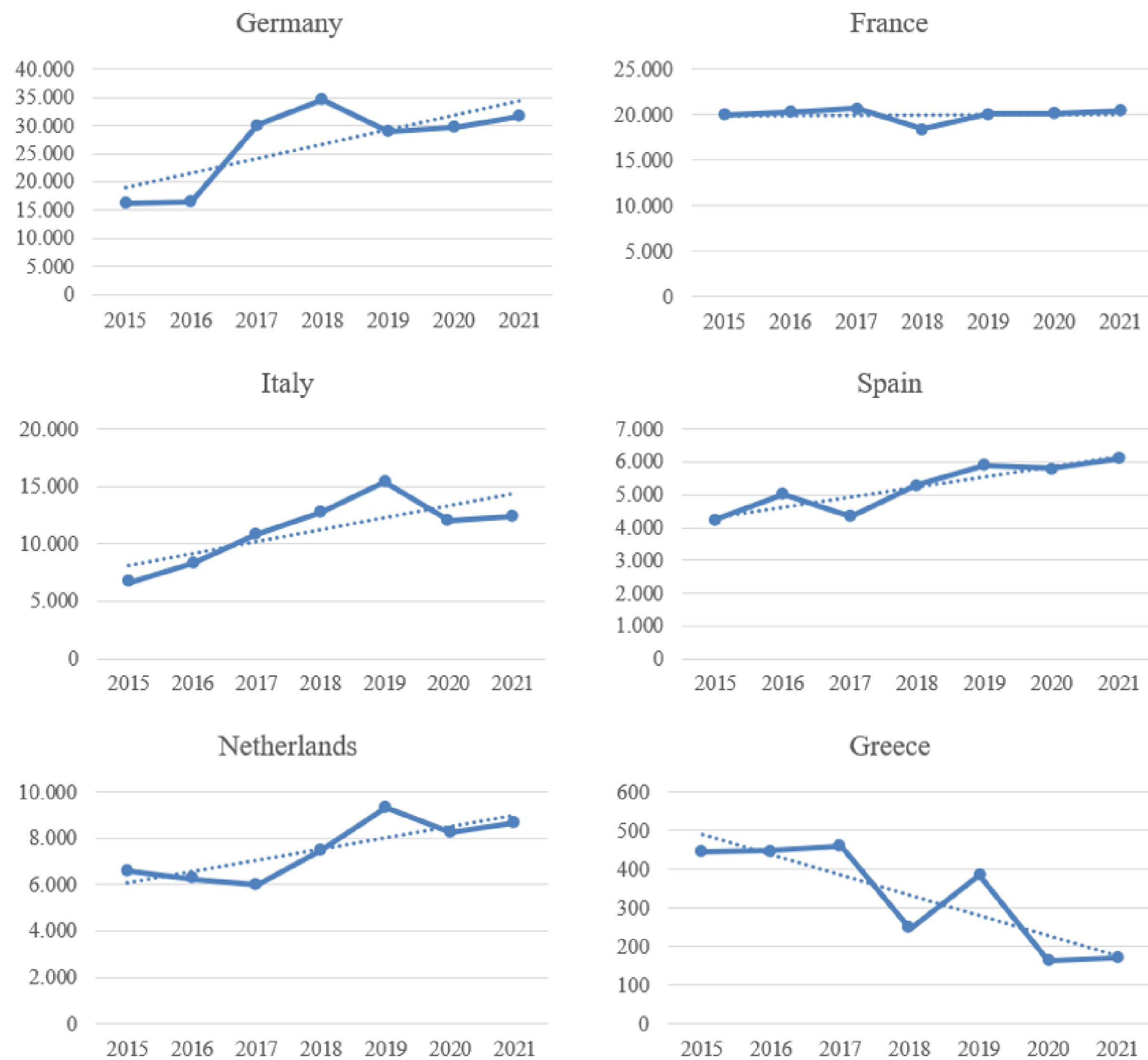


Figure 4a. Private investment related to Circular Economy sectors (millions of €) (Source: Eurostat and own elaboration.)

Italy and Spain excel among the moderate contributors, with significant and steady investment increases (Figure 4a). Italy's investments have more than doubled, rising from €6.684 in 2021, translating into a high average growth rate of 10.9%, highlighting its growing importance in CE, particularly in labour-intensive sectors like recycling and repair. Traditionally not considered a leader, Spain has reflected sustained growth, from €4.236 in 2015 to €6.108 in 2021, with an average growth rate of 6.3%, positioning it as an emerging player in Southern Europe. These trends challenge the literature's tendency to understate the contributions of these countries. These findings challenge assumptions about Italy and Spain's role in the CE adoption, highlighting their significant contributions to investment growth and job creation. A reassessment of their position within the CE framework is necessary to reflect their emerging leadership, particularly in labour-intensive sectors accurately.

In contrast, Eastern European countries, including Romania, Hungary, and Bulgaria, lag significantly in CE investments, with figures remaining below €1.100M throughout the period, except for Poland (Figure 4b). These countries face persistent institutional and financial challenges that hinder their ability to capitalize on the opportunities presented by CE. For example, Bulgaria's investments plateau between €308M and €395M, reflecting limited integration of CE practices. Similarly, despite its potential, Greece has experienced stagnation and even decline in investments during specific years, with a low of €247 million in 2018 (Figure 4a). These trends reinforce the literature's characterization of Eastern Europe as a lagging region, with more modest average growth rates, slightly above 5% in the case of Poland and Hungary, and 4,2% and 3% in the case of Bulgaria and Romania, respectively, which emphasize the urgent need for targeted interventions to boost investment and institutional capacity.

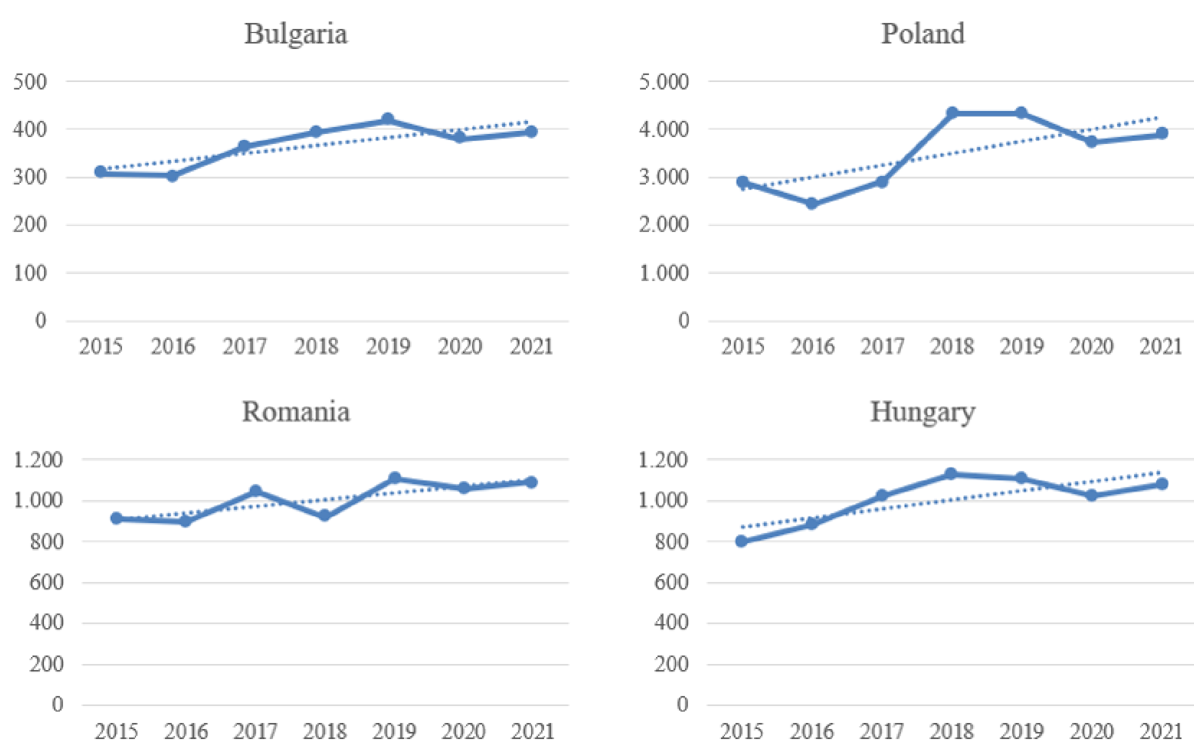


Figure 4b. Private investment related to Circular Economy sectors (millions of €) (Source: Eurostat and own elaboration.)

Indeed, when analysing the percentage of CE investment in relation to total investment, it is interesting to identify the five countries with the highest (top 5) and lowest (bottom 5) percentages, as illustrated below, highlighting the significant role of CE investment in Belgium as opposed to the smaller presence in Ireland in relative terms (Figure 5).

Figure 5. Proportion of investment in the CE as a percentage of total investment (Source: Eurostat and own elaboration.)

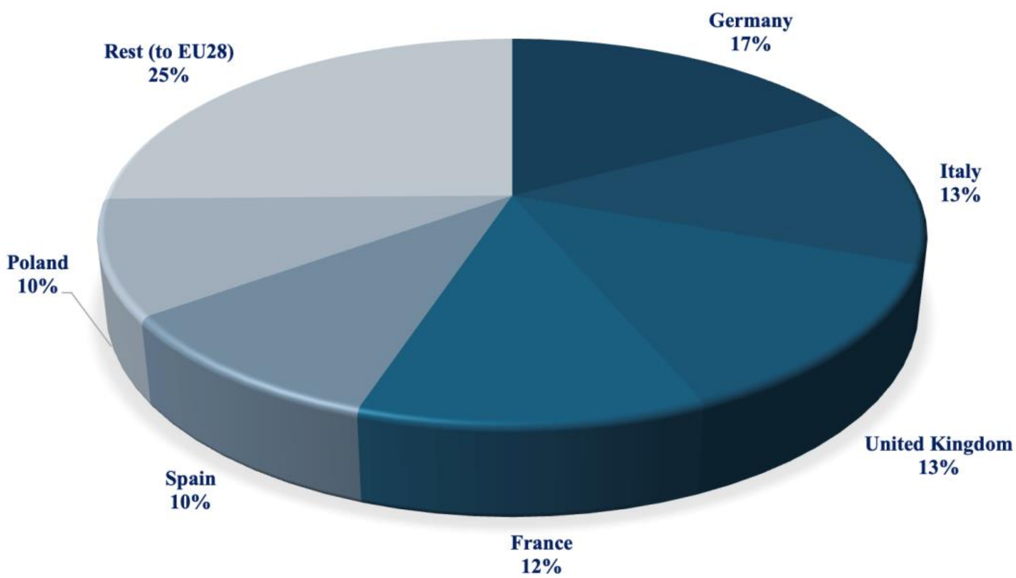


Figure 6. Distribution of total employment in the CE within the EU28 (Source: Eurostat and own elaboration.)

