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Zooming Out: Circular Economy Development in the European Union and its Implications on the Economy and Society

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Abstract

The concept of the circular economy has emerged as a response to the challenges posed by resource constraints, waste accumulation, and pollution, threatening both social welfare and business profitability. The circular economy aims for sustainable development, encompassing environmental quality, economic prosperity, and social equity across current and future generations. Despite its recognition as a pivotal solution, there needs to be more comprehensive understanding regarding its development and its economic and social impacts. Therefore, the objective of this paper is to investigate the progress of circular economy sectors in the European Union to get an overview of the circular economy advancements and discuss geographical economic and social effects. The focus is on the indicators of gross value added, private investments, and full-time employment within recycling, repair, and reuse sectors because these sectors provide good proxies for the circular economy activities in the European economy. Results suggest a linear growth of circular economy sectors across the European Union, albeit with variations among member states. The paper discusses the implications of circular economy transition on the economy and society, particularly on the labour market, skill demands, and technology integration, emphasising the need for a critical academic discourse. It questions assumptions about job creation and local employment, especially considering technological advancements that may reduce manual labour in recycling plants. Future research is invited to focus on these macro-level implications and critically reflect on the societal implications of a circular economy transition to shape a more fair and socially inclusive economy.

Keywords: Circular Economy · Transition · Indicators · Society · European Union

1. INTRODUCTION

Both governments and businesses start realising that resource constraints, increasing waste streams, and pollution are serious threats to social welfare and well-being as well as business profits (Wijkman and Skanberg 2017). As an answer to these challenges, the circular economy (CE) is proclaimed as one of the best solutions to master the transition to sustainable development (Nikolaou and Tsagarakis 2021; Suchek et al. 2022; Zeng et al. 2022). The aim of the CE is to accomplish sustainable development, including the simultaneous creation of environmental quality, economic prosperity, and social equity benefiting the current as well as future generations (Kirchherr et al. 2017). However, an overview of the current development of this transition and a discussion of the implications on the economy and society is lacking. Therefore, the objective of this paper is to investigate the progress of CE sectors in the European Union member states to get an overview of the CE advancements and discuss geographical economic and social effects. Additionally, the overall aim is to start an academic discussion of the real economic and social impacts of the sustainability transition by selecting the

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development of CE sectors in the European Union (EU) as examples. Drawing on Eurostat data about the development of CE sectors between 2005 and 2021 in the EU member states, this paper takes a macro-level perspective and provides an overview of gross value added (GVA), private investments (INV) and number of full-time jobs (FTE) into the CE sectors over time. CE sectors comprise the recycling, repair, and reuse sectors (Eurostat 2022b). Even though these sectors only represent a subset of a much wider economic impact of the CE, the recycling, repair, and reuse sectors are considered good proxies for the mainstreaming of the CE in other sectors (Eurostat 2022b). There are more circular strategies than recycling, repair, and reuse, with in total nine differentiated strategies (Potting et al. 2017). For a useful application of materials, strategies of recovering and recycling can be applied, which requires innovations in core technologies, but there is a rather low degree of product design or business model innovation, and neither socio-cultural change required (Potting et al. 2017). For extending the lifespan of products and single parts, the repurpose, remanufacture, refurbish, repair, and reuse strategies are useful, which also increase the degree of circularity with fewer use of natural resources and less environmental pressure, product and business model innovation, socio-institutional change but less innovation needed in technologies (Potting et al. 2017). Both strategy groups are represented in this study. The strategy group with the highest degree of circularity, product and business model innovation, and socio-institutional change consists of the reduce, rethink, and refuse strategies (Potting et al. 2017). No comparative datasets were found for these CE strategies. However, it becomes apparent that the CE has a greater overall impact in other sectors, too, but this is more diffuse and, therefore, difficult to isolate.

The results show a continuous but rather low increase in the three CE sectors regarding the three indicators GVA, INV, and FTE from 2005 until 2021 in the EU average. However, the development of CE sectors is different among the EU member states. The overview of CE sector development in the EU is supplemented by a discussion of the implications of CE development on the economy and society. Assumptions like in the annex of the Eurostat data proclaiming that CE sectors would be particularly job intensive and contribute to local employment are critically discussed by analysing the data (Eurostat 2022b). With a transition from a linear to a circular economy, the labour market will change: some skills will become redundant and new skills will be needed. Not only will this development have huge implications on the labour market but also other closely connected themes such as digitisation, the development of new technologies, and Artificial Intelligence (AI) (Neri et al. 2023). The European Commission (2018) investigates these issues with a report that builds a model forecasting the labour market in the EU with a CE. They find an overall positive picture of job market development but with clear differences in EU countries and sectors, as well as under the assumption that the waste sector will heavily increase and become job intensive. But what if the recycling plants become more efficient and sophisticated technology will no longer require much human intervention? Newly constructed recycling plants are especially planned to become more efficient in processing. This would lead to a significant reduction in jobs. Even if jobs will be required, which kind of jobs will be necessary? What about salaries, working conditions, and so forth?

