

Delving into Stakeholders' Perceptions of the Efficient Transition to the Circular Economy

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Abstract: *The importance of knowledge management in facilitating a successful transition to a circular economy through the creation of a circular business model, as a substitute for the conventional linear economic approach, has not been extensively explored. The capacity of a company to coordinate, generate, and disseminate knowledge plays a crucial role in developing environmentally friendly industries and creating new employment opportunities. This article employs a literature review methodology to establish the connection between knowledge management and the shift towards a circular economy. The findings reveal that a company's eco-innovation process relies heavily on strategic knowledge management. Consequently, a comprehensive understanding of the system and self-motivated creativity are crucial components of expertise in creating sustainable circular business models. Hence, companies must consistently enhance their knowledge base to improve business processes, eco-efficiency, and eco-innovation.*

Keywords: *circular economy, transition, sustainability, business.*

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Introduction

Romania, like many other countries, is facing the challenge of transitioning to a circular economy. In this vein, there is a lack of research on the specific challenges and opportunities of transitioning to a circular economy in the Romanian context. Past studies have provided insights into different facets of this transition and, as a result, have identified research gaps that underline the need for more in-depth examination of the specific challenges and opportunities in the Romanian context (Aceleanu et al., 2019; Mihai, 2020; Ghența & Matei, 2018; Modoi & Mihai, 2022; Mihai & Minea, 2021; Nastase et al., 2021).

In Romania, recent progress has been made in recycling indicators; however, critical areas such as resource circularity and employment generation still demand attention (Aceleanu et al., 2019). Effective municipal waste management is pivotal within the circular economy landscape (Aceleanu et al., 2019), as is the development of integrated waste management systems aimed at recycling construction and demolition waste into valuable building materials (Mihai, 2019). Yet, the journey toward a circular economy in Romania faces systemic challenges, including bureaucratic hurdles, regulatory complexities, and limited investment in human capital and innovation activities, particularly for small and medium-sized enterprises (SMEs) (Ghența & Matei, 2018). Overcoming these barriers necessitates the formulation of long-term economic strategies supported by consistent governmental decisions (Ghența & Matei, 2018).

Additionally, a pressing need exists for comprehensive research and insights into specific waste streams, such as e-waste and end-of-life vehicles, within the Romanian context, which is crucial for designing effective circular economy initiatives (Modoi & Mihai, 2022). Furthermore, Romania grapples with a noticeable urban-rural disparity, with larger urban areas experiencing more significant economic growth compared to smaller towns and rural communities (Mihai & Minea, 2021). Mitigating this disparity and bridging regional gaps are vital for a successful transition to a circular economy (Mihai & Minea, 2021).

Despite these considerable challenges, Romania holds significant opportunities to embrace circular economy principles. The potential exists for the development of smart cities that seamlessly integrate circular economy principles into municipal waste management systems (Aceleanu et al., 2019). Additionally, the generation of case studies, such as those in the toy industry, can provide valuable insights and practical guidance for

businesses seeking to adopt circular economy practices in Romania (Nastase et al., 2021).

Consequently, this research aims to fill this gap by providing a systemic view of the circular economy, delineating the necessary steps for its actualization, cultivating inter-industrial value chains, and underscoring features within the green economy.

The research aim of this study is to investigate the transition to a circular economy in Romania, with a focus on the challenges and opportunities. The specific objectives are to: examine the European and national frameworks related to the circular economy; uncover the national implications, including effects on the environment and job creation; identify commendable European and national practices in applying circular economy principles.

The present research is important as it will provide a comprehensive understanding of the transition to a circular economy in Romania. The findings will be useful for policymakers, businesses, and academics in developing and implementing effective circular economy strategies.

The empirical investigation conducted from July 1 to August 21, 2022, aimed to examine the European and national frameworks related to the circular economy, uncover the national implications, including effects on the environment and job creation, and identify commendable European and national practices in applying circular economy principles.

The initial section serves as an introduction, reviewing existing literature on the circular economy and articulating answers to questions concerning its formulation in Romania, the role of stakeholders, and viable methods for its advocacy within the Romanian context. The subsequent section is devoted to the terminology and concepts concerning the circular economy, green economy, and sustainable development (as previously also tackled by Păunescu & Blid 2016), emphasizing the unique characteristics and prospective opportunities of transitioning from a traditional linear model. An overview of theoretical approaches, conceptual interrelations, and international initiatives in these areas is also provided.

The focus then shifts to the specificities of European and national legislative frameworks for the circular economy transition, coupled with an analysis of its potential. This portion highlights challenges in implementing the new Circular Economy Package. Obstacles tied to enactment and surveillance of the circular economy were emphasized, referencing the need to revamp national legislation, encourage stakeholders to formulate standards for certain waste streams, and enhance integrated development methodologies.

The paper will conclude with a discussion of the challenges and opportunities of transitioning to a circular economy in Romania, and recommendations for policymakers, businesses, and academics. To achieve the assumed objectives, the research will be guided by a set of essential questions that will drive the investigation. Through rigorous analysis, we will explore the public and private sector's perceptions concerning the potential of the circular economy in Romania. Additionally, we will delve into identifying the most relevant resource flows within the circular economy paradigm in the Romanian context. Our research will also endeavor to uncover the essential tools required to facilitate the implementation of circular and green economy practices in Romania. Lastly, we will examine the various barriers that obstruct the seamless transition towards a circular economy. These research questions form the bedrock of our study, aiming to offer in-depth insights into the complexities of Romania's transition to a circular economy. Our findings will inform policies, guide businesses, and enrich the academic discourse on sustainable development.

Literature analysis

In response to the challenges posed by the traditional linear economic model, the concept of a circular economy emerged as a sustainable alternative (Allwood, 2014). First introduced in the 1970s by Stahel and Reday, the circular economy was proposed as a workplace strategy for resource efficiency, job opportunities, and dematerialization of industrial economics (Geissdoerfer et al., 2017). The circular economy gained traction in China in 1998 and has since received global attention from policymakers, researchers, and practitioners seeking to advance Sustainable Development Goals (Qi, et al., 2016).