The employment data highlights significant regional and national disparities in CE sector performance across Europe. Germany leads in employment (Figure 6), with numbers growing from 651,777 full-time equivalent (FTE) positions in 2015 to 785,297 in 2021, representing an annual employment growth rate of 3.1%, reflecting its role as an advanced CE leader**.** France also had 453,890 FTE in 2015 to 523,904 in 2021, thereby reinforcing its position as a key player. In Southern Europe**,** Italy stands out with employment levels exceeding 600,000 FTE, emphasizing its reliance on labour-intensive CE activities, such as recycling and repair. This country is categorized as a moderate contributor rather than a leader in the CE. While the literature highlights Italy's challenges, such as inefficiencies in waste management, the employment figures suggest a strong capacity for generating jobs, which could position Italy closer to advanced countries in terms of its socio-economic contribution to CE.

Similarly, Spain demonstrates moderate but consistent growth, rising from 384.276 FTE in 2015 to 454.085 in 2021 (as Figure 6 illustrates, 10% of European CE employment is located in Spain). The literature does not typically highlight Spain as a leader in CE, but employment data suggest its growing importance. Data show a significant and steady increase in CE employment, which not only suggests its emerging role in the CE but also fosters hope for its potential to become a leader, particularly for its ability to create jobs in the recycling and reuse sectors.

In contrast, Eastern Europe lags significantly**.** Romania and Bulgaria show limited employment growth, with figures remaining below 100.000 FTE throughout the period, highlighting ongoing institutional and financial constraints. These trends underline persistent regional disparities that align with the literature's characterization of advanced and lagging countries while revealing areas where targeted interventions are needed to foster equitable growth in CE sectors. Regarding the proportion of employment in the CE as a percentage of total employment, it is interesting to identify the five countries with the highest (top 5) and lowest (bottom 5) percentages, as illustrated in Figure 7.

Figure 7. Proportion of employment in the CE (as a percentage of total employment). (Source: Eurostat and own elaboration.)

While this analysis provides a valuable empirical perspective on CE adoption across Europe, it is essential to acknowledge certain limitations. First, the employment data from Eurostat primarily reflect formal CE jobs, potentially underestimating the contributions of the informal sector, especially in recycling and waste collection. Second, while investment data captures private-sector financial flows, it may not fully reflect public investments or policy-driven CE funding mechanisms. Lastly, regional disparities in data availability may influence cross-country comparisons. Despite these limitations, the use of officially recognized and standardized data sets, coupled with normalization techniques, enhances the reliability of the findings.

This study better incorporates an annual growth rate analysis to capture CE adoption dynamics over time. This adjustment ensures that investment and employment trends are comparable across different economic contexts, allowing for a more precise evaluation of which countries are progressing fastest in CE integration. Overall, the data aligns with the literature's classification of advanced and lagging countries while highlighting important nuances. Italy and Spain's rising investments underscore their emerging roles, particularly in job creation and economic transformation. Western Europe continues to dominate CE investments, while Eastern Europe requires immediate and focused strategies to bridge gaps and foster equitable development. Tailored policies that promote financial support, innovation, and institutional improvements in lagging regions are crucial to reducing disparities and fully realizing the potential of circular economy practices across Europe.

The empirical analysis of the relationship between investment in the CE as a percentage of GDP and employment in CE as a share of total employment using a scatterplot reveals a consistently negative correlation across the two years analysed, 2015 and 2021. In Figure 8, each data point represents a country, and the red dotted trend line illustrates the direction of the association between the two variables. In 2015, the coefficient of determination, $R^2 = 0.0935$, and the Pearson correlation coefficient, $r = -0.306$, suggest a weak negative relationship. Although the p-value associated with this correlation is not statistically significant at the conventional 5% level, it approaches the 10% threshold, indicating a marginal association that may reflect underlying structural dynamics in the early stages of CE implementation.

By 2021, the relationship weakens further, with $R^2 = 0.0426$ and $r = -0.206$, and the p-value exceeds any conventional significance level. This decline in both the strength and statistical relevance of the relationship suggests that the explanatory power of CE investment concerning employment outcomes has diminished over time. While a positive correlation might be expected—on the assumption that higher investment would stimulate job creation in CE sectors—the empirical evidence suggests the opposite. This counterintuitive result may reflect the influence of structural, institutional, or technological factors that mediate the translation of investment into employment.

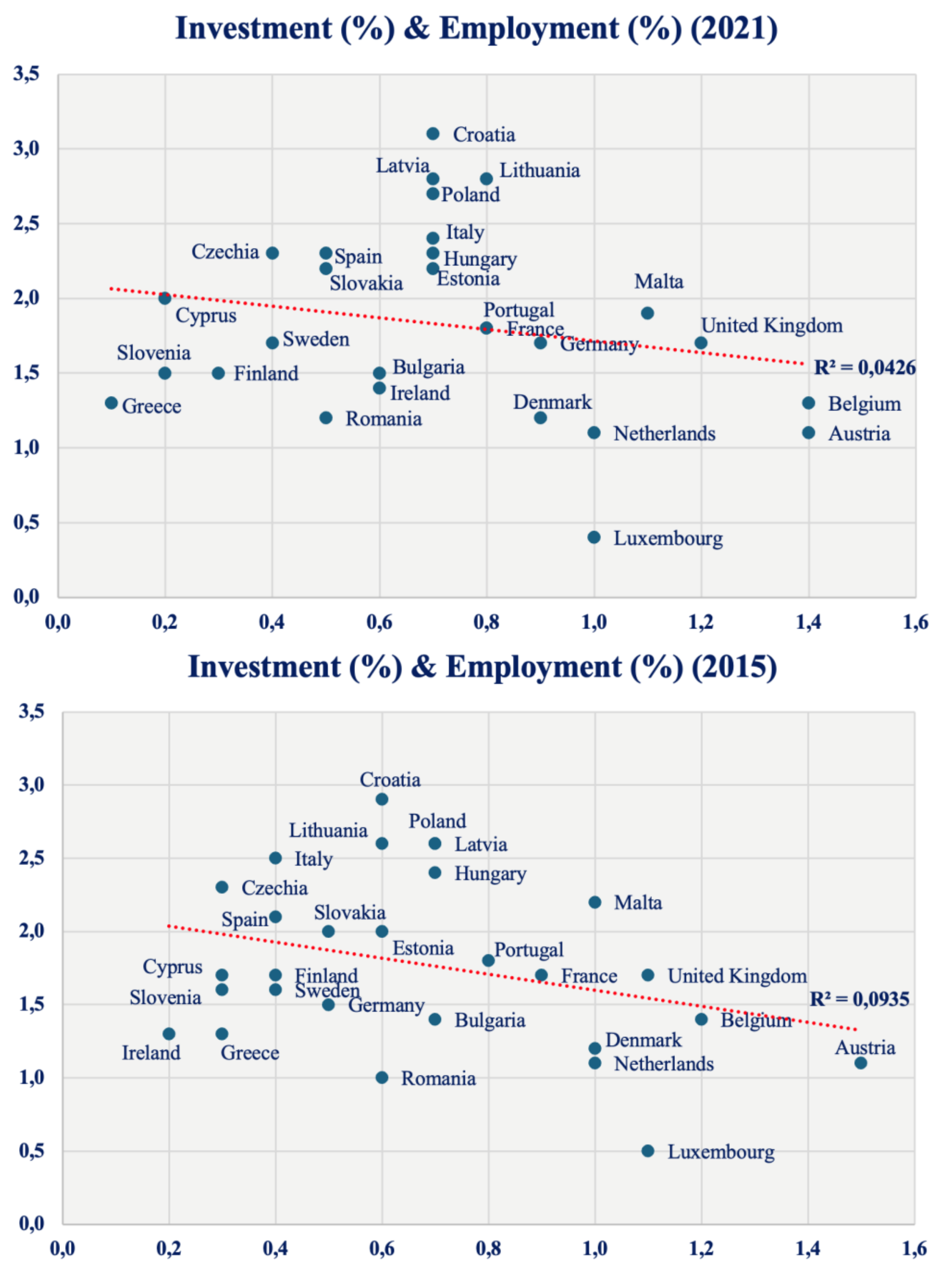


Figure 8. CE Investment & Employment Relationship. (Source: Own elaboration.)

These findings align with the broader literature reviewed in Section 2, which emphasizes the complexity of CE's economic impacts and the limitations of assuming linear relationships between investment and employment. The literature highlights that CE adoption is shaped not only by financial inputs but also by industrial specialization, innovation capacity, and policy coherence. For instance, countries with strong eco-innovation frameworks and advanced recycling infrastructures, such as Germany and the Netherlands, demonstrate higher CE integration. In contrast, others with weaker institutional settings face structural barriers to effective CE transitions.

Furthermore, these results are related to the analysis of the key drivers of CE adoption across Europe presented in Section 3, which underscores that while investment is a necessary condition for CE development, it is not sufficient on its own to generate proportional employment gains. The divergence between investment and employment trends may be attributed to the increasing capital intensity of CE sectors, the automation of recycling processes, and the shift toward service-based models that do not necessarily require significant labour inputs. Moreover, regional disparities in governance, infrastructure, and education systems further modulate the employment effects of CE investment.