We find it necessary to start discussing these issues critically and from an academic perspective because the implications of major economic changes have huge implications on society. Therefore, we aim to open an academic discussion on the real economic and societal impacts of the CE. Hence, the research questions of this paper are the following:

1. How is the development of circular economy sectors in the European Union?
2. What implications does circular economy development have on the European Union's economy and society?

The paper is structured as follows. After introducing the theoretical background of this paper by defining the terms and policy frameworks used, literature about economic and social implications is presented, that leads to framing the research gap of this paper. After that, the methodology and dataset are presented, followed by the results of the analysis, which are discussed and set in context with existing literature. Lastly, theoretical and practical contributions are presented with corresponding policy suggestions for an upscale of a more fair and just CE transition.

2. THEORETICAL BACKGROUND

This section introduces the terms and frameworks on which this study relies on. First, the CE and its sectors are defined, and corresponding strategies are described. In the second part, EU policies for the CE transition are presented. Next, existing academic literature, grey, and policy reports about the economic and social implications of the CE transition are presented and discussed. This also includes the necessary skill development of the workforce to encounter the CE transition. Lastly, the research gap is framed.

2.1 Circular Economy Sectors and Strategies

There is no doubt that the CE has become an established field of research (Kirchherr et al. 2023; Lehtimäki et al. 2023), and different streams are already developed (Centobelli et al. 2020; Suchek et al. 2022). Therefore, a variety of definitions of the CE exists. Eurostat bases its CE definition on several works. However, the baseline is defined as "an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/ distribution and consumption processes." (Kirchherr et al. 2017, p. 229). Further, the CE is described as a sub-set of the whole economy, while economic goods and services of the CE aim to "maintain the value of products and materials as long as possible and minimise waste and resource use, thereby closing or narrowing the [raw] material cycle." (Eurostat 2022b). This paper follows the given definitions by Eurostat and the European Commission. The CE can be analysed on a micro-level (organisational perspective, product, materials), meso-level (industry collaborations, industrial symbiosis, eco-industrial parks), or macro level (city, region, nation, and beyond) (Nikolaou and Tsagarakis 2021; Saidani et al. 2019). Examples of macro-level indicators of the CE are the regional CE Development Index (RCEDI) or the National CE Indicator System (NCEIS) (Saidani et al. 2019). By zooming out of single cases or ecosystems, this paper takes a macro-level perspective and discusses the implications of a system transition towards the CE on society.

The findings of Llorente-González and Vence (2020) suggest an underscoring of the ongoing relevance of circular activities within European economies. Nevertheless, their current impact falls short of the pivotal role required for navigating the transition to a CE. A typical CE cycle consists of the recovery of an existing product with subsequent energy use and material adaptation, which includes a transformation in industry processes, distribution of the updated product, usage from the consumer, and again recovery (Prieto-Sandoval et al. 2018). According to Potting et al. (2017), there are nine strategies, termed the "9R strategies," for implementing a CE. Strategies such as recovery and recycling can be employed to enhance material application efficiency, necessitating advancements in core technologies. However, these strategies show minimal emphasis on product design or business model innovation, as well as socio-cultural change. Conversely, strategies focusing on extending product and component lifespan—namely, repurpose, remanufacture, refurbish, repair, and reuse—promote higher circularity levels, reducing natural resource usage and environmental impact. These strategies entail greater innovation in product and business models, as well as socio-institutional change, albeit with less emphasis on technological advancements. This study encompasses both sets of strategies. Notably, the group comprising reduce, rethink, and refuse strategies is identified as having the highest degree of circularity, along with significant product and business model innovation and socio-institutional change. However, there is a lack of comparative datasets available for these CE strategies. Eurostat takes the 9R strategies (Potting et al. 2017) as a reference to identify CE activities via purpose and aim of respecting CE products and services.

2.2 EU Policies for Circular Economy Transition

Investigating CE development in the EU, it is important to have a closer look at important events and policies regarding the CE. For example, the Paris Agreement on the Sustainable Development Goals (SDGs) was ratified in 2015, which combined improvements in economic prosperity, human well-being in society, and the protection of healthy environments (Zeng et al. 2022). The SDGs are based on five pillars: people, planet, prosperity, peace, and partnership, and the CE offers natural-based solutions supporting those five pillars (Khajuria et al. 2022). Meanwhile, in 2015, the EU created the Circular Economy Action Plan (European Commission 2015), which was based on former waste

directives (Moreau et al. 2017). In 2019, the CE action plan was renewed (European Commission 2020), resulting in the EU Green Deal (European Commission 2020). Therefore, we assume that from 2015, the commitment of the EU countries for CE engagement was initiated, and real progress should be measured concerning gross value added, private investments, and jobs in the related CE sectors.