The circular economy approach is considered a sustainable model that requires a transformation of production and consumption systems to promote resource efficiency, reuse, and recycling (De los Rios & Charnley, 2017; Vătămănescu et al., 2018). The European Commission's Circular Economy Action Plan, for instance, aims to develop a sustainable, low-carbon, resource-efficient, and competitive European economy (Dincă, 2022). Such efforts are necessary because traditional linear systems pose significant environmental and social risks (Hapenciuc et al., 2015; Vătămănescu et al., 2016).

Several influences inform the circular economy, including cradle-to-cradle economics, circular and yield economics, regenerative design, industrial ecology, biomimicry, and the blue economy. However, transitioning from a linear to a circular economy presents significant

challenges, such as the need for political commitment, financing of innovation and research, and the development of standards for efficient resource use and waste management (Qi et al., 2016).

The transition to a circular economy requires reconsideration of unsustainable aspects, identification of future opportunities, and implementation of eco-friendly strategies (Vătămănescu et al., 2017; 2018). For instance, mobile commerce businesses can develop eco-friendly strategies to minimize their environmental impact. Ultimately, the realization of a circular economy that harmoniously combines with green growth is key to promoting sustainable production and consumption models that can sustain economic activities in the long term.

The circular economy is an integral part of sustainable development, as it emphasizes the importance of optimizing resource consumption to prevent waste and promote reuse. To achieve this goal, new life cycle approaches are necessary, which can overcome the barriers associated with the consumer market uptake of the latest technological innovations in this field. In 2022, the European Union launched the Circular Economy Action Plan, which aims to reduce waste and pollution and create a more sustainable economy. The plan includes several measures to promote circularity, such as mandatory extended producer responsibility schemes for packaging and electronics, and targets for the reuse and recycling of materials.

The EU is a global leader in the transition to a circular economy. The Circular Economy Action Plan is an ambitious plan that will help the EU to achieve its climate and sustainability goals. Here are some specific examples of how the EU is implementing the Circular Economy Action Plan: The EU is working to develop a common market for recycled materials. This will make it easier for businesses to use recycled materials in their products and services; The EU is also working to support the development of new circular technologies. For example, the EU has funded research into new ways to recycle plastics and electronics; The EU is also working to raise awareness of the circular economy among businesses and consumers. For example, the EU has launched a public awareness campaign called "Close the loop".

The EU's transition to a circular economy is still in its early stages, but the EU is making good progress. The Circular Economy Action Plan is a key part of the EU's efforts to create a more sustainable future. Nevertheless, in the quest to understand the dynamics of Romania's transition to a circular economy, previous studies offer a comprehensive perspective. Frone (2017) first underscores the strategic role of eco-

innovation parks in promoting the circular economy within Romania, fostering collaboration among diverse enterprises. Strat (2018) introduces an innovative county-level indicator designed to assess Romania's circular economy potential, shedding light on concentration poles and regions with limited potential. Vermeșan et al., (2020) present an assessment of Romania's early-stage transition, emphasizing the coexistence of challenges and opportunities. Notably, Romania remains heavily reliant on the linear economic system, with barriers rooted in attitudes and mentality toward the circular economy. Dobre-Baron et al. (2022) take an econometric approach to predict Romania's future performance in adopting the circular economy model, suggesting favorable conditions for long-term improvement. Collectively, these insights offer significant contextual information for our first research question, aiding in the comprehension of how both the public and private sectors in Romania perceive the potential of the circular economy.

The concept of circularity, i.e., closing the economic loop, was first introduced in the 1976 report "The potential to substitute human labor for energy." The report presented a vision of an economic loop that could create new jobs, increase economic competitiveness, save resources, and prevent waste. The interest in the circular economy approach is extensively debated in the study "The Performance Economy" (Stahel, 2010), which proposes a change in economic thinking from "doing things the right way" to "doing the right thing" to address the concerns associated with sustainability (Păduraru et al., 2016). Stahel (2010) recommends a sufficient approach that focuses on intelligent system solutions rather than individual products. The ultimate goal is to implement a performing economy that targets research, creates new jobs, and exploits the opportunities of a performing system of extended producer responsibility (Dincă, 2021). Accomplishing these objectives in a coordinated manner will bring substantial benefits to economic actors.

The implementation of a performing economy targets the production area where innovation plays a central role, and resources are recirculated through a circular system (Vătămănescu et al., 2019, 2021). Special attention is given to intelligent solutions from the area of processes specific to life sciences, such as chemistry, biology, and nanotechnologies. Innovation plays a crucial role in terms of extended producer responsibility, developing new methods to optimize life cycle costs, new technologies to optimize the (re)use of components, extend the life of products, provide options for repair, quality monitoring tools, and more (Vătămănescu & Alexandru, 2018). According to Stahel's perspective (2010), the key elements

influencing a thriving economy encompass: the level of competitiveness, advancements in science and technology, trading activities (including, but not limited to, extension of product life and the market for remanufactured products), and cultural consumption patterns (such as the ratio of new to old motor vehicles per family member in differing countries).

Incorporating recent findings and bridging into the second research question, previous studies conjointly underscore Romania's capacity for enhancing its embrace of circular economy principles. Potârniche et al. (2022) conducts a comparative analysis of Romania's circular economy metrics against those of other EU member states, revealing shortfalls in municipal recycling rates. Additionally, Dobre-Baron et al.'s (2022) econometric analysis anticipates favorable conditions for Romania's future improvement in adopting the circular economy model. Furthermore, Petrea's (2023) focus on the food and beverage sector identifies issues like subpar recycling rates and substantial food waste, while proposing remedies that include sustainable education and reduced reliance on plastic packaging. These findings shed light altogether on potential flows for growth in Romania's circular economy journey, all the while acknowledging the challenges that warrant attention.