Finally, the cluster analysis presented reinforces this interpretation by categorizing countries into distinct groups based on their CE investment and employment profiles. Notably, some countries exhibit high employment shares in CE despite relatively low investment levels, suggesting that labour-intensive CE activities—such as repair and reuse—may thrive even in the absence of substantial capital flows. Conversely, countries with high investment but modest employment shares may be focusing on infrastructure development or technology-driven CE strategies that are less labour-intensive.

The proximity of the 2015 p-value to the 10% significance level may indicate that, at that time, CE investment had a more direct or measurable impact on employment, possibly due to the labour-intensive nature of early CE initiatives. As CE policies matured and technological efficiencies increased, the marginal employment effects of additional investment appear to have diminished. This evolution underscores the need for a more nuanced understanding of the mechanisms linking CE investment to labour market outcomes. It highlights the importance of complementary policies—such as skills development, innovation support, and regional cohesion measures—to maximize the socioeconomic benefits of the circular transition.

In the context of graphical convergence analysis, a negative slope in the trend line indicates the presence of β-convergence: countries or regions with lower initial levels of a given variable (e.g., circular economy investment or employment) tend to exhibit higher subsequent growth rates. However, individual observations may deviate from this general trend, and such deviations carry important interpretive value.

Countries located above the trend line have experienced higher growth rates than predicted by their initial conditions. This suggests that these countries are outperforming the average catch-up trajectory, possibly due to more effective policy implementation, stronger institutional frameworks, or greater innovation capacity in the circular economy domain. These cases may represent positive outliers or early adopters that are accelerating their transition beyond what would be expected given their starting point.

Conversely, countries situated below the trend line have recorded lower growth rates than the average for their initial level. This underperformance may reflect structural barriers, policy inefficiencies, or limited absorptive capacity, which hinder their ability to converge with more advanced peers. Identifying such cases is crucial for understanding the heterogeneity of convergence dynamics and for designing targeted interventions to support lagging regions. Overall, the position of each country relative to the trend line provides valuable insights into the effectiveness and inclusiveness of the circular economy transition across the EU.

Nevertheless, if a positively sloped trend line is observed in the scatter plot, this would indicate a pattern of divergence, contrary to the regional convergence objectives promoted by the EU. Such a result suggests that countries with higher initial levels of CE investment or employment are further widening their advantage over less advanced peers. This dynamic may reflect self-reinforcing mechanisms, where initial strengths lead to disproportionate gains over time. The presence of divergence has important implications for the design of cohesion and sustainability policies, as it highlights the risk of increasing disparities in CE development across member states and underscores the need for targeted interventions to support lagging regions.

Figure 9 displays a cross-sectional scatter plot used to assess β-convergence in circular economy (CE) investment per capita across European countries. The vertical axis represents the average annual growth rate of CE investment per capita over the study period, while the horizontal axis plots the initial level of CE investment per capita, expressed in natural logarithms. The negative slope of the fitted trend line suggests the presence of β-convergence: countries with lower initial levels of CE investment per capita tend to exhibit higher subsequent growth rates in this variable. This inverse relationship is consistent with the theoretical framework of Barro and Sala-i-Martin (1992), which posits that, under certain conditions, economies with lower initial capital stocks or investment levels should grow faster than their more advanced counterparts, thereby narrowing the gap over time.

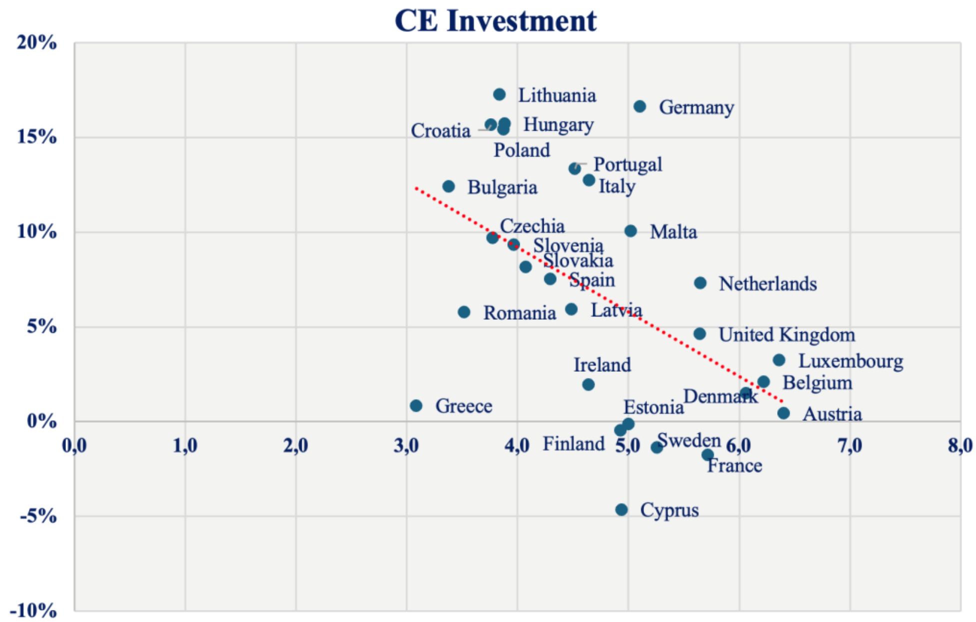


Figure 9. β-Convergence in Circular Economy Investment per Capita. (Source: Own elaboration.)

The scatter plot analysis of per capita investment across EU countries reveals a clear bifurcation in performance relative to the estimated trend line. Countries positioned above the red trend line—indicating higher-than-expected investment levels given their characteristics—include Germany, Croatia, Lithuania, Hungary, Poland, Portugal, Italy, Bulgaria, Czechia, Slovenia, Malta, the Netherlands, the United Kingdom, Luxembourg, and Belgium. These countries demonstrate stronger-than-expected growth in CE investment per capita relative to their initial levels.

Conversely, countries below the trend line—namely Austria, Denmark, Sweden, Estonia, Finland, Ireland, France, Romania, Latvia, Greece, and Cyprus—exhibit lower-than-expected investment levels that fall below the trend line, suggesting more modest growth trajectories despite higher initial investment levels. This divergence underscores the heterogeneity in investment behaviour across the EU and highlights the importance of country-specific factors in shaping capital formation trajectories.

This graphical evidence supports the hypothesis that CE investment is converging across EU member states, potentially reflecting the diffusion of circular economy policies and the effectiveness of EU-wide funding mechanisms and regulatory frameworks.

Figure 10 presents a scatter plot illustrating the relationship between the initial level of employment in the circular economy (CE) — measured as a percentage of total employment in 2015 — and the average annual growth rate of this share over the period 2015–2021, across the 27 EU Member States and the United Kingdom. The fitted linear trend line, shown in red, exhibits a positive slope, indicating that countries with a higher initial share of CE employment tended to experience higher subsequent growth rates in this indicator.

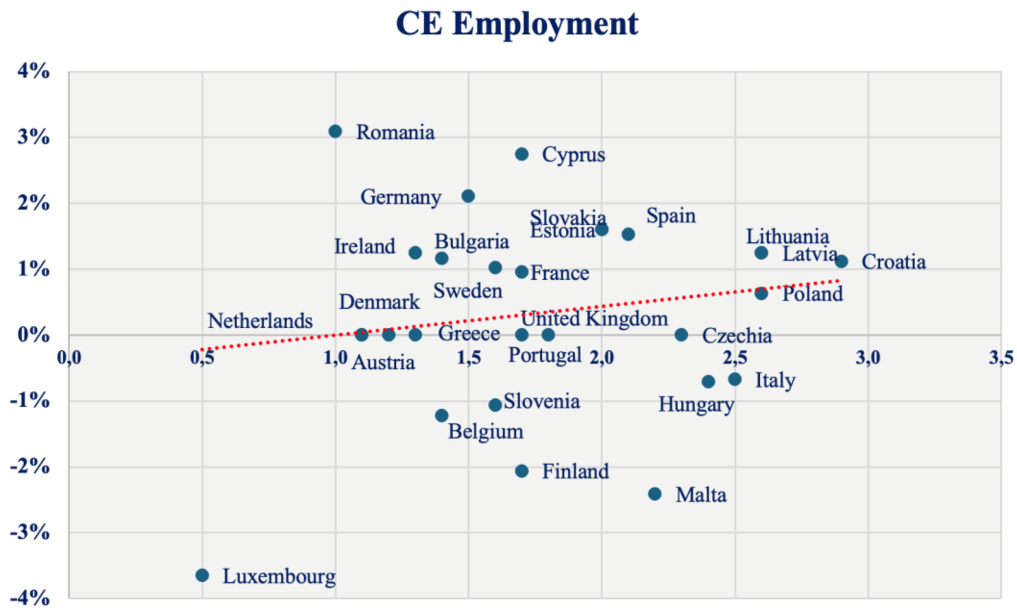


Figure 10. β-Convergence analysis in employment in the Circular Economy (as a percentage of total employment). (Source: Own elaboration.)

This empirical pattern is inconsistent with the hypothesis of β-convergence, as formulated by Barro and Sala-i-Martin (1992), which predicts a negative relationship between initial levels and subsequent growth. Instead, the observed positive association suggests the presence of divergence dynamics: countries that were already more advanced in terms of CE employment have continued to expand their relative advantage. At the same time, those with lower initial shares have grown more slowly or even declined in value.

Countries such as Romania, Germany, Ireland, Bulgaria, Sweden, Greece, Cyprus, Slovakia, Estonia, France, Spain, Croatia, Lithuania, and Latvia are positioned above the trend line, indicating that their performance in circular employment has exceeded the average trend. These countries are diverging positively, reinforcing their leading positions or catching up rapidly. Such divergence may reflect underlying structural asymmetries, including differences in institutional capacity, labour market adaptability, or the degree of integration of circular economy principles into national policy frameworks. It may also point to path-dependent processes or increasing returns to scale in CE-related sectors, whereby early movers benefit from cumulative advantages that reinforce their lead over time.