Politically, the EU aims to integrate the two sectors as the Social Economy Action Plan of the European Commission draws connections between social and circular activities (European Commission 2021). In turn, the Circular Economy Action Plan of the European Commission relates to the mutual benefits of the CE and social inclusion (European Commission 2020; van Opstal and Borms 2023). In the EU, the CE is referred to bring 1.2 million new jobs by 2030 (Mercanti 2022). The EU Green Deal focuses on regions, industries, and workers mostly affected by a CE transition and tries to become aware of the transition's social and economic impacts (Mercanti 2022). Especially the inclusion of people with disabilities into CE activities is aimed at, but remains a challenge in current implementation (Mercanti 2022). Van Opstal and Borms (2023) go a step further and identify the CE as a possible solution to local unemployment disparities and occupational mismatch.

The forecast report of the European Commission (2018) draws a very positive picture of the labour market development in the EU. In the report, it is assumed that in a CE, the GDP of the EU will increase by almost 0,5% by 2030. This will lead automatically to a net increase in jobs of around 700.000, mainly coming from an increase in the waste, recycling, repair, and service sectors. The sectors production of durable goods such as electronics and machinery, as well as the construction sector, are expected to decline. However, the report also reflects on the assumption of the waste sector will become very labour- intensive: this could be over-estimated, because of increased automation, product material enhancement to ease recycling and technology development could negate the positive effect on job creation. In the model, the waste sector is the driving one, and especially here, efficiency gains are expected from enhanced technology (Neri et al. 2023). The report also expects different developments in the EU countries but remains on a superficial level by reporting that the Central and Eastern EU countries benefit more than Western EU countries because of previous investments in fossil fuel sectors.

Even though this paper focuses on employment in a CE, it cannot be investigated in isolation from environmental concerns and economic development of a country. The labour market is individual in each country with different social welfare systems and different plans of emissions and natural resource reductions. Wijkman and Skanberg (2017) find that these topics are barely covered in academic literature and policy reviews. Especially the issue of heavily taxed employment versus untaxed or even subsidised use of natural resources is problematic because damaging the natural environment is incentivised and positive gains for the workforce are prevented (Wijkman and Skanberg 2017). Additionally, labour is not only positive for the state due to increased tax revenues and saved costs for social welfare but also for the individual persons due to higher satisfaction, competence gains and personal development (Wijkman and Skanberg 2017). With this distorted tax environment it is, according to Wijkman and Skanberg (2017), no surprise that firms overuse natural resources and underuse human capital. This leads to environmental as well as societal challenges and has to be addressed by political decisions. In this vein, Stahel (2010) advises to position labour in the center of economy and for a CE scenario, the social and solidarity economy could be a constructive example because labour-intense activities are increased in a CE and human work would become more qualitative and diverse in e.g. remanufacturing (Moreau et al. 2017). According to Stahel (2010), the CE increases employment. Three quarter of the labour force is engaged in manufacturing and service sectors, which is even more needed in a CE while the production of physical goods, e.g., steel or glass, will become less. However, energy inputs are mainly used to extract raw materials for manufacturing, which will mainly be substituted by reusing components and goods (Stahel 2010).

2.3 Economic and Societal Implications of the Circular Economy

Societal implications of the CE remain an under-researched stream within the CE domain (Mies and Gold 2021; Moreau et al. 2017; Valencia et al. 2023). Interestingly, the CE is also perceived as a "cross-cutting socio-technical transition affecting technology, business, and societal and cultural layers." (Lehtimäki et al. 2023, p. 586), meaning that there is to be more considered than only a change in

technology or production system. A transition to a CE includes a change in society as well and this comes down to societal cultures, norms, beliefs, values, etc. (Lehtimäki et al. 2023). Therefore, research should consider and further investigate these implications.

There are only a few research articles covering the social implications of the CE, and they often stay at a superficial level by proclaiming that the CE has the potential to achieve the SDGs (Nikolaou and Tsagarakis 2021) and the CE creates local semi-skilled jobs, which is good for society and government (Geissdoerfer et al. 2018). Researchers seem to agree that jobs have become more local in a CE because they comprise an increase in service activities, which are more domestically bound than just selling products (Geerken et al. 2019). When studying the social implications of the CE, Padilla-Rivera et al. (2020) found in their review article that the waste management sector was the most relevant studied in the literature. They apply several thematic areas and aspects to include the social dimension within the CE: labour practices and decent work, human rights, society, product responsibility, and others, of which society is the thematic area with the highest percentage evident in the reviewed literature (Padilla-Rivera et al. 2020). Within society, topics around employment showed the highest level of occurrence. The authors explain this finding because the CE is often found to create new employment opportunities. However, this positive trend of more CE creates more jobs should be supported by governments proposing new policies and incentives to foster this development (Padilla-Rivera et al. 2020). Industries are also responsible for new employment opportunities by innovating their business models towards closing material loops and more efficient product and material use (Padilla-Rivera et al. 2020). Workers, too, play an important role in a successful transition because specific training and skills are necessary to fulfil the new employment demands of a CE (Padilla-Rivera et al. 2020). However, the question remains if the CE has the potential to create a sufficient number of new jobs with sufficient payment and fulfilling the SDG targets. Llorente-González and Vence (2020) find a dispersed picture when studying the CE sectors of repair, reuse and recycling but in general, all three sectors are categorised as low-wage but labour-intensive jobs. While waste collection and recycling are found to be capital-intensive, reuse and repair initiatives have demonstrated a higher labour intensity (Llorente-González and Vence 2020). However, the EU focuses with its action plan more on recycling activities than on reuse or repair. From a social perspective, this is not an ideal choice since the reuse and repair sectors create more jobs with less resource consumption and require fewer capital investments (Llorente-González and Vence 2020). The authors also call for an active policy intervention to shape CE development into a socially inclusive transition. This argument becomes even stronger, when reflecting on the commercial aims of the linear economy where recycling is much more favourable as someone can earn much from an increasing amount of waste which needs to be recycled (Llorente-González and Vence 2020; Stahel 2019). As the CE aims at eliminating waste and recycling is the least preferred choice in the 9R strategies (Potting et al. 2017), recycling companies may fear their business. The question arises as to why the EU focuses on the recycling sector if this is favouring the linear economy instead of a circular one?