The article "Circular Economy and Sustainable Development: A Review and Research Agenda" (Lamba et al., 2023) is a comprehensive review of the literature on the circular economy and sustainable development. The article argues that the circular economy is a key enabler of sustainable development, and that it can help us to achieve a number of important sustainability goals, such as reducing waste and pollution, conserving resources, and creating jobs. One of the key takeaways from the article is that the circular economy is a complex and systemic concept. It is not just about recycling and composting, but it is also about designing products and services for circularity, and about changing the way we consume and produce goods.

The article "Circular Economy Implementation in Developing Countries: Challenges and Opportunities" (Ghisellini et al., 2022) delves into the complexities of implementing the circular economy in developing nations, shedding light on both the promise it holds for achieving sustainable development goals and the hurdles that must be overcome. This discussion resonates significantly with Romania's own aspirations and challenges regarding the circular economy. Romania, as an emerging economy, encounters akin challenges and opportunities. It, too, aims to harness the circular economy's potential to mitigate waste, reduce pollution, conserve resources, and generate employment opportunities. However, in

common with the developing countries highlighted in the article, Romania faces barriers such as limited financial resources, a dearth of technical expertise, suboptimal infrastructure, and governance and regulatory deficiencies.

These shared challenges underscore the imperative to pinpoint and implement tailored strategies and measures that directly address the third research questions guiding our study. Specifically, we aim to identify the essential tools necessary to facilitate the successful implementation of circular and green economy principles in Romania, aligning closely with the third research question. Moreover, the regulatory and governance issues spotlighted in the article closely resemble the impediments that Romania must navigate during its transition toward a circular economy, as outlined in our fourth research question. This correspondence emphasizes the importance of delving into and comprehending the distinctive obstacles specific to Romania's context. By drawing parallels between these insights gleaned from the article and the challenges inherent to Romania's circular economy journey, a more nuanced understanding emerges, guiding the way towards overcoming these hurdles and fully unlocking the circular economy's potential for sustainable development in the country.

Conceptual Definitions and Scope: Circular Economy, Green Economy, and Sustainable Development

Discussions on the potential of the circular economy are closely linked to environmental protection, as well as advancements in competitiveness, innovation, and technological research (Vătămănescu et al., 2017, 2018, 2021). Keeping products, materials, and resources within the economic circuit and reducing waste production are increasingly common objectives across public authorities, the business environment, research institutes, and non-governmental organizations. At the European level, several initiatives have emerged to support the implementation of the circular economy and disseminate information to interested parties (Vătămănescu et al., 2021). These include the European Circular Economy Stakeholder Platform, which facilitates the exchange of best practices and maintains a database of European good practices.

The concept of the *green economy*, as proposed by the United Nations Environment Programme (UNEP) in 2011, is closely linked to the circular economy. It aims to improve welfare and social equity while significantly reducing environmental risks and the ecological deficit. The transition to a green economy can be interpreted from various perspectives, including the efficient use of resources through innovative approaches that optimize

resource consumption and minimize GHG emissions and waste. Additionally, sustainable resource management practices aim to preserve natural capital, enhance ecosystem resilience, and promote social inclusion (Stratone et al., 2022; Vătămănescu et al., 2022). The circular economy approach is interconnected with these objectives, which aim to manage waste, promote resource efficiency, and achieve a higher degree of social well-being (Figure 1. Green Economy versus Circular Economy).

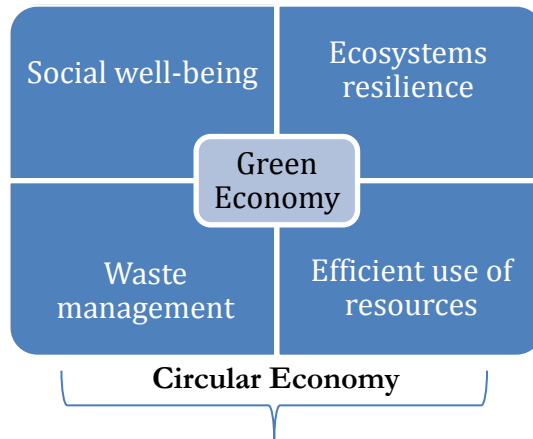


Figure 1. Green Economy versus Circular Economy
Source: Authors' own interpretation upon research

The concept of the green economy has become an increasingly important topic of discussion at the international level. The Paris Agreement achieved at the 21st Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change was a significant moment in global efforts to reduce the rise in global average temperature by 2°C. The green economy encompasses a number of thematic areas including investments in innovation, technology transfer, ecological products, and sustainable consumer behavior. The green and circular economy perspectives contribute to a broader approach to sustainable development, uniting the protection of the environment, increased competitiveness, and productivity of available resources within an economy (Ferioli et al., 2022).

The European Commission has defined the scope of the green economy, focusing on the efficient use of resources, sustainable production and consumption models, waste prevention and management, and water resource management. The transition to a green economy is a long-term process that requires political commitment from states seeking a change in economic development models. Various initiatives have been proposed, such as increasing public awareness of renewable energy, energy-efficient

buildings, low-emission technologies and processes (Gazzola et al., 2019; Văţămănescu et al., 2023), promoting new indicators to complement Gross Domestic Product, and developing green investment markets.

The circular and green economies are integral parts of sustainable development, as defined by the Brundtland Commission (1987), which strives to meet the needs of the present without sacrificing the ability of future generations to meet their own needs. The commission's findings became the basis of Agenda 21, the Rio Declaration, and the 27 principles for environmental protection. Both the Brundtland Commission and the Rio Conference emphasized the need for a new approach to natural resources, which was taken up through the Millennium Development Goals in 2000.

The United Nations Conference on Sustainable Development's outcome document, "The Future We Want" (2012), formed the basis for the creation of the High-Level Political Forum on Sustainable Development. The 2030 Agenda for Sustainable Development adopted at the UN Summit for Sustainable Development (New York, September 2015) aims to eradicate poverty and achieve sustainable development worldwide by 2030. The 17 global goals, 169 targets, and 232 indicators of the 2030 Agenda represent a universal program of global action in the field of sustainable development. States, both developed and developing, are now focused on identifying solutions to the challenges associated with the implementation and monitoring process.