The graphical convergence analysis conducted in this study provides empirical support for the theoretical and policy-oriented discussions presented throughout the manuscript. Specifically, the evidence of β-convergence in circular economy (CE) investment per capita across EU member states aligns with the notion that cohesion policies and EU-wide funding mechanisms have facilitated catch-up dynamics among less advanced countries. The negative slope observed in the scatter plot indicates that countries with lower initial levels of CE investment have experienced higher subsequent growth rates, suggesting that structural and financial support mechanisms are effectively narrowing disparities in capital formation. This finding complements the discussion in Section 2.2, which emphasizes the role of industrial structure and technological diffusion in shaping investment trajectories. Moreover, the performance of Southern and Eastern European countries—such as Poland, Portugal, Italy, and Bulgaria—above the trend line reinforces the argument in Section 3.1 that these regions are leveraging CE as a pathway for modernization and economic renewal.

In contrast, the analysis of CE employment as a share of total employment reveals a pattern of divergence, with a positively sloped trend line indicating that countries with higher initial employment shares have continued to expand their relative advantage. This outcome challenges the hypothesis of β-convergence and suggests the presence of self-reinforcing mechanisms or structural asymmetries that inhibit catch-up in labour market integration within the CE. Section 2.3 of this work highlights the dependence of CE employment on sectoral composition and labour market adaptability, which helps explain why countries such as Germany, Ireland, and Sweden—already advanced in CE employment—have maintained or accelerated their lead. The divergence observed in the employment dimension also resonates with the findings in Section 3.2, where the limited expansion of labour-intensive CE sectors in lagging countries is attributed to insufficient policy support and institutional capacity.

The heterogeneity revealed by the convergence analysis underscores the need for a more nuanced understanding of CE dynamics, which is addressed through the cluster analysis presented below. The identification of countries above and below the trend lines in both investment and employment dimensions suggests the existence of multiple convergence paths or "clubs," each characterized by distinct structural and institutional features. This empirical pattern validates the application of cluster analysis as a complementary methodological approach, enabling the classification of countries into internally homogeneous and externally heterogeneous groups. The manuscript's discussion on the relevance of clustering techniques, supported by recent literature, gains further credibility in light of the convergence results, which demonstrate that uniform policy prescriptions may be inadequate in addressing the diverse trajectories of CE adoption across Europe.

We also consider that the convergence analysis not only reinforces the manuscript's core arguments regarding regional disparities and structural heterogeneity in CE development but also provides a robust empirical foundation for the policy recommendations outlined in the Conclusions. By identifying patterns of convergence and divergence, the analysis highlights the importance of targeted interventions and differentiated strategies to support lagging regions and promote inclusive and sustainable transitions toward a circular economy.

Although convergence analysis has become a central tool in empirical economics to assess whether economies or regions tend toward a common steady state over time, empirical findings often reveal that convergence is not uniform across all units of observation. In such cases, the identification of multiple convergence paths or "clubs" suggests the presence of structural heterogeneity that cannot be fully captured by convergence metrics alone. This limitation justifies the application of cluster analysis as a complementary methodological approach.

Cluster analysis enables the classification of countries or regions into internally homogeneous and externally heterogeneous groups based on multiple dimensions of economic performance. This technique is particularly valuable when convergence analysis reveals divergence or club convergence, as it allows researchers to explore the underlying structural characteristics that differentiate these groups. As noted by Saba and Ngepah (2023), while the Phillips and Sul (2007) methodology can detect convergence clubs, further classification techniques such as cluster analysis are necessary to understand the economic, institutional, or policy-related factors that drive club formation.

Moreover, cluster analysis enhances the explanatory power of convergence studies by uncovering latent group structures that may reflect differences in innovation capacity, labour market dynamics, environmental policy, or investment in sustainability. Basel et al. (2021) emphasize that convergence clubs often emerge due to persistent disparities in governance quality, exposure to globalization, and social development, which can be systematically identified through cluster analysis (Fingleton, 2004).

From a methodological standpoint, cluster analysis does not impose assumptions of homogeneity or linearity, making it well-suited for analysing complex, multidimensional datasets. As Sarstedt & Mooi (2019) argue, this flexibility allows researchers to detect meaningful patterns that may remain hidden in traditional econometric approaches (Mendez, 2020). Therefore, the integration of cluster analysis following convergence analysis provides a more nuanced understanding of economic dynamics. It facilitates the identification of structurally similar groups, supports the formulation of targeted policy recommendations, and contributes to a deeper interpretation of convergence processes in heterogeneous economic environments.

Subsequently, through cluster analysis, countries can be categorized into three distinct clusters based on the aforementioned variables: the percentage of employment in the CE and the investment in the CE, derived from the total terms of both concepts (Figure 11).

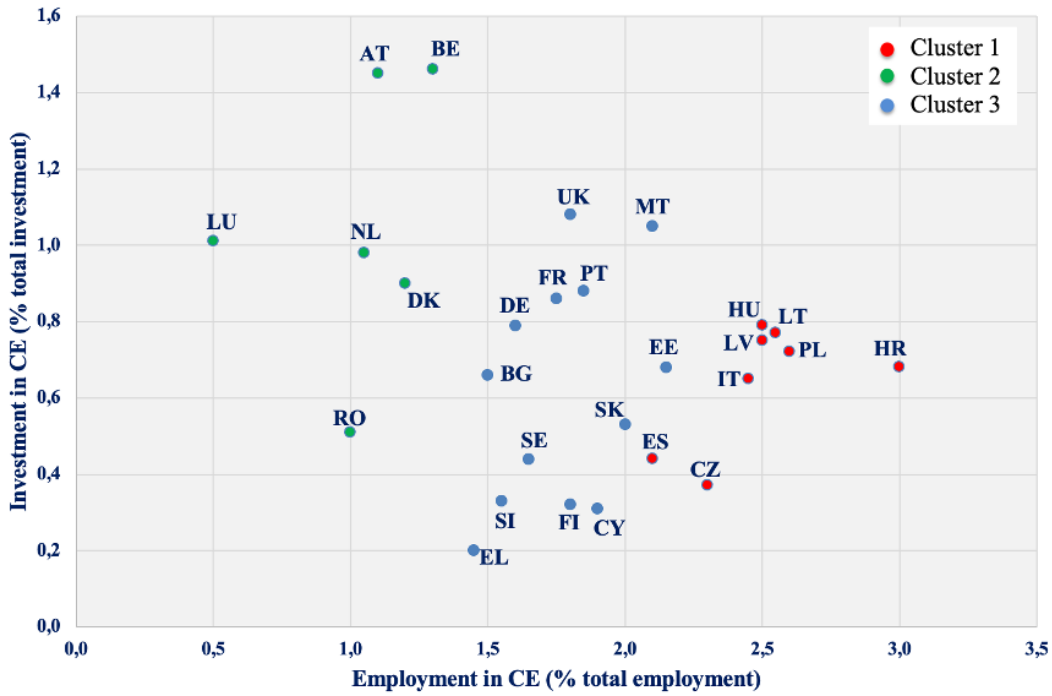


Figure 11. Clusters of EU28 countries based on employment and investment in CE (Source: Eurostat and own elaboration.)

The clusters were obtained using the K-means clustering algorithm, an unsupervised learning technique to group data into different clusters based on their characteristics. Grouping countries into these three clusters can facilitate the identification of patterns and trends in the adoption of CE practices across diverse national contexts. The following explanation provides a detailed delineation of each cluster:

- Cluster 1 (red): This cluster includes countries with high CE employment but lower investment levels. Examples of countries in this cluster include Croatia, Italy, Poland, and Lithuania. These countries have a high share of the CE in employment, but investment in this area is relatively low. This suggests a need for increased investment to sustain employment in the sector.
- Cluster 2 (green): This cluster includes countries with lower CE employment levels but higher CE investment levels. Examples of countries in this cluster include Luxembourg, Malta, and Austria. These countries are investing significantly in the CE, although the share in employment is lower. This could indicate a focus on building infrastructure and capacity before it is reflected in employment.
- Cluster 3 (blue): This cluster comprises countries with moderate employment and investment levels in the CE. Examples of countries in this cluster include Belgium, France, Germany, and Portugal. These countries have a balanced approach to implementing CE practices, as evidenced by their moderate employment and investment levels in the circular economy.

Identifying clusters is an effective strategy for optimizing resource allocation, which can be utilized to evaluate the impact of CE policies and programs. Through comparative analysis within each cluster, it is possible to identify the most effective policies and replicate them in other countries exhibiting similar characteristics. For example, countries in cluster 2, which demonstrate high investment but low employment participation, may benefit from targeted support to develop the skills and abilities of their workforce, thereby maximizing the return on investment.

6. Conclusions and Recommendations

The transition to a CE in Europe has revealed significant regional disparities in adoption and implementation. Developed countries such as Germany, France, and Finland lead due to robust governance, advanced infrastructure, and innovation-driven approaches. In contrast, less-developed regions, particularly in Eastern and Southern Europe, face institutional weaknesses, resource dependency, and limited financial and human capital. These disparities underscore the urgent need for tailored approaches to ensure all regions benefit equitably from CE's potential (Figure 12).