In a case study for the Belgian economy, it has been reported that new CE activities like recycling and reuse are domestic and will reduce added value and jobs but also GHG emissions abroad (Geerken et al. 2019). So, domestic economies with a CE can benefit from the local approach by new job creation but this happens by substituting foreign economic activities from the linear economy (Geerken et al. 2019).

The CE will probably bring more qualitative jobs and a shift from material intensive to more labour-intensive activities (van Opstal and Borms 2023). Therefore, investing in new skills is necessary (van Opstal and Borms 2023). However, the European Commission (2018) reports on the CE as being only one driver of skillset change. For example, digital technologies and cross-cutting competences have a greater impact on shifting workplaces. The CE also requires the use of digital technologies, but therefore, the CE itself does not have a transformative impact on labour markets regarding skillsets, but the CE should be seen in this interconnected context. It can be concluded that the CE is just one case that shows the importance of transversal skills and adaptability of workers (European Commission 2018). Lehmann et al. (2022) find no evidence that increased human capital positively affects CE levels. The work of Burger et al. (2019) partially explains this result as CE skills cannot just be taught in educational programs because of the need for very specific skills on the job. Hence, the educational

requirements in a CE are very heterogenous and do not differ much from the current linear economy (Burger et al. 2019). Concerning work integration of vulnerable groups in a CE, van Opstal and Borms (2023) study about circular start-ups show a strong significant positive relationship between circularity ambitions and work integration ambitions. Nevertheless, there might be differences in the work integration ambitions of startups regarding the skills they need than those of big incumbent firms (van Opstal and Borms 2023).

2.4 Framing the Research Gap

Eurostat proclaims that the CE significantly contribute to creating jobs and economic growth (Eurostat 2024). However, the development of relevant CE sectors have to be monitored to evaluate if the CE transition actually delivers these results for sustainable development. When speaking of a CE transition to achieve sustainable development, it is shown that the economic dimension of sustainability is the most widely included indicator, followed by the environmental dimension, and the social dimension is less considered (Kristensen and Mosgaard 2020). Due to this bias in academic research on the CE, the link between the CE and sustainable development is still underdeveloped (Kristensen and Mosgaard 2020). Additionally, academic research does not provide an overview of the current development of CE sectors in the EU. This topic is important as we deal with a sustainability transition process for the economy and society. Therefore, the topic is of utmost importance to academia, politics, and businesses alike to think about future developments and how to shape a new circular system to create positive societal impact. Discussing the current developments in the EU could serve as an example to discuss future implications of the CE. The common assumption that the CE automatically contributes to societal development like the creation of jobs can be, but is not always valid (Brusselaers et al. 2022). It is the common understanding that the CE will shift economic activities and create winners and losers in all countries and sectors (Geerken et al. 2019). However, the CE's success depends on societal outcomes and varies case by case (Lahcen et al. 2022). The CE also causes structural changes in society (Prieto-Sandoval et al. 2018), and the effects of the CE on society remain a gap in research (Saidani et al. 2019). As the acceptance of society is the key factor for a successfully implemented CE in the long term, researchers should overcome this lack of proper understanding of the social dimension of sustainability in the CE (Lehtimäki et al. 2023; Valencia et al. 2023). This results in "a suggestion for future research to focus on integrating the social aspect into the circularity framework and developing CE towards a circular society." (Lehtimäki et al. 2023, p. 585). The Circularity Gap report calls for identifying and managing potential blind spots of circular solutions so that the CE transition is safe and just. Therefore, collecting data and tracking metrics is necessary to manage circular job development across all sectors (Van Veldhoven et al. 2022).

Within this defined research gap, this paper addresses these issues critically because the implications of major economic changes which the CE will cause have major implications on society.