The circular economy represents a pivotal global concept, holding the potential for transformative change on a worldwide scale as it introduces a novel economic paradigm aimed at decoupling economic growth from resource consumption and environmental degradation (Hofstetter et al., 2021). This transition from the traditional linear model of "take-make-dispose" to a circular model of "reduce-reuse-recycle" not only champions resource efficiency, minimizes waste generation, and mitigates environmental impacts but also aligns with the principles of sustainable development, emphasizing the integration of economic, social, and environmental dimensions (Barbaritano et al., 2019).

Both at the European and global levels, the proliferation of circular economy initiatives is driven by a shared recognition of the urgent need to address pressing environmental challenges, including climate change, resource depletion, and pollution, as outlined by Hofstetter et al. (2021). The circular economy offers a comprehensive approach to tackle these challenges, fostering sustainable production and consumption patterns, promoting innovation, and creating new economic opportunities, thereby

aligning with the principles of sustainable development (Barbaritano et al., 2019).

As previously pointed out, in Romania, there is a recognized need to transition to a circular economy, marked by progress in enhancing recycling indicators, yet the development of sectors related to resource circularity and employment remains essential (Mihai, 2020; Hategan et al., 2021). The government has initiated measures to support this transition, encompassing waste management policies and the promotion of renewable energy sources; nevertheless, challenges persist, including bureaucratic complexities, regulatory engagement difficulties, and limited investment in innovation, particularly among small and medium-sized enterprises. Achieving a comprehensive circular economy in Romania necessitates the development of integrated waste management systems, heightened focus on specific waste streams such as e-waste and end-of-life vehicles, and addressing urban-rural disparities and regional gaps. In conclusion, the circular economy offers a sustainable framework for economic development, evident in global initiatives (Nikolaou et al., 2021), while Romania's progress underscores the importance of further enhancing waste management, research, and reducing regional disparities in its circular economy journey.

European and National Legislation: Nuances of Transitioning to a Circular Economy

The European Union (EU) has adopted a comprehensive action plan for the circular economy since 2015. The plan aims to promote a competitive circular economy, which will accelerate sustainable economic growth and job creation. According to the European Commission, the circular economy package's impact study identifies benefits such as job creation, positive effects on EU waste sector competitiveness, reduction of greenhouse gas emissions, and the re-introduction of secondary raw materials to reduce the EU's dependence on raw material imports. The study suggests that over 170,000 direct jobs could be created by 2035 and more than 600 million tons of GHG could be avoided between 2015 and 2035. The plan aims to strengthen the industry's capacity to develop new digital technologies that facilitate the transition to a more circular and low-carbon economy. It is worth stressing that increased competitiveness requires the use of smart technologies throughout industrial value chains, capitalizing on Europe's leading position in a circular and low-carbon economy.

Focusing on the most relevant flows for the circular economy in Romania, recent research sheds light on Romania's progress and challenges in adopting circular economy principles (Botezat et al., 2018; Vermesan et

al., 2020; Topliceanu et al., 2022; Burlacu et al., 2022). Botezat et al. (2018) reveal that Romanian firms have embraced circular economy principles to varying extents, with their green-oriented supply chain cooperation practices forming distinct clusters that partially influence circular economy practices and wholly affect circular economy-targeted performance. Vermesan et al. (2020) underscore that Romanian literature on the circular economy lacks structure, and the nation remains predominantly reliant on a linear economic system, encountering difficulties in fully assimilating circular economy principles. While Topliceanu et al. (2022) report that Romania has made strides toward circular economy transition, they emphasize the need for further improvements and emphasize the significance of a long-term vision, political commitment, consistency, and funding in the transition process. Additionally, Burlacu et al. (2022) point out that Romania's circular economy perspective is informed by citizen perceptions, highlighting the country's progress in certain indicators while emphasizing the remaining challenges. Overall, these insights jointly offer a comprehensive view of Romania's circular economy journey, emphasizing the importance of addressing existing gaps and fostering a more sustainable economic model.

At both the European and national levels, implementation and monitoring of the circular economy require updating national legislation, establishing standards, and consulting stakeholders. Public policy commitment at the national level is essential for sustainable business development and promoting the efficient use of resources. Romania's National Strategy for Sustainable Development also aims to promote sustainable consumption and production practices and decouple economic growth from environmental degradation (Vătămănescu et al., 2019, 2023). To support the circular economy, new financing lines have been introduced at the national level. However, adequate funding is required to achieve the circular economy's potential to generate new resources and sustainable business models in the context of the post-2020 multiannual financial framework.

Since 2008, Romania has been guided by the National Strategy for the Sustainable Development of Romania Horizons 2013-2020-2030 (Ministry of the Environment and Sustainable Development, 2008). This strategy underscores the ambition of endorsing sustainable consumption and production methodologies. By 2020, a key objective set forth in the strategy is to uncouple economic expansion from environmental harm, shifting the balance between resource utilization and value addition, and approximating the EU's average performance metrics concerning the sustainability of consumption and production.

The inauguration of new financing lines for the circular economy at a national scale, specifically those tailored for the execution of sectoral policies, technologies, or processes that champion resource efficiency or emphasize circular economy synergies, epitomizes a significant stride and a pronounced affirmation of political dedication. This dedication manifests through initiatives such as the Local Action Groups for executing Local Development Strategies, funded by the Leader initiative within the PNDR framework, the Operational Program for Fisheries and Maritime Affairs, and the allocation of funds to facilitate the accreditation of national testing laboratories. These laboratories undertake intricate analyses, especially in the compost domain, the residue sector of wastewater treatment facilities, assessing the prevalence of pharmaceuticals, cosmetics, or other trace contaminants, and definitively establishing their suitability for agricultural application (Vătămănescu et al, 2021).