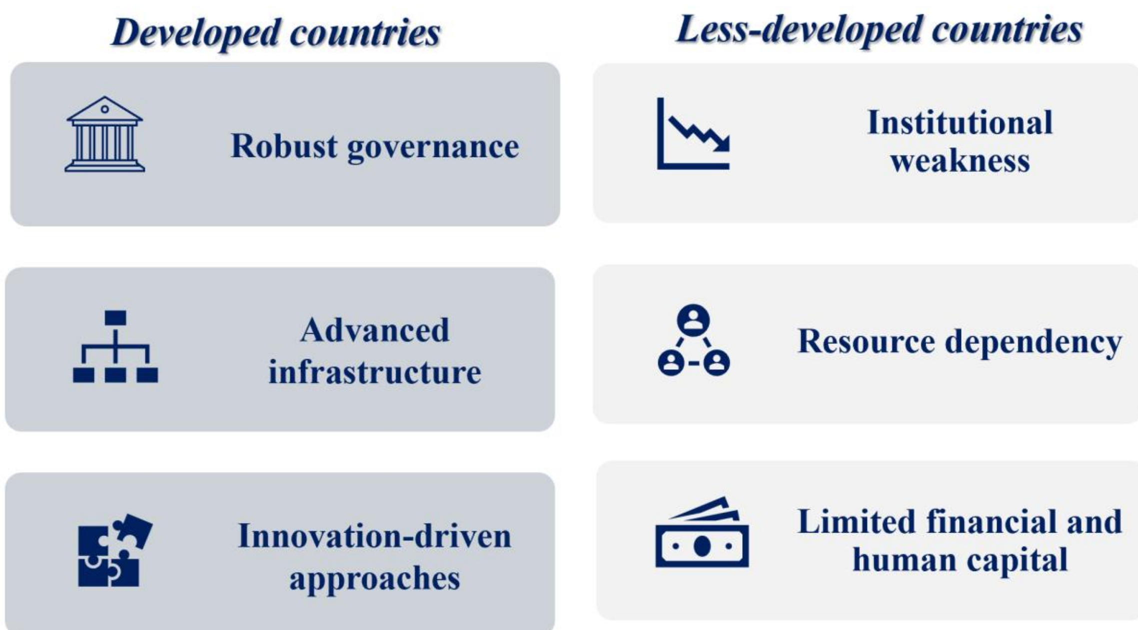


Figure 12. Factors Influencing the Development of the Circular Economy. (Source: Own elaboration)

CE offers substantial economic and environmental benefits, including a projected 2.0% increase in the EU's GDP, a 1.6% rise in employment, and a 24.6% reduction in CO_2 emissions by 2030. While advanced economies focus on high-tech innovations, less developed regions rely on labour-intensive CE activities, such as recycling and repair. Despite these opportunities, gaps in investment and employment trends between regions highlight the urgent need for harmonized yet adaptable strategies.

The empirical analysis reveals significant disparities in CE investment and employment across Europe, aligning with but challenging some assumptions in the literature. While Germany and France confirm their leadership with consistent CE investments and employment growth, Southern European countries, such as Italy and Spain, outperform expectations, showing steady progress in labour-intensive sectors like recycling and repair. This contrasts with prior literature that often underestimates their contributions. Conversely, Eastern European countries, such as Romania and Bulgaria, continue to lag, with stagnant investments and minimal employment growth, reinforcing concerns about persistent institutional and financial barriers.

Furthermore, our results indicate that investment in the CE does not automatically translate into job creation. The relationship between these two variables is weak and has declined over time, suggesting that factors such as automation, sectoral specialization, and the maturity of public policies play a decisive role in shaping labour market outcomes. While some countries exhibit convergence in per capita CE investment, this trend contrasts with divergence in employment levels, reinforcing the need for complementary policies that promote skill development, labour mobility, and inclusive innovation.

The identification of three distinct clusters of countries—investment leaders, balanced performers, and employment leaders—enables the design of differentiated policy strategies. Countries with high investment but low employment levels could benefit from initiatives that foster workforce training and the development of entrepreneurial ecosystems. Conversely, countries with high employment participation but limited investment require financial and institutional support to sustain their momentum. Balanced countries may serve as benchmarks for the diffusion of best practices across the EU.

These findings highlight the need to reassess regional contributions and address policy and resource allocation gaps to foster equitable CE transitions. Innovation and skill development are key drivers for successful CE implementation. Countries with robust regulatory frameworks and substantial investments in research and development (R&D) have consistently shown higher circularity rates and greater economic resilience. However, regions with lower education levels and limited sector-specific skills struggle to scale up CE initiatives, emphasizing the need for targeted education and training programs.

Harmonized EU strategies, such as the Circular Economy Action Plan (CEAP), provide a critical framework for addressing disparities; however, they must be complemented by region-specific measures. Strategically allocating EU funding to less-developed regions must enhance targeted investment, prioritize infrastructure improvements, build institutional capacity, and provide financial support for CE activities.

Labour-intensive sectors such as recycling and repair should be emphasized to generate immediate economic and employment benefits. Secondly, it is required to foster innovation in developed regions that serve as benchmarks and provide knowledge opportunities for lagging regions. It is also necessary to implement tailored regional policies to complement harmonized EU strategies. Sector-specific education and training programs are essential to ensure workers can transition from traditional manufacturing roles to CE industries. Therefore, green stimulus packages could ensure an inclusive transition to the CE model, as they balance economic recovery with long-term sustainability goals.

Finally, the transition to a CE in Europe represents a transformative pathway toward sustainability, offering substantial benefits in terms of macroeconomic, environmental, and social impacts.

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Declarations

Competing interests The authors declare no competing interests.

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Appendix 1.

Appendix 1. presents the details of the literature review on the different modelling approaches used to estimate the economic and environmental impacts of the Circular Economy. Each estimation method provides complementary results, with different levels of complexity and data requirements. (Source: Own elaboration)

Authors	Region /Timeframe	Scope and Key Findings
Ellen MacArthur Foundation (2015)	EU 2015-2030	**Scope:** Circular economy toolkit for policymakers with ambitious EU GDP scenarios. **Key findings:** Ambitious EU-wide interventions could increase GDP by up to 6.7% by 2030, and significant reductions in CO_2 emissions are feasible. CE enables innovation, reduces resource dependency, and is projected to generate $320 billion in investments in the EU by 2025.
Mitchell & Keith (2015)	EU28 2015-2030	**Scope**: Economic benefits and job creation potential of expanding circular economy activities across Europe. **Key findings**: Employment: Up to 3 million gross jobs and 520,000 net jobs by 2030, and unemployment will be reduced by 0.31 percentage points. Opportunities exist for low— and mid-skill occupations. Material Productivity: Enhanced productivity through increased recycling, repair, reuse, and remanufacturing sectors.
Wijkman & Skanberg (2017)	Finland, France, Netherlands, Spain, Sweden (2010)-2017	**Scope:** Economic and job benefits of CE. **Key findings:** Highlighted economic resilience and job creation but emphasized taxation and policy gaps hindering CE adoption.
Meyer et al. (2015, 2018)	Global, EU 2030-2050	**Scope:** Global and EU-wide macroeconomic impacts of circularity interventions. **Key findings:** Ambitious scenarios project a median global GDP increase of 2.0% by 2030 and a potential reduction in CO2 emissions of up to 55% by 2050.
McCarthy et al. (2018)	Global, EU 2030	**Scope:** Macroeconomic assessment of circular economy transition and its impacts on GDP and material use. **Key findings:** Circular economy scenarios contribute to GDP increases (0-15%) with shifts in material extraction across countries. Assumptions on productivity and materials significantly affect outcomes.
Aguilar-Hernández et al. (2018)	Global 2010-2020	**Scope:** Impacts of circularity interventions using environmentally extended input-output analysis (EEIO). **Key findings:** Circular initiatives increase economic growth and moderately reduce CO_2 emissions. However, there is limited focus on the localized impacts of circularity measures.
Beccarello & Di Foggia (2018)	Italy, EU 2015-2020	**Scope:** Economic impacts of higher recycling targets and waste management systems under a circular economy framework. **Key findings:** Higher recycling targets are linked to job creation, production growth, and increased value added. Highlights the role of private consortia in achieving EU circular economy goals.
Best et al. (2018)	EU 2030	**Scope:** Material efficiency and circular economy scenarios in the European Union. **Key findings:** The GDP impact ranges from -6% to 7%, with job creation varying between -0.1% and 1%. Variability due to technological changes and rebound effects.
Geerken et al. (2019)	Belgium 2019	**Scope:** CE's potential to substitute linear economic activities. **Key findings:** Domestic job creation in CE sectors often substitutes foreign linear economy activities, reducing external value.
Wiebe et al. (2019)	EU, Asia 2030	**Scope:** Trade-offs between job creation and environmental impacts across regions **Key findings:** Trade-offs are evident; an EU employment increase of 2.7% may hurt Asian economies. Global employment is projected to increase by 2.2%.

Appendix 1 (Cont.). presents the details of the literature review on the different modelling approaches used to estimate the economic and environmental impacts of the Circular Economy. Each estimation method provides complementary results, with different levels of complexity and data requirements. (Source: Own elaboration)