3. METHODOLOGY

This paper builds on descriptive statistics and a Friedman Test to analyse a dataset from Eurostat comprising the thematic area "competitiveness and innovation" of the CE indicators gross value added at factor costs (GVA), private investments in tangible goods (INV), and jobs in full-time employment (FTE) of CE sectors in the EU member states from 2005 to 2021. The indicators used by Eurostat are developed in three steps. First, a conceptual framework is developed by classifying the CE sectors. Second, corresponding CE activities are identified and matched against the linear economic factors. Third, estimates based on official statistics are produced, including PRODCOM, national accounts, the Labour Force Survey, and others (Eurostat 2022b). GVA is calculated by value added at factor costs, which is the gross income from operating activities after the adjustment of operating subsidies and indirect taxes. INV is defined as gross investment in new and existing tangible capital goods. They can be bought from third parties or produced for their own use, but investments in intangible goods and financial assets are excluded. FTE measures the number of persons employed in the CE sectors. This indicator is calculated by the total number of persons working in a specific observation unit (mostly a firm), comprising internal workers such as employees, managers, partners,

or unpaid family workers, and external workers working for the firm but from outside, like sales representatives, delivery services, teams for repair and maintenance. Specifically excluded are persons working on behalf of another, so firms that do not have a circular purpose, doing, for example repair or maintenance duties (Eurostat 2022a). CE sectors comprise the recycling, repair and reuse, rental, and leasing sectors (Eurostat 2022b). Activities in these sectors comprise the creation and utilisation of products or services within the CE with the aim of boosting them. Support services such as administration, education, training, information dissemination, communication, research, and development are also included in CE sectors as their outcomes are consequently classified as products of the CE. Two classifications of goods and services within the CE framework are delineated: those primarily serving CE objectives (like waste collection, treatment, recycling equipment, secondary raw materials, etc.) and those initially intended for non- circular purposes but designed to fulfill secondary CE objectives by enhancing resource efficiency compared to conventional equivalents (like e-books, leasing, and renting services) (Eurostat 2022b). There are also reported borderline cases, so for example, car sharing offers a circular business model intending to extend the life span of the car, but nevertheless, a car as a product is not designed for the CE and does not have the primary purpose of advancing the CE. Therefore, car sharing is not included in the dataset. Incineration as energy recovery is also not included in the dataset because it constitutes the end of life of the materials. If, for example, a product is designed to reduce the material use by applying select strategies of the 9R framework (Potting et al. 2017), the firms pursuing these activities are included in the dataset. The final CE sector list integrates NACE and PRODCOM classifications (Eurostat 2022b). Among them are companies producing recyclates from plastic waste, tire retreading, wastewater treatment, machinery for waste processing, repair of fabricated metal products, retail sale of second-hand goods, renting and leasing of several goods, etc. (Eurostat 2022b). Decisive is the purpose and the aim of a product's design for circularity including expanded life-span or repurpose/ reuse opportunities, the transformation of industrial processes towards the CE (e.g., industrial symbiosis), and new means of consumption (European Commission 2023). The dataset was retrieved in November 2023.

The aim is to evaluate the development of the CE sectors in the EU based on the three indicators GVA, INV, and FTE over time. This dataset also allows comparisons among the EU member states. Given the explorative nature of this study, descriptive statistics are applied to show the development of the CE sectors in each member state over time. By calculating the yearly growth average, the EU member states can be compared, and indicators can be related to each other. In the second step, a Friedman Test is used to double-check the time-dependent growth, calculating the Chi-Square and significance (Friedman 1937; Sheskin, 2020). This method is developed to handle timely dependent data as they are given by Eurostat. This makes the Friedman Test the necessary statistical method to investigate on this dataset.

4. RESULTS AND DISCUSSION

This section presents the results of the analysis and discusses the development of the CE sectors in the EU with the existing literature in order to assess the findings and relate them to the literature. In the second part of this section, the results of the CE sector development are set in context with economic and social implications by referring to corresponding existing literature.

4.1 Development of CE Sectors Recycling, Repair, Reuse

The results obtained by the Friedman Test show a significant positive growth trend in CE sectors over time in the EU from 2005 to 2021 for the three indicators GVA, INV, and FTE. The results are significant as the significance level is below 0,001. Table 1 presents the testing statistics of the three indicators, and Table 2 presents the results.

Table 1. Friedman-Test

	GVA	INV	FTE
N	28	28	28
Chi-Square	307,150	189,038	231,675
Df	16	16	16
Asymp. Sig.	<,001	<,001	<,001

Table 2. Rankings of the Three Indicators GVA, INV, FTE

	Middle rank GVA	Middle rank INV	Middle rank FTE
2021	15,50	13,95	14,64
2020	14,04	12,71	13,79
2019	15,32	14,11	14,21
2018	14,11	12,88	13,71
2017	12,61	12,29	12,68
2016	11,04	10,61	10,43
2015	9,98	9,30	8,71
2014	7,95	7,82	7,57
2013	7,46	5,46	7,41
2012	7,50	7,04	7,66
2011	7,41	7,52	7,04
2010	7,38	6,45	6,79
2009	5,46	5,46	6,54
2008	7,63	10,82	9,11
2007	4,13	6,13	5,25
2006	3,36	5,59	4,18
2005	2,14	4,88	3,29

Descriptive statistics reveal that INV increased the most over time in the EU as a whole with an average of 7,59% growth rate. The GVA increases over time with a growth rate of 4,48%. However, FTE in the CE sectors shows a much slower growth rate of only 1,76%. Table 3 presents a comparative analysis of GVA, INV, and FTE in the CE sectors and uncovers the growth rates in each member state. The data is categorised based on patterns of economic performance observed within the respective countries, which can be quite dispersed.