Active involvement is required not only at the level of public policy, but also at the level of implementing the circular economy concept on the national territory. The circular economy has gained special attention as a result of its potential to generate new resources, create new opportunities, and develop sustainable business models (Vătămănescu & Alexandru, 2018). This has made it a priority for public authorities, the business environment, research institutes, and non-governmental organizations.

Throughout the years, numerous studies have explored the tools and barriers associated with the broader transition to a circular and green economy, both in general and within the specific context of Romania (Ritzén & Sandström, 2017; Dragoi et al., 2018; Radu, 2018; Tan et al., 2022.). Dragoi et al. (2018) emphasize the potential of the circular economy as an innovative and sustainable economic model that can bring about economic well-being and social protection. However, Ritzén and Sandström (2017) caution that despite its promise, the circular economy remains sparsely implemented in practice due to a multitude of barriers, including financial, structural, operational, attitudinal, and technological challenges. Tan et al. (2022) concur, highlighting the presence of barriers hindering the transition, including limited practical implementations and the necessity for effective measures to incentivize or mitigate influential factors. Moreover, Radu (2018) zooms in on the barriers related to green ICT adoption in Romania, citing challenges such as e-waste recycling and reuse, insufficient R&D expenditure, and gaps in digital skills. These insights collectively underscore the significance of comprehending both the tools and obstacles involved in the transition toward a circular and green economy in Romania. While the circular and green economy models hold promise, these studies

emphasize the necessity of addressing substantial barriers to successfully navigate this transition in the Romanian context.

Methodology

To fulfill the specific objectives of the study, a mixed-methods research methodology was used. The first stage of the study involved a literature review of studies, technical reports, and existing good practices on the circular economy at the European and international levels. The second stage involved the development and administration of a questionnaire to both the public and private sector in Romania to map actors' perceptions regarding the potential of the circular economy in Romania, identify the most relevant flows for the circular economy in Romania, the tools necessary to facilitate the implementation of the circular and green economy in Romania, and the barriers related to the transition towards a circular economy.

The questionnaire was developed using Qualtrics and was distributed to approximately 280 respondents via email. We chose a convenient sampling method due to its practicality, cost-effectiveness, and the exploratory nature of our study. The participation rate was 81.21% of the total respondents, of which 50.98% work in the public sector and the remaining 49.02% in the private sector. The empirical endeavor was conducted from July 1 to August 21, 2022. The questionnaire had the following structure below (Table 1).

Table 1. Questionnaire of the research

No.	Question
1	Please specify your sector of activity: private or public
2	Please specify the industry you represent (open question)
3	Are you familiar with the concept of circular economy? Yes / No
4	Would you define the concept of a circular economy through a set of measures aimed at (please select the options you think are correct): • Difficulties related to product repair • Lack of separate waste collection • Lack of recycling solutions • Others (please specify)
5	In your opinion, what are the implementation problems with the circular economy? (open question)
6	Are you familiar with the concept of green economy? Yes/ No
7	Would you define the concept of green economy through a set of measures aimed at (please select the options you think are correct): • Renewable energy • Infrastructure and city governance

	• Water resources management • Waste management • Sustainable soil management
8	How can these concepts be applicable to the Romanian economic model? By: • Product life cycle analysis • Improving ecological design • Promoting new opportunities • Research, development, innovation • Others (please specify)
9	What connections or synergies can be achieved between sectors of activity in order to increase the productivity of resource use. Please list the top 3 sectors with the highest growth potential: • Agriculture and fisheries • Energy industry • Mining industry • Construction industry • Transport industry • Biodiversity • Climate change industry • Other industries
10	Which waste streams are relevant for the circular economy in Romania?' • Packaging waste • Waste from electrical and electronic equipment • Food waste • Mining waste • Construction and demolition waste • Others (please specify)
11	What tools can facilitate the implementation of the circular and green economy in Romania? • Green public procurement • Investment projects • Research projects • Education and awareness projects
12	Is the transition to the circular economy integrated into the development strategies or plans of the company/institution where you work? Yes or No
13	In your opinion, what are the biggest obstacles in the transition to a circular economy? (open question)

Source: Authors' own research

The quantitative data from the questionnaire was analyzed using SPSS. Normality was assessed using the Shapiro-Wilk test and reliability was assessed using Cronbach's alpha. Here, the Shapiro-Wilk test indicated that the collected data for each conceptual dimension were not normally distributed whereas the reliability tests confirmed the suitability of the proposed scales, exceeding the 0.7 threshold for Cronbach's alpha (as specifically mentioned in the following section). The qualitative data from the questionnaire was analyzed using thematic analysis.

The research questions that were addressed through the data analysis include: What are the public's and private sector's perceptions regarding the potential of the circular economy in Romania? What are the most relevant flows for the circular economy in Romania?

What are the tools necessary to facilitate the implementation of the circular and green economy in Romania? What are the barriers related to the transition towards a circular economy?

The last step was to hold a brainstorming session with a diverse group of stakeholders, including representatives from the public and private sectors, academia, and civil society. The first brainstorming session on Circular Economy was held on August 21st, 2022, using the Zoom platform. The sample for this session was made up of employees from various private sector companies who are involved in Corporate Social Responsibility activities. The sample structure comprised of two men and five women. The goal of this session was to generate ideas for instruments that could facilitate the implementation of the circular and green economy in Romania. Further, the second session on the topic of Green Economy was held also on August 21st, 2022, gathering five participants.

The findings from the data analysis and from the brainstorming session will be used to formulate recommendations for policymakers, businesses, and other stakeholders on how to promote the transition to a circular economy in Romania.

Results and discussions

The present study seeks to offer a more accurate depiction of the evaluation of waste management in Romania, as well as the prospects for promoting the circular economy and transitioning to the green economy. A research questionnaire was employed as a specific research tool to accomplish this goal.