Authors	Region /Timeframe	Scope and Key Findings
Trica et al. (2019)	EU 2008-2018	**Scope:** Sustainability of the circular economy model based on environmental factors. **Key findings:** Resource Productivity: A 1% increase in resource productivity leads to a 0.25% increase in GDP per capita. Environmental Employment: A 1% increase results in a 0.15% increase in GDP per capita. Recycling Rate: A 1% increase in recycling rate contributes to a 0.12% increase in GDP per capita. Environmental Innovation: A 1% increase in environmental innovation leads to a 0.08% increase in GDP per capita.
Domenech & Bahn-Walkowiak (2019)	European Union 2010-2019	**Scope:** Resource efficiency policies and their heterogeneity among EU member states. **Key findings:** Laggard countries (e.g., Eastern Europe) have greater potential for CE growth; policy variations reduce overall EU effectiveness.
OECD (2020)	Global, Cities & Regions 2020-2050	**Scope:** Analysing drivers, governance frameworks, and economic impacts of circular economy transitions in urban areas. **Key findings:** Implementing circular economy measures could add USD 4.5 trillion to global growth by 2030, and EU GDP could increase by 0.5% by 2030. By 2030, 700,000 jobs are expected to be available in the EU, and up to 40% of CO2 emissions in key sectors (steel, plastics, aluminium, cement, and food) are expected to be reduced by 2050.
European Commission (2015, 2020)	EU 2015-2030	**Scope:** EU Circular Economy Action Plan and regional policies **Key findings:** CE measures are projected to increase EU GDP by 2.0%, employment by 1.6%, and reduce CO_2 emissions by 24.6%. Predicted 700,000 new jobs by 2030, with mixed progress in waste management, recycling, and societal inclusion.
Padilla-Rivera et al. (2020)	Global (including Europe) 2015-2020	**Scope:** Social dimensions of CE. **Key findings:** CE policies enhance local employment but require targeted policies to maximize job creation and promote societal equity.
Hysa et al. (2020)	EU 2006-2017	**Scope:** Relationship between circular economy indicators and economic growth. **Key findings:** A 1% increase in the environmental tax rate leads to a 0.17% increase in GDP per capita. Recycling Rate of Waste: A 1% increase results in a 0.1% increase in GDP per capita. Private Investment and Jobs in Circular Economy: A 1% increase in private investment leads to a 0.06% increase in GDP per capita. Patents Related to Recycling: A 1% increase contributes to a 0.02% increase in GDP per capita. Trade of Recyclable Raw Materials: A 1% increase leads to a 0.03% increase in GDP per capita.
Ferranti & Germani (2020)	EU (23 countries) 2008-2017	**Scope:** Relationship between CE employment and socio-economic variables: unemployment, poverty, HDI. **Key findings:** Employment in CE sectors reduces unemployment (-3.6 points per 1% increase), improves HDI, and reduces poverty risk (-1.8%).
Llorente-González & Vence (2020)	EU 2015-2020	**Scope:** Labour intensity in recycling, repair, and reuse sectors **Key findings:** Recycling is capital-intensive; however, the repair and reuse sectors offer higher job creation and societal benefits.
Škrinjarić (2020)	Europe 2010-2016	**Scope:** Empirical assessment of CE goals in European countries **Key findings:** The best-performing countries (Germany, the Netherlands, and Denmark) exhibit strong GDP growth and robust R&D investment.

Appendix 1 (Cont.). presents the details of the literature review on the different modelling approaches used to estimate the economic and environmental impacts of the Circular Economy. Each estimation method provides complementary results, with different levels of complexity and data requirements. (Source: Own elaboration)

Authors	Region /Timeframe	Scope and Key Findings
Laubinger et al. (2020)	Global (OECD countries)	**Scope:** Labour market implications of circular economy policies. **Key findings:** CE policies can lead to net-positive employment effects, particularly when revenues from material taxes are recycled to reduce labour taxes. Employment effects vary by sector and region, with job gains in green sectors (e.g., recycling) and losses in material-intensive industries. Comprehensive policy design, encompassing skill transferability and labour mobility, is crucial for managing transitions effectively.
Aguilar-Hernández et al. (2021)	Global, EU, National Levels 2020-2050	**Scope:** Meta-analysis of circular economy scenarios (CESs) to assess GDP, employment, and CO_2 emissions impacts up to 2050. **Key findings:** Ambitious CESs (2030): Median GDP increase of 2.0% (IQR: 0.4%-4.6%), employment increase of 1.6% (IQR: 0.9%-2.0%), CO_2 emissions reduction of -24.6%. Moderate CESs exhibit more minor impacts, characterized by negligible GDP growth (0.1%) and lower CO_2 reductions (-4.1%).
Lehmann et al. (2022)	EU (28) 2011-2017	**Scope:** Identifying circular economy dimensions (environmental degradation, resource efficiency) and macroeconomic drivers. **Key findings:** Innovation can reduce environmental degradation, but it does not necessarily improve resource efficiency. Investment improves both dimensions with long-term positive effects. Economic growth negatively correlates with circularity. Circular economy levels depend on prior-year levels,
Brusselaers et al. (2022).	Belgium 2020-2025	**Scope:** Macroeconomic and environmental impacts of circular measures in small economies. **Key findings:** This study highlights the need for fiscal policies to mitigate the economic impacts of circular transitions. It emphasizes sectoral variations in job creation and resource utilization.
Rodríguez et al. (2023).	Chile, Colombia, Mexico, Peru 2020-2030	**Scope:** Dynamic macroeconomic modelling of the circular economy transition using input-output matrices. Key findings: GDP: Expected growth between 0.9% and 2.2% by 2030. Employment: Increase of 1.2%-2.1%. CO_2 emissions: reductions from -7.3% (Chile) to +0.4% (Peru).
Luthin et al. (2023).	Global, with emphasis on Europe 2015-2023	**Scope:** Assessing social impacts and indicators using Social Life Cycle Assessment (S-LCA) **Key findings**: Identified 40 direct social impacts with positive and negative effects. Key indicators: job creation, health and safety, training, and education.
Boonman, Verstraten, van der Weijde (2023)	EU 2023	**Scope:** Macroeconomic and environmental impacts of innovation-driven circular economy policies using CGE models. **Key findings:** Implementing circular policies can increase EU GDP by 3.9% by 2030. Innovation-led measures reduce CO_2 emissions and create sectoral shifts in employment. Distributional policies are crucial for balancing sectoral gains and losses.
Kolpinski & Kratzer (2024)	EU 2005-2021	**Scope:** Development of circular economy sectors and socio-economic impacts. **Key findings:** Linear growth in CE sectors (4.48% GVA, 7.59% investments, 1.76% FTE); uneven impacts across EU member states.
Barbero, et al (2024).	EU 2014-2020	**Scope:** Use of EU funds for circular economy projects. **Key findings:** Institutional quality, human capital, and income drive the allocation of CE R&D funds, with geographical disparities also evident.
Castillo-Díaz et al. (2024)	EU 2012-2021	**Scope:** Analysis of circular economy (CE) performance in EU Member States. **Key findings:** Germany, Italy, France, and Belgium lead in CE implementation; significant disparities between member states.

Appendix 2.

Appendix 2. presents CE investment and employment figures across European countries, incorporating normalized indicators to ensure comparability across different economic contexts. Investment is expressed as a percentage of GDP, employment is measured as a percentage of the total national workforce, and CE investment per capita is provided to illustrate financial commitment at the individual level. These adjustments prevent larger economies from skewing the analysis and offer a more balanced evaluation of CE adoption trends across Europe.

Table 1. Private investment related to circular economy sectors (Millions of €) (Source: Eurostat (data retrieved on 24.11.2024).)

	2015	2016	2017	2018	2019	2020	2021
European Union - 27 countries (from 2020)	83.946	89.738	106.893	112.430	110.811	115.991	121.578
European Union - 28 countries (2013-2020)	117.210	121.082	134.617	143.322	145.722	:	:
Belgium	4.962	7.154	6.228	6.533	7.511	7.029	7.251
Bulgaria	308	304	364	394	419	380	395
Czechia	587	598	726	811	871	858	905
Denmark	2.701	2.486	2.931	2.735	2.453	2.960	3.063
Germany	16.201	16.386	30.114	34.489	28.970	29.751	31.507
Estonia	122	132	157	195	187	192	200
Ireland	439	402	483	575	1.704	2.109	2.699
Greece	447	448	458	247	386	163	171
Spain	4.236	5.008	4.335	5.308	5.889	5.792	6.108
France	19.941	20.257	20.660	18.397	20.050	20.108	20.405
Croatia	275	289	358	409	348	379	404
Italy	6.684	8.310	10.854	12.803	15.421	12.070	12.423
Cyprus	53	58	107	92	73	50	51
Latvia	164	124	189	241	342	224	233
Lithuania	222	347	476	339	348	416	447
Luxembourg	578	515	588	432	800	681	722
Hungary	797	880	1.021	1.130	1.106	1.022	1.081
Malta	99	110	122	133	144	155	166
Netherlands	6.616	6.257	6.009	7.506	9.313	8.267	8.700
Austria	5.272	5.517	5.616	5.483	5.667	5.448	5.474
Poland	2.888	2.440	2.908	4.325	4.342	3.727	3.890
Portugal	1.457	1.578	1.814	2.004	2.112	1.731	1.771
Romania	913	899	1.044	918	1.103	1.060	1.091
Slovenia	109	117	164	188	260	109	108
Slovakia	425	465	459	514	430	484	502
Finland	779	803	634	741	741	728	733
Sweden	1.909	2.451	2.260	1.816	1.976	2.200	2.265
United Kingdom	29.480	27.458	23.754	24.723	30.194	31.936	33.722

Note: The indicator includes "Gross investment in tangible goods" in the following three sectors: the recycling sector, the repair and reuse sector, and the rental and leasing sector. Gross investment in tangible goods is defined as investment during the reference year in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e., capitalised production of tangible capital goods), having a useful life of more than one year, including non-produced tangible goods such as land. Investments in intangible and financial assets are excluded from this calculation.