For example, the indicators GVA and FTE for Greece show even a decrease and INV only a very low increase. This means that the status from 2005 could not even be maintained, and the development towards CE is negative, which can be explained by the overall low economic development of Greece in the past decades.

The second segment of the table identifies member states exhibiting low growth rates across all three indicators. Austria, France, Portugal, and Sweden are characterised by marginal growth in GVA, INV, and FTE employment. This confirms the logical assumption that low growth rates in GVA and INV cannot lead to an increase in jobs (FTE).

The next category of countries represents a much more illogical and even alarming meaning. Belgium, Bulgaria, Croatia, Czechia, Denmark, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Romania, Slovenia, Spain, and the United Kingdom demonstrate an increasing growth trend in GVA and INV, albeit with comparatively lower growth rates in FTE employment. This economic profile is concerning because it means that higher growth in GVA and INV does not automatically lead to more jobs (FTE). Hence, the actual numbers partially deviate from literature findings where an increase in CE sector employment is predicted (Geissdoerfer et al. 2018). In contrast, Padilla-Rivera et al. (2020) find that an increase in FTE jobs in CE sectors is only happening with accompanying policies which enable the CE sector growth. Since all EU member states are bound to the Circular Economy Action Plan, they all implemented it in their national law and regulations. However, there seems to be a difference in effective policies since countries like Cyprus and Finland achieve moderate growth in FTE jobs with moderate growth in GVA but very low or even negative growth rates in INV. Conversely, when GVA growth is rather low, but INV has a higher growth rate, a higher growth rate in FTE jobs is monitored for the cases of Germany, Hungary, and Ireland. Lastly, Estonia and Slovakia are recognised for exhibiting high growth rates across GVA, INV, and FTE employment, marking a notable performance within the EU.

Table 3. Descriptive Statistics Indicators GVA, INV and FTE for 28 EU Member States[2]

EU member states	GVA	INV	FTE
(1) Decrease in GVA, low INV and decrease in FTE			
Greece (EL)	-4,08%	0,19%	-1,14%
(2) Low growth in GVA, INV, FTE			
Austria (AT)	2,31%	1,03%	0,33%
France (FR)	1,28%	0,92%	1,07%
Portugal (PT)	1,94%	3,61%	0,20%
Sweden (SE)	2,98%	4,94%	1,64%
(3) Increasing growth in GVA and INV but low growth rate in FTE			
Belgium (BE)	2,89%	6,20%	0,21%
Bulgaria (BG)	7,07%	7,96%	0,60%
Croatia (HR)	6,77%	7,76%	2,62%
Czechia (CZ)	5,03%	7,95%	0,74%
Denmark (DK)	4,44%	7,59%	0,69%

[2] Albeit the United Kingdom left the EU in 2020, the dataset was still complete until 2021, so the country was included into the analysis

Italy (IT)	5,05%	8,05%	0,94%
Lithuania (LT)	14,63%	21,60%	2,14%
Luxembourg (LU)	5,07%	12,35%	2,60%
Latvia (LV)	3,93%	6,15%	1,23%
Malta (MT)	10,04%	15,53%	1,01%
Netherlands (NL)	2,10%	10,69%	0,86%
Poland (PL)	4,81%	7,23%	1,54%
Romania (RO)	5,83%	8,47%	0,94%
Slovenia (SI)	5,55%	2,48%	1,59%
Spain (ES)	5,55%	11,17%	2,54%
United Kingdom (UK)	6,39%	13,77%	1,45%
(4) Increasing growth in GVA, very low (even negative) growth in INV and moderate growth in FTE			
Cyprus (CY)	3,24%	-1,90%	3,00%
Finland (FI)	3,31%	0,09%	1,38%
(5) Low GVA growth but high INV and also high FTE			
Germany (DE)	4,96%	11,51%	3,38%
Hungary (HU)	2,35%	13,48%	6,09%
Ireland (IE)	0,78%	14,75%	4,07%
(6) High GVA, INV and also FTE			
Estonia (EE)	7,85%	4,31%	3,81%
Slovakia (SK)	3,51%	4,65%	3,73%
(7) Total: Decent growth in GVA, higher growth in INV and very low growth in FTE			
Average EU 28 member states	**4,48%**	**7,59%**	**1,76%**