The information put forth in this study was obtained through a multidimensional approach that spanned various levels. After the documentation phase, a questionnaire was created and presented to 280

individuals, both from the public and private sectors in Romania (private – 49.02% and public – 50.98%) with the aim of mapping actors' perceptions on the following topics: increasing the potential of the circular economy in Romania, identifying the most relevant waste flows for the circular economy in Romania, the tools necessary to facilitate the implementation of the circular and green economy in Romania, and the barriers related to the transition to a circular economy, among others.

When examining responses to questions related to the circular and green economy, several noteworthy aspects were identified, including a growing interest in the circular economy, with 76.47% of respondents indicating this, and an even more pronounced interest in the green economy at 96.08%.

To enhance the potential of the circular economy in Romania, various measures were suggested by the respondents. These include informing and educating the population to ensure the correct usage of the separate waste collection system, which garnered 86.27% support. Implementing a calendar of specific measures and instruments was backed by 66.67%. There was an emphasis on better recirculating resources at the national economy level, with another 66.67% of respondents indicating this. Further strategies involved the development of online waste trading platforms to optimize the production and/or distribution process, supported by 52.97%, and the creation of an online database or portal to guide interested parties on the implementation of the circular economy, which was endorsed by 50.98% of respondents.

The three most important industries, between which connections or synergies can be made to increase the productivity of the use of resources, are represented by the waste management industry (33.33%), energy industry (29.41%), and agriculture and fisheries industry (11.76%) .

In Romania, packaging waste stands out as a substantial waste stream, constituting 88.24% of the total waste output. It predominantly includes materials designated for packaging, encompassing plastics, paper, glass, and metals. While many of these materials are recyclable, the majority are unfortunately relegated to landfills or incinerators, leading to ecological and health concerns.

Waste from electrical and electronic equipment (WEEE) emerges as another significant contributor to Romania's waste landscape, making up 72.55% of the total generated waste. This category encompasses a range of electronic appliances, from computers and televisions to refrigerators. It's worth noting that WEEE can be laden with hazardous elements such as lead, mercury, and cadmium, which present considerable health and

environmental challenges. The circular economy's solution to WEEE is rooted in the principles of material reuse and recycling.

Construction and demolition waste also features prominently in Romania's waste statistics, comprising 66.67% of the overall waste. Key constituents of this waste stream include concrete, wood, metals, and asphalt. The circular economy's strategy for handling construction and demolition waste emphasizes material recycling and reuse, curbing the demand for fresh raw materials.

Agricultural waste, constituting 60.68% of Romania's total waste, mainly derives from farm-produced organic waste, such as animal manure and crop remnants. A circular economy's approach to this waste is its conversion into compost, offering dual benefits: crop fertilization and soil quality enhancement.

Similarly, food waste is a concerning issue, representing 62.75% of the country's total waste. This category predominantly consists of discarded food from households, eateries, and retail outlets. The circular economy addresses this waste by promoting waste reduction, surplus food reallocation, and composting techniques.

Lastly, mining waste, which encompasses materials like tailings and waste rock, accounts for 33.33% of Romania's total waste output. The circular economy's perspective on mining waste pivots around minimizing waste production and exploring avenues for material reuse and recycling.

In Romania, the waste stream categorized as "others" constitutes 13.73% of the total waste generated. This category encompasses food waste, household and municipal refuse, organic detritus, and compost. Circular economy strategies for these streams prioritize waste reduction, materials' reuse and recycling, and the conversion of organic waste into compost.

In the context of determining tools essential for facilitating the circular and green economy's realization in Romania, several areas of emphasis emerged: the need for investment projects was marked by 84.31% of respondents, while public education and awareness projects garnered 88.24% support. 60.78% saw research projects as pivotal, and 52.94% identified public procurement of green solutions as essential.

The feedback from respondents offers vital perspectives on the impediments Romania faces in its shift towards a circular economy. A significant 62.75% see the cost of requisite infrastructure as a major hurdle, underscoring the financial implications of establishing an eco-friendly waste management system. Moreover, 68.63% spotlight Romania's absence of adept recycling solutions, accentuating the pressing need for robust research and developmental initiatives to birth advanced recycling techniques.

50.98% of respondents recognized the dearth of public-private collaborations, suggesting a pronounced requirement for enhanced synergies between these sectors to smoothen the transition. High operational expenses intrinsic to the circular economy model were pinpointed by 43.14%, underlining the imperative for policy interventions and incentives that nudge businesses and consumers towards sustainability.

The feedback further brought to light challenges that have a specific bearing on Romania. There's a call for revamping the educational framework to resonate with circular economy tenets, optimizing resource utilization, and instituting efficacious economic tools. Furthermore, 23.53% of respondents spotlighted the lackluster performance of state entities, signifying a pressing demand for augmented governmental backing and capital allocation towards waste management edifices.

In essence, the respondent-driven insights render a holistic understanding of the stumbling blocks Romania grapples with, in its quest for a circular economy. Issues like inadequate recycling modalities, steep infrastructural outlays, and the clamor for fortified public-private liaisons, paired with the quest for impactful legislative frameworks, echo challenges that resonate globally.

Focusing on the proposed research questions, the first one envisaged the dimension regarding the potential of the circular economy in Romania. In this vein, the reliability test for the scale measuring respondents' interest in the circular economy was computed, Cronbach's alpha being 0.85, thus indicating good internal consistency. Once the suitability of the scale was confirmed, the focus was set on the retrieved results which indicated that the majority of subjects (76.47%) had interest in the circular economy.

Subjects suggested a variety of measures to enhance the potential of the circular economy in Romania. These include informing and educating the population about the circular economy and how to implement it (86.27%), implementing a calendar of specific measures and instruments to support the transition to a circular economy (66.67%), better recirculating resources at the national economy level (66.67%), developing online waste trading platforms (52.97%) and creating an online database or portal to guide interested parties on the implementation of the circular economy (50.98%).

The second research question - What are the most relevant flows for the circular economy in Romania? – has revolved around another key dimension capturing the pivotal flows apposite for the circular economy. Moreover, Cronbach's alpha for the scale on data on respondents'

perceptions of the most relevant flows for the circular economy in Romania was 0.80, indicating good internal consistency.