Table 2. Private investment related to circular economy sectors Percentage of gross domestic product (GDP) *(Source: Eurostat (data retrieved on 24.11.2024).)*

	2015	2016	2017	2018	2019	2020	2021
European Union - 27 countries (from 2020)	0,7	0,7	0,8	0,8	0,8	0,9	0,8
European Union - 28 countries (2013-2020)	0,8	0,8	0,9	0,9	0,9	:	:
Belgium	1,2	1,7	1,4	1,4	1,6	1,5	1,4
Bulgaria	0,7	0,6	0,7	0,7	0,7	0,6	0,6
Czechia	0,3	0,3	0,4	0,4	0,4	0,4	0,4
Denmark	1	0,9	1	0,9	0,8	0,9	0,9
Germany	0,5	0,5	0,9	1	0,8	0,9	0,9
Estonia	0,6	0,6	0,7	0,8	0,7	0,7	0,7
Ireland	0,2	0,1	0,2	0,2	0,5	0,6	0,6
Greece	0,3	0,3	0,3	0,1	0,2	0,1	0,1
Spain	0,4	0,4	0,4	0,4	0,5	0,5	0,5
France	0,9	0,9	0,9	0,8	0,8	0,9	0,8
Croatia	0,6	0,6	0,7	0,8	0,6	0,8	0,7
Italy	0,4	0,5	0,6	0,7	0,9	0,7	0,7
Cyprus	0,3	0,3	0,5	0,4	0,3	0,2	0,2
Latvia	0,7	0,5	0,7	0,8	1,1	0,8	0,7
Lithuania	0,6	0,9	1,1	0,7	0,7	0,8	0,8
Luxembourg	1,1	0,9	1	0,7	1,3	1,1	1
Hungary	0,7	0,8	0,8	0,8	0,8	0,7	0,7
Malta	1	1	1	1	1	1,2	1,1
Netherlands	1	0,9	0,8	1	1,1	1	1
Austria	1,5	1,5	1,5	1,4	1,4	1,4	1,4
Poland	0,7	0,6	0,6	0,9	0,8	0,7	0,7
Portugal	0,8	0,8	0,9	1	1	0,9	0,8
Romania	0,6	0,5	0,6	0,4	0,5	0,5	0,5
Slovenia	0,3	0,3	0,4	0,4	0,5	0,2	0,2
Slovakia	0,5	0,6	0,5	0,6	0,5	0,5	0,5
Finland	0,4	0,4	0,3	0,3	0,3	0,3	0,3
Sweden	0,4	0,5	0,5	0,4	0,4	0,5	0,4
United Kingdom	1,1	1,1	1	1	1,2	:	:

Note: The indicator includes “Gross investment in tangible goods” in the following three sectors: recycling, repair and reuse, and rental and leasing.

Table 3. Private Investment Related to Circular Economy Sectors Per Capita (€) (Source: Eurostat (Data Retrieved On 24.11.2024).)

	2015	2016	2017	2018	2019	2020	2021
European Union - 27 countries (from 2020)	226,7	180,0	256,6	189,1	201,8	240,1	252,0
European Union - 28 countries (2013-2020)	326,9	302,5	415,6	341,3	351,9	390,4	414,6
Belgium	503,9	410,3	423,9	438,7	630,2	546,4	570,3
Bulgaria	29,3	23,5	35,6	44,4	44,4	53,9	59,1
Czechia	43,7	45,9	46,2	55,6	56,5	68,4	76,2
Denmark	430,7	378,2	460,6	473,3	432,4	507,0	471,1
Germany	165,2	154,0	176,4	197,2	198,6	363,7	415,4
Estonia	148,5	117,8	85,2	92,7	100,3	119,0	147,2
Ireland	103,7	100,0	104,1	92,9	83,8	99,5	116,4
Greece	21,9	13,5	34,3	41,5	41,6	42,6	23,0
Spain	73,3	79,3	86,1	91,3	107,7	92,9	113,1
France	304,0	273,8	272,7	299,2	303,2	308,2	273,4
Croatia	43,1	54,8	60,3	66,6	70,9	89,2	103,1
Italy	104,2	93,6	113,7	111,1	138,3	181,1	214,0
Cyprus	139,7	121,2	39,0	62,5	67,9	123,8	105,0
Latvia	88,9	83,9	91,6	83,3	63,6	97,7	125,5
Lithuania	46,4	54,3	77,9	76,7	121,4	168,4	120,5
Luxembourg	581,0	624,0	628,8	1.003,0	871,9	976,7	703,7
Hungary	48,5	45,6	71,3	81,5	90,4	105,1	116,5
Malta	151,9	175,2	198,3	220,2	239,5	256,9	269,8
Netherlands	284,5	261,4	266,9	389,7	366,3	349,7	434,3
Austria	603,4	592,8	613,2	605,9	628,9	636,6	618,9
Poland	48,2	50,2	65,8	76,1	64,3	76,6	113,9
Portugal	91,5	91,7	115,6	140,5	152,5	175,5	193,9
Romania	33,8	32,2	67,0	46,2	45,8	53,4	47,3
Slovenia	52,9	37,8	39,3	52,8	56,6	79,3	90,3
Slovakia	59,0	62,8	70,3	78,3	85,6	84,3	94,3
Finland	138,2	120,9	133,8	142,0	145,9	115,0	134,3
Sweden	192,8	175,9	168,6	193,8	245,2	223,3	177,5
United Kingdom	282,8	294,1	350,7	450,9	417,0	358,4	371,0

Note: The indicator includes "Gross investment in tangible goods" in the following three sectors: recycling, repair and reuse, and rental and leasing, divided by Total Population.

Table 4. Persons employed in the circular economy Full-time equivalent (FTE) (Source: Eurostat (data retrieved 24. 11. 2024).)

Time	2015	2016	2017	2018	2019	2020	2021
European Union - 27 countries (from 2020)	3.864.021	3.937.798	4.068.083	4.131.897	4.183.245	4.232.633	4.284.745
European Union - 28 countries (2013-2020)	4.714.583	4.850.412	4.944.394	5.157.385	5.188.628	:	:
Belgium	62.338	61.463	62.281	63.234	62.091	63.816	63.868
Bulgaria	48.132	51.013	51.855	52.418	53.871	51.751	52.323
Czechia	117.124	120.738	120.430	120.905	125.173	123.938	124.592
Denmark	32.930	33.435	34.814	36.639	36.394	35.758	36.207
Germany	651.777	677.723	700.179	744.774	739.622	764.770	785.297
Estonia	12.174	11.644	12.372	13.829	13.343	13.810	14.152
Ireland	27.163	28.227	30.489	30.721	32.165	33.250	33.541
Greece	55.509	66.723	61.594	70.128	72.533	61.139	59.634
Spain	384.276	405.105	414.861	426.566	455.530	448.860	454.085
France	453.890	470.463	515.908	518.745	524.507	521.357	523.904
Croatia	44.872	44.088	46.104	51.368	58.574	50.818	52.113
Italy	603.247	612.645	591.196	585.644	644.581	617.149	613.339
Cyprus	6.120	6.840	7.449	8.291	8.664	8.348	8.827
Latvia	23.214	23.624	23.397	22.420	21.108	23.720	24.105
Lithuania	34.866	35.211	35.822	35.808	37.606	38.335	39.115
Luxembourg	1.839	1.924	1.956	2.106	2.074	2.100	2.158
Hungary	102.645	110.391	114.922	119.781	109.768	105.907	109.215
Malta	4.474	4.749	4.809	4.949	5.029	4.857	4.970
Netherlands	95.504	97.501	101.143	105.760	108.283	104.905	105.173
Austria	48.252	48.376	50.091	47.466	48.075	49.423	49.173
Poland	418.033	422.007	427.247	429.029	435.574	437.080	441.671
Portugal	82.202	84.026	93.140	98.264	90.728	85.587	87.525
Romania	84.244	85.799	86.361	86.347	90.179	88.583	91.467
Slovenia	15.231	15.361	15.837	16.974	20.938	15.918	15.816
Slovakia	44.737	45.547	47.036	49.438	48.995	51.486	52.248
Finland	41.962	41.816	51.148	60.513	47.235	41.951	41.744
Sweden	78.165	80.333	83.566	80.130	81.185	83.884	85.100
United Kingdom	541.108	572.923	540.190	576.754	573.442	581.750	590.936

Note: The indicator measures the "Number of persons employed" in the following three sectors: the recycling sector, the repair and reuse sector, and the rental and leasing sector.

Table 5. Persons Employed in The Circular Economy Percentage of Total Employment - Numerator in Full-Time Equivalent (Fte) (Source: Eurostat (Data Retrieved 24. 11. 2024).)

	2015	2016	2017	2018	2019	2020	2021
European Union - 27 countries (from 2020)	1,9	2	2	2	2	2,1	2,1
European Union - 28 countries (2013-2020)	2,1	2,1	2,1	2,2	2,1	:	:
Belgium	1,4	1,3	1,3	1,3	1,3	1,3	1,3
Bulgaria	1,4	1,5	1,5	1,5	1,5	1,5	1,5
Czechia	2,3	2,3	2,3	2,2	2,3	2,3	2,3
Denmark	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Germany	1,5	1,6	1,6	1,7	1,6	1,7	1,7
Estonia	2	1,9	1,9	2,1	2	2,2	2,2
Ireland	1,3	1,3	1,4	1,4	1,4	1,5	1,4
Greece	1,3	1,5	1,4	1,5	1,5	1,3	1,3
Spain	2,1	2,1	2,1	2,2	2,2	2,3	2,3
France	1,7	1,7	1,9	1,8	1,8	1,8	1,8
Croatia	2,9	2,8	2,9	3,1	3,5	3	3,1
Italy	2,5	2,5	2,4	2,3	2,5	2,5	2,4
Cyprus	1,7	1,8	1,8	1,9	1,9	1,9	2
Latvia	2,6	2,7	2,6	2,5	2,4	2,7	2,8
Lithuania	2,6	2,6	2,6	2,6	2,7	2,8	2,8
Luxembourg	0,5	0,5	0,5	0,5	0,4	0,4	0,4
Hungary	2,4	2,5	2,5	2,6	2,3	2,3	2,3
Malta	2,2	2,3	2,1	2,1	2	1,9	1,9
Netherlands	1,1	1,1	1,1	1,1	1,1	1,1	1,1
Austria	1,1	1,1	1,1	1,1	1,1	1,1	1,1
Poland	2,6	2,6	2,6	2,6	2,7	2,7	2,7
Portugal	1,8	1,8	1,9	2	1,8	1,8	1,8
Romania	1	1	1	1	1	1	1,2
Slovenia	1,6	1,6	1,6	1,7	2	1,5	1,5
Slovakia	2	2	2	2	2	2,1	2,2
Finland	1,7	1,6	2	2,3	1,8	1,6	1,5
Sweden	1,6	1,7	1,7	1,6	1,6	1,7	1,7
United Kingdom	1,7	1,8	1,7	1,8	1,7	:	:

Note: The indicator measures the “Number of persons employed” in the following three sectors: the recycling sector, the repair and reuse sector, and the rental and leasing sector.

Table 6. Annual And Compound Annual Growth Rates of Private Investment Related to Circular Economy Sectors (Source: Eurostat (Data Retrieved 24. 11. 2024).)