4.2 Implications on Economy and Society

The Friedman Test shows a linear growth in jobs from 2005 until 2021. The growth is low and did not increase after the introduction of the SDGs and the Circular Economy Action Plan in 2015 (European Commission 2015). This implies that the increased political agenda in favour of the CE

since 2015 did not lead to a scale-up and exponential growth of jobs in the CE sectors. The Circular Economy Action Plan was not the expression of a short-term political will but led to the proclamation of the EU Green Deal in 2019, so it is quite an important political guideline with high financial incentives involved. The next five to ten years will show if the EU Green Deal from 2019 leads to a successful CE transition. Concerning is that full-time employment is growing in a slow linear fashion, so there are new jobs in these sectors, but from this historical dataset, it does not become visible that the large political will for a circular sustainable transition is reflected in employment opportunities in the EU, so, it is hard to judge which policies lead to more job creation in the CE sectors because many different aspects are involved. For example, it is unknown where exactly investments go into: if they go into renovating existing recycling plants to become more efficient, this probably leads to reducing the number of jobs because technological innovation eradicates jobs like processing, sorting, and preparing waste streams (Cukier 2019). This is interesting because especially after 2018, many new recycling plants were built – more than 24.900 between 2018 and 2020 with 50.000 before 2018 and more than

200.000 after 2020 (Alves 2024) – but apparently, jobs do not grow in a similar scale. This could indicate that jobs done by humans become redundant as AI and other sophisticated technologies can take over many tasks initially done by humans. Neri et al. (2023) find that, especially for SMEs, digital technologies are an enabler for CE practices when it comes to production, efficiency, cost savings, and quality increase. If investments lead to entrepreneurship and new company creation, more jobs are created - for the entrepreneurs and employees when scaling up. However, technology innovation alone leads rather to a loss of jobs. The reuse and repair sectors bring much more value to society than the recycling sector because they create more jobs with individual and more creative tasks with less resource consumption as they require fewer capital investments (Llorente-González and Vence 2020). This also favours entrepreneurship more than the capital-intensive recycling sector. For example, opening a repair shop or developing a platform for reusing materials is much less capital-intensive than building a recycling plant or engaging in public waste collection. Llorente-González and Vence (2020) find that the jobs in the three sectors are low-wage, but it seems that there is more potential in the repair and reuse sectors for more desired jobs and increasing service offers. From an environmental perspective, the repair and reuse sectors are also favoured over recycling as they lead to increasing the lifespan of products and materials, and therefore, lead to a better conservation of natural resources (Potting et al. 2017). However, the EU focuses on recycling in their Action Plan.

This development needs an active political intervention because an increase of desirable jobs is needed to let people participate in the new circular system. This is of crucial importance because this new circular economic system should not only solve environmental concerns such as carbon emissions, waste streams, etc., but should also lead to a more inclusive and fair society (Llorente-González and Vence 2020). Since a circular transition aims at sustainable development, not only the economic system will change but also the way people work, live and consume (Lehtimäki et al. 2023). This has a very big influence on people's lives and has to be taken into account. Therefore, the EU aims to combine the Social and Circular Economy with corresponding Action Plans (European Commission 2021). We agree on the local focus of a circular system like van Opstal and Borms (2023), who identified the CE as a possible solution to local unemployment disparities and occupational mismatch. The case study of the Belgian economy shows that domestic economies gain from a focus on CE sectors, whereas value is reduced for economies abroad since the CE approach is more local.

The evaluation of historical data in this study supports the negative CE labour market forecasting of the European Commission (2018), which predicts 700.000 new jobs in the CE sectors by 2030. In 2018, the EU's total number of jobs related to CE sectors was 4.459.001. A net increase of 700.000 jobs by 2030 would mean a yearly growth rate of 1,31% for an EU average. Considering the growth rate of 1,76% for jobs until 2021, it is expected that the growth of jobs will go down. The question remains how a real transformation of the current linear economy to a sustainable circular economy will take place if the number of jobs in the respecting sectors will not increase. This should be a starting point towards a discussion on the objectives of the CE transformation and how to achieve it.

5. IMPLICATIONS ON ACADEMIA AND PRCATICE

This chapter concludes by stating theoretical and practical contributions, discussing policy suggestions, and explaining the limitations of the study transparently to finish with suggestions for future research. The aim of this paper is to provide an overview of the status quo of the CE sector development in the EU and start a discussion about economic and social implications. The results show that the jobs in the CE sectors grow in a linear fashion, but the growth is relatively slow and needs a boost to achieve a CE transition like it is demanded in the Circular Economy Action Plan from 2015 and European Green Deal (2019). The historical data present growth rates of 4,48% in GVA and 7,59% for INV. Compared to the growth rate of only 1,76% in FTE, so full-time jobs in the CE sectors, it becomes apparent that investments into the sectors and increased value added do not automatically lead to new jobs.