Results has highlighted that the three most important industries for synergies in Romania are the waste management industry (33.33%), energy industry (29.41%), and agriculture and fisheries industry (11.76%) whereas the most significant waste streams in Romania are packaging waste (88.24%), WEEE (72.55%), construction and demolition waste (66.67%), agricultural waste (60.68%), food waste (62.75%), and mining waste (33.33%).

Moving forward, subjects' approaches toward the third research - What are the tools necessary to facilitate the implementation of the circular and green economy in Romania? -identified the following tools as essential for facilitating the implementation of the circular and green economy in Romania: investment projects; public education and awareness projects; research projects and public procurement of green solutions. More specifically, investment projects were identified as the most essential tool for facilitating the implementation of the circular and green economy in Romania (84.31%), followed by public education and awareness projects (88.24%), research projects (60.78%), and public procurement of green solutions (52.94%).

As in the case of the previous two research questions which addressed specific conceptual dimensions, Cronbach's alpha test for reliability of the scale measuring respondents' perceptions of the tools necessary to facilitate the implementation of the circular and green economy in Romania was 0.83, indicating good internal consistency.

Finally, the fourth research question - What are the barriers related to the transition towards a circular economy? – pointed to the following barriers to the transition towards a circular economy in Romania: cost of requisite infrastructure; lack of adept recycling solutions; dearth of public-private collaborations; high operational expenses; inadequate educational framework; lackluster performance of state entities. At this level, the cost of requisite infrastructure was identified as the most significant barrier to the transition towards a circular economy in Romania (62.75%), followed by lack of adept recycling solutions (68.63%), dearth of public-private collaborations (50.98%), high operational expenses (43.14%), inadequate educational framework (29.41%), and lackluster performance of state entities (23.53%).

The scale referring to the respondents' perceptions of the barriers related to the transition towards a circular economy in Romania showed that the reliability test using Cronbach's alpha was 0.82, indicating good internal consistency.

Addressing the question, "What instruments can facilitate the implementation of the circular and green economy in Romania?", sheds light on potential focal areas for advancing sustainable economic modalities nationwide. An interactive research approach was adopted, leveraging a brainstorming session tailored to both vet and affirm the components outlined in the questionnaire. This approach also aimed to initiate an informal dialogue between public and private stakeholders, fostering the discovery of resolutions to shared challenges. Through this symbiotic idea exchange and best practice sharing, the intent was to discern innovation niches, kindle dialogues and alliances concerning the elevation of Romania's circular and green economy, and elevate cognizance of cross-sectoral synergies.

In this deliberation, the discourse predominantly revolved around grasping the nuances of concepts such as the circular economy, green economy, and synergies. It also delved into discerning synergies, exemplary practices, crystallizing the distinctive attributes of a circular economy blueprint suited for Romania, and pinpointing both opportunities and obstructions.

The first brainstorming session on Circular Economy was held on August 21st, 2022, using the Zoom platform. The sample for this session was made up of employees from various private sector companies who are involved in Corporate Social Responsibility activities. The sample structure comprised of two men and five women, who were randomly selected from both urban and rural areas. Of the total respondents, four were from urban areas and three from rural areas. All respondents had professional experience ranging from 3 to 10 years.

During this session, the working group identified several elements specific to the circular economy, such as resource efficiency, clean energy, pollution reduction, sustainability, technological improvement, disassembly, adaptation, and loop-closing strategies. The group also highlighted the importance of having a favorable policy framework and a circular economy implementation system in place. Additionally, they discussed the role of IoT and common platforms of the "shared platforms" type, as well as industrial symbioses in achieving a circular economy (Figure 2).



Figure 2. Specific elements for circular economy
Source: Authors' own research

During the discussions, it was established that the circular economy and the green economy are interconnected, and both contribute to achieving sustainable development objectives. The green economy is known to promote economic, social, and health well-being of citizens by reducing pollution, combating climate change, promoting eco-technologies, encouraging green public procurement, and fostering economic prosperity.

Opportunities and barriers were identified during the discussions. Among the opportunities, education was identified as a key factor, along with the presence of a European legislative framework for the circular economy. Other opportunities included the development of a bonus system for industrial symbiosis and the association of the circular economy with competitiveness at the company level. Additionally, promoting the economic value of the circular economy through resource consumption, innovative products, cost reduction, development of economic and fiscal instruments and new sustainable business models, such as car-sharing, were also identified as opportunities. Barriers included the political factor, such as a lack of commitment, education, and poor implementation of legislation. Other barriers included the lack of collection infrastructure, technical standards for some subfields, and the need to establish an effective collaboration between the private and academic environment. Synergies were identified as providing support for partners for industrial symbiosis processes and cost-benefit analysis at the company level.

The preliminary proposals for the DPSIR model considered several suggestions from participants for the components of the model. Driving forces were identified as the availability and accessibility of natural resources, costs, climate change, diversity, and pollution. Pressures included population

decline, megatrends, and geopolitical security/conflicts. Status was identified as low resource productivity, low degree of recycling, and high energy intensity. Impact included increased consumption of resources, uncompetitive energy systems, difficult access to emerging markets, and a low level of innovation. Proposed answers included resource taxation instead of labor taxation, green public procurement, technical assistance, public-private partnerships, the development of an analysis study by types of industries regarding waste, and on-site inspections.

In the second brainstorming session, focused on the green economy, the study group proposed several elements specific to this area. These included increasing awareness, improving separate collection infrastructure, ecological design, and resource productivity. It is worth noting that the green economy has been associated with social inclusion and low greenhouse gas emissions.