	2016	2017	2018	2019	2020	2021	2015 - 2021
European Union - 27 countries (from 2020)	6,9%	19,1%	5,2%	-1,4%	4,7%	4,8%	6,4%
European Union - 28 countries (2013-2020)	3,3%	11,2%	6,5%	1,7%	:	:	:
Belgium	44,2%	-12,9%	4,9%	15,0%	-6,4%	3,2%	6,5%
Bulgaria	-1,3%	19,7%	8,2%	6,3%	-9,3%	3,9%	4,2%
Czechia	1,9%	21,4%	11,7%	7,4%	-1,5%	5,5%	7,5%
Denmark	-8,0%	17,9%	-6,7%	-10,3%	20,7%	3,5%	2,1%
Germany	1,1%	83,8%	14,5%	-16,0%	2,7%	5,9%	11,7%
Estonia	8,2%	18,9%	24,2%	-4,1%	2,7%	4,2%	8,6%
Ireland	-8,4%	20,1%	19,0%	196,3%	23,8%	28,0%	35,3%
Greece	0,2%	2,2%	-46,1%	56,3%	-57,8%	4,9%	-14,8%
Spain	18,2%	-13,4%	22,4%	10,9%	-1,6%	5,5%	6,3%
France	1,6%	2,0%	-11,0%	9,0%	0,3%	1,5%	0,4%
Croatia	5,1%	23,9%	14,2%	-14,9%	8,9%	6,6%	6,6%
Italy	24,3%	30,6%	18,0%	20,4%	-21,7%	2,9%	10,9%
Cyprus	9,4%	84,5%	-14,0%	-20,7%	-31,5%	2,0%	-0,6%
Latvia	-24,4%	52,4%	27,5%	41,9%	-34,5%	4,0%	6,0%
Lithuania	56,3%	37,2%	-28,8%	2,7%	19,5%	7,5%	12,4%
Luxembourg	-10,9%	14,2%	-26,5%	85,2%	-14,9%	6,0%	3,8%
Hungary	10,4%	16,0%	10,7%	-2,1%	-7,6%	5,8%	5,2%
Malta	11,1%	10,9%	9,0%	8,3%	7,6%	7,1%	9,0%
Netherlands	-5,4%	-4,0%	24,9%	24,1%	-11,2%	5,2%	4,7%
Austria	4,6%	1,8%	-2,4%	3,4%	-3,9%	0,5%	0,6%
Poland	-15,5%	19,2%	48,7%	0,4%	-14,2%	4,4%	5,1%
Portugal	8,3%	15,0%	10,5%	5,4%	-18,0%	2,3%	3,3%
Romania	-1,5%	16,1%	-12,1%	20,2%	-3,9%	2,9%	3,0%
Slovenia	7,3%	40,2%	14,6%	38,3%	-58,1%	-0,9%	-0,2%
Slovakia	9,4%	-1,3%	12,0%	-16,3%	12,6%	3,7%	2,8%
Finland	3,1%	-21,0%	16,9%	0,0%	-1,8%	0,7%	-1,0%
Sweden	28,4%	-7,8%	-19,6%	8,8%	11,3%	3,0%	2,9%
United Kingdom	-6,9%	-13,5%	4,1%	22,1%	5,8%	5,6%	2,3%

Table 7. Annual And Compound Annual Growth Rates of Private Investment Related to Circular Economy Sectors Per Capita (Source: Eurostat (Data Retrieved 24. 11. 2024).)

	2016	2017	2018	2019	2020	2021	2015 - 2021
European Union - 27 countries (from 2020)	-20,6%	42,6%	-26,3%	6,7%	18,9%	5,0%	1,8%
European Union - 28 countries (2013-2020)	-7,5%	37,4%	-17,9%	3,1%	11,0%	6,2%	4,0%
Belgium	-18,6%	3,3%	3,5%	43,7%	-13,3%	4,4%	2,1%
Bulgaria	-19,9%	51,6%	24,8%	0,0%	21,4%	9,8%	12,4%
Czechia	5,0%	0,6%	20,4%	1,6%	21,0%	11,3%	9,7%
Denmark	-12,2%	21,8%	2,7%	-8,6%	17,2%	-7,1%	1,5%
Germany	-6,8%	14,6%	11,8%	0,7%	83,2%	14,2%	16,6%
Estonia	-20,7%	-27,7%	8,8%	8,2%	18,6%	23,7%	-0,1%
Ireland	-3,5%	4,1%	-10,8%	-9,8%	18,7%	17,0%	1,9%
Greece	-38,6%	154,7%	21,0%	0,4%	2,5%	-46,0%	0,8%
Spain	8,3%	8,5%	6,0%	18,0%	-13,7%	21,7%	7,5%
France	-9,9%	-0,4%	9,7%	1,3%	1,7%	-11,3%	-1,8%
Croatia	27,1%	10,0%	10,4%	6,4%	25,9%	15,6%	15,6%
Italy	-10,2%	21,5%	-2,3%	24,5%	30,9%	18,2%	12,7%
Cyprus	-13,3%	-67,9%	60,4%	8,6%	82,5%	-15,2%	-4,6%
Latvia	-5,6%	9,2%	-9,1%	-23,7%	53,7%	28,5%	5,9%
Lithuania	17,0%	43,5%	-1,6%	58,3%	38,8%	-28,4%	17,3%
Luxembourg	7,4%	0,8%	59,5%	-13,1%	12,0%	-28,0%	3,2%
Hungary	-6,0%	56,4%	14,3%	10,9%	16,3%	10,8%	15,7%
Malta	15,4%	13,2%	11,1%	8,8%	7,3%	5,0%	10,1%
Netherlands	-8,1%	2,1%	46,0%	-6,0%	-4,5%	24,2%	7,3%
Austria	-1,8%	3,4%	-1,2%	3,8%	1,2%	-2,8%	0,4%
Poland	4,2%	31,1%	15,7%	-15,5%	19,2%	48,7%	15,4%
Portugal	0,3%	26,1%	21,5%	8,6%	15,1%	10,5%	13,3%
Romania	-4,7%	108,1%	-31,0%	-0,9%	16,8%	-11,5%	5,8%
Slovenia	-28,5%	3,8%	34,5%	7,3%	40,1%	13,9%	9,3%
Slovakia	6,5%	11,9%	11,4%	9,2%	-1,4%	11,8%	8,1%
Finland	-12,5%	10,7%	6,1%	2,8%	-21,2%	16,8%	-0,5%
Sweden	-8,7%	-4,2%	15,0%	26,5%	-8,9%	-20,5%	-1,4%
United Kingdom	4,0%	19,3%	28,6%	-7,5%	-14,1%	3,5%	4,6%

Table 8. Annual And Compound Annual Growth Rates of Persons Employed Related to The Circular Economy Full-Time Equivalent (FTE) (Source: Eurostat (Data Retrieved 24. 11. 2024).)

	2016	2017	2018	2019	2020	2021	2015 - 2021
European Union - 27 countries (from 2020)	1,9%	3,3%	1,6%	1,2%	1,2%	1,2%	1,7%
European Union - 28 countries (2013-2020)	2,9%	1,9%	4,3%	0,6%	:	:	:
Belgium	-1,4%	1,3%	1,5%	-1,8%	2,8%	0,1%	0,4%
Bulgaria	6,0%	1,7%	1,1%	2,8%	-3,9%	1,1%	1,4%
Czechia	3,1%	-0,3%	0,4%	3,5%	-1,0%	0,5%	1,0%
Denmark	1,5%	4,1%	5,2%	-0,7%	-1,7%	1,3%	1,6%
Germany	4,0%	3,3%	6,4%	-0,7%	3,4%	2,7%	3,2%
Estonia	-4,4%	6,3%	11,8%	-3,5%	3,5%	2,5%	2,5%
Ireland	3,9%	8,0%	0,8%	4,7%	3,4%	0,9%	3,6%
Greece	20,2%	-7,7%	13,9%	3,4%	-15,7%	-2,5%	1,2%
Spain	5,4%	2,4%	2,8%	6,8%	-1,5%	1,2%	2,8%
France	3,7%	9,7%	0,5%	1,1%	-0,6%	0,5%	2,4%
Croatia	-1,7%	4,6%	11,4%	14,0%	-13,2%	2,5%	2,5%
Italy	1,6%	-3,5%	-0,9%	10,1%	-4,3%	-0,6%	0,3%
Cyprus	11,8%	8,9%	11,3%	4,5%	-3,6%	5,7%	6,3%
Latvia	1,8%	-1,0%	-4,2%	-5,9%	12,4%	1,6%	0,6%
Lithuania	1,0%	1,7%	0,0%	5,0%	1,9%	2,0%	1,9%
Luxembourg	4,6%	1,7%	7,7%	-1,5%	1,3%	2,8%	2,7%
Hungary	7,5%	4,1%	4,2%	-8,4%	-3,5%	3,1%	1,0%
Malta	6,1%	1,3%	2,9%	1,6%	-3,4%	2,3%	1,8%
Netherlands	2,1%	3,7%	4,6%	2,4%	-3,1%	0,3%	1,6%
Austria	0,3%	3,5%	-5,2%	1,3%	2,8%	-0,5%	0,3%
Poland	1,0%	1,2%	0,4%	1,5%	0,3%	1,1%	0,9%
Portugal	2,2%	10,8%	5,5%	-7,7%	-5,7%	2,3%	1,1%
Romania	1,8%	0,7%	0,0%	4,4%	-1,8%	3,3%	1,4%
Slovenia	0,9%	3,1%	7,2%	23,4%	-24,0%	-0,6%	0,6%
Slovakia	1,8%	3,3%	5,1%	-0,9%	5,1%	1,5%	2,6%
Finland	-0,3%	22,3%	18,3%	-21,9%	-11,2%	-0,5%	-0,1%
Sweden	2,8%	4,0%	-4,1%	1,3%	3,3%	1,4%	1,4%
United Kingdom	5,9%	-5,7%	6,8%	-0,6%	1,4%	1,6%	1,5%