So, from a theoretical perspective, this study contributes to the growing body of academic literature about the CE transition by focusing on the European context. We agree with Arnold (2023) who states that "Being circular does not automatically mean sustainable" (p. 1), as it is shown that at least for one social indicator (jobs measured in FTE), the past development of the CE sectors is not enough to serve the EU society in a sufficient manner. Hence, this paper critically discusses the positive and negative economic and social implications of a CE transition, as this is often dealt with more generically in existing literature. As many studies conclude with the CE as a driver for new job creation (Padilla-Rivera et al. 2020; Wijkman and Skanberg 2017), we found that the past development is not sufficient, and policy is needed to support the uptake of this development with new guidelines, restrictions and incentives. Wijkman and Skanberg (2017) conclude that there will be new job creation for the CE, but other sectors will also shrink and it is necessary to make sure that the outcome is positive in absolute terms. A positive development is not achieved by the EU alone, but efforts of all member states are required to not only boost job creation but also make sure that this transition is fair and just so everyone

- especially the currently disadvantaged groups of the linear economy - receive a fair share of these new opportunities (Mercanti 2022). One part is making sure that the inclusion of persons with disability is promoted (Mercanti 2022). Overall, it is necessary to estimate the potential of the CE and its influence on current systems to know under which conditions the sustainable development is achieved, and the negative impacts of the transition from a linear to a circular system are outweighed (Saidani et al. 2019). Previous studies show that no particular new skill development is needed to be well-equipped to do jobs in CE sectors, but digital technologies will play an important role, so skills for the digital economy will become more necessary. For example, the findings of van Opstal and Borms (2023) do not show the need for upskilling or reskilling persons, but digital skills are needed more and more (Neri et al. 2023).

The EU has much power to change laws, regulations, guidelines, and incentive schemes to shape a CE transition for sustainable development. It can change institutional conditions by transforming political processes to enhance a fair CE for everyone (Moreau et al. 2017). The EU political support framework to enhance the CE transition should nevertheless be more flexible to adapt to the local conditions of the member states and should consider economic, social, and environmental consequences (Zeng et al. 2022). The findings of this study confirm Wijkman and Skanberg (2017), who figured that a real CE transition needs an investment boost. This is not only to grow CE sectors in GVA and INV but also to create more jobs and also jobs which are desired by people. Labour should be positioned in the center of the economy and the labour-intense activities of the CE should become more qualitative and diverse in tasks along the 9R strategies for the CE (Moreau et al. 2017; Stahel 2010). Policy interventions also shape measures for the society transition towards the CE by establishing new formats for participation and the promotion of initiatives and social innovations (Kadner et al. 2021). Therefore, transparency is important to gain consumer trust in CE products and services, which can be achieved through product labelling and declarations (Kadner et al. 2021). Education and training programmes help in creating awareness and knowledge of how to act or behave in favour of a circular society (Jaeger- Erben et al. 2021). It is also important to establish an institution to make scientific insights public and bring it into industrial practice and society (Kadner et al. 2021). So, this paper calls for policy makers to assess better the potential of the CE for social development

and companies to find not only circular business models but also shape a more fair and equitable labour market. The CE sectors in this paper represent examples but in this current transition process, every circular action or change in processes are required to be thought in a more systemic way to shape workplaces and the society of the future. So, as a practical contribution, this paper makes the current CE status quo transparent and companies are called to dedicate their investments not only into technology innovations but also involve social innovations and include a more human approach in shaping this new circular system.

As this paper aims to start a critical discussion on how to shape a CE transition in a sustainable and inclusive way, it clearly focuses on certain indicators deemed important measures for the CE transition. Assessing the CE potential at such a macro level, it is difficult to quantify all needed economic activities to illustrate the whole picture. Therefore, a selection of indicators was made for the "competitiveness and innovation" indicators of the CE sectors GVA, INV, and FTE, which is a limitation to assess the economic development of the CE sectors. Especially FTE is considered an important indicator discussing the social implications of the CE, but also other indicators should be involved to get a better picture of societal development. However, no other dataset has been found that represents social indicators other than jobs. There are other indicators discussing the environmental objectives stemming from a CE transition which are excluded in this paper. Someone can also argue that the CE sectors captured at Eurostat are not a sufficient representation of CE activities in the EU but due to difficulties in capturing economic activities with a clear CE objective, this subset of sectors was defined by Eurostat (Eurostat 2022b). We clearly invite researchers to dive deeper into this topic on a macro-level to forecast the development of the CE transition with the perspective on sustainable development. It becomes apparent that the economy will change when transitioning to a CE, and the labour market is not catching up at the moment. It is of crucial importance to think about the needed societal transition in a CE, and providing sufficient well-paid jobs in an inclusive labour market plays an important role in its acceptance and success. Therefore, future research should address these caveats and research the topic under different conditions, in other parts of the world, and with other datasets that allow for future forecasting.

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AUTHOR CONTRIBUTIONS

Charleen von Kolpinski: Project administration, Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing.
Jan Kratzer: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Software, Visualization, Writing – review & editing.

DECLARATIONS

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