Within the study group, there was an in-depth discussion centered around the opportunities and barriers associated with the topic at hand. This investigation, while juxtaposed with the earlier brainstorming session, was marked by its depth and thoroughness. Opportunities spanned several dimensions: economic benefits, evident in areas such as enhanced recycling capacities and the promotion of green purchasing; legislative advances, like the adaptation of community acquis; social benefits, including job generation with emphasis on supporting vulnerable groups; and structural developments, notably the identification of emerging job roles, bolstering rural and applied education, and fostering innovation.

Conversely, the barriers presented themselves in various forms. Economically, hurdles like insufficient funds for innovation, inadequate budget allocation for action plans, and diminished purchasing power were evident. Legislative barriers comprised the incomplete adoption of European legislation. Social challenges revolved around limited public awareness and prevalent poverty, whereas structural barriers pertained to inconsistent legislative enforcement and a dearth of expert personnel within administrative domains (Figure 3).

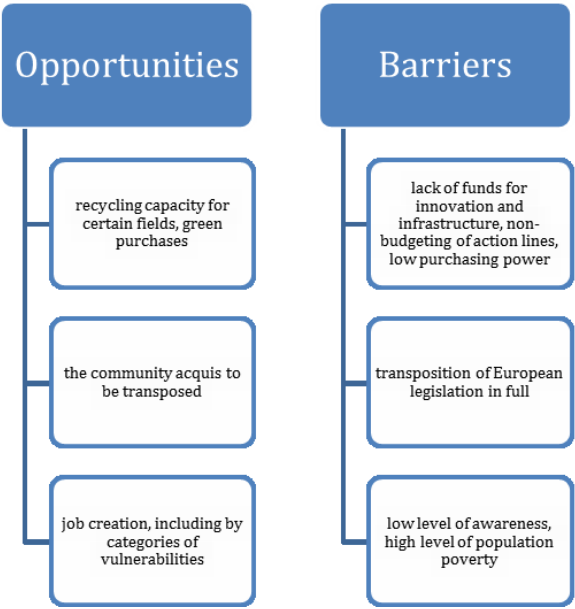


Figure 3. Opportunities and barriers for green economy implementation
Source: Authors' own research

Regarding the initial suggestions for the DPSIR model, participants offered insights into its components. They identified driving forces like elevating living standards and ensuring access to basic utilities, especially in rural areas. Pressures encapsulated the escalating demand for resources. The status aspect underscored concerns such as air and soil contamination, coupled with suboptimal resource productivity. The impact facet highlighted rising health concerns and resource misutilization. Lastly, potential solutions encompassed the execution of the circular economy framework and its integration into university curriculum.

To sum up the main empirical facts and figures, the findings supported that the majority of respondents (over 75%) expressed interest in the circular economy, which is consistent with the evidence provided by other studies, such as Dobre-Baron et al. (2022), who found that Romania has favorable conditions for the long-term adoption of the circular economy model.

Also, the most important industries for synergies in Romania are the waste management industry, energy industry, and agriculture and fisheries industry, results which are also supported by the extant literature. For example, a study by Strat (2018) found that the concentration poles of

Romania's circular economy potential are located in regions with a strong presence of these industries.

Furthermore, as per the study's findings, the most significant waste streams in Romania are packaging waste, WEEE, construction and demolition waste, agricultural waste, food waste, and mining waste. This is also supported by the literature - for example, a study by Vermeşan and Tiuc (2020) found that these waste streams pose a significant challenge to Romania's transition to a circular economy.

The essential tools for facilitating the implementation of the circular and green economy in Romania are investment projects, public education and awareness projects, research projects, and public procurement of green solutions. This evidence is also supported by the literature, a study by Frone (2017) revealing that eco-innovation parks can play a strategic role in promoting the circular economy by fostering collaboration among diverse enterprises.

When it comes to the most significant barriers to the transition towards a circular economy in Romania, the main issues pinpointed are the cost of requisite infrastructure, lack of adept recycling solutions, dearth of public-private collaborations, high operational expenses, inadequate educational framework, and lackluster performance of state entities is also supported by the literature. These findings are also in line with a study by Vermeşan and Tiuc (2020) which found that these factors pose significant challenges to Romania's transition to a circular economy.

Conclusions

The research contributes to the body of knowledge in the field of the circular economy in Romania in several ways. First, it provides a comprehensive overview of the conceptual intercorrelations between the circular economy, green economy, and sustainable development. Second, it identifies several potential synergies between the circular economy and other sectors of activity. Third, it provides an indicative list of examples of good practice on the industrial symbiosis sector. Fourth, it translates all these elements into policy recommendations that can promote the circular economy in Romania.

The research is novel and unique in the following ways: it is the first study to explore the synergies between the circular economy and other sectors of activity in Romania; it is the first study to identify good practices in industrial symbiosis in Romania; it is the first study to develop a

comprehensive set of policy recommendations for promoting the circular economy in Romania.

The research is relevant and important because it addresses a pressing need in Romania. Romania is facing several challenges related to environmental protection and sustainable development. The circular economy offers a promising solution to these challenges. By adopting circular economy principles, Romania can reduce its resource consumption, reduce greenhouse gas emissions, and create new jobs.

This study has explored the conceptual intercorrelations between the circular economy, green economy, and sustainable development, and how they can be harmoniously combined with the green economy framework at the international, European, and national level. The study has also identified potential synergies between the circular economy and other sectors of activity, and provided an indicative list of examples of good practice on the industrial symbiosis sector. Based on these findings, the study has developed a number of policy recommendations that can promote the circular economy in Romania.

The circular economy is applicable to all sectors of activity and can achieve synergies that can create new opportunities for development. Hence, active involvement is necessary not only at the level of public policy but also at the territorial implementation level. Sustainable solutions that optimize resource consumption to close the loops are crucial objectives at the European level.

The study's findings have important implications for policymakers, businesses, and the public. Policymakers can use the findings to develop targeted policies and programs to support the transition to a circular economy. Businesses can use the findings to identify opportunities to reduce their environmental impact and improve their resource efficiency. The public can use the findings to make more informed choices about the products and services they consume.

The study has a number of limitations that might be addressed by future research. First, it is based on a relatively small sample size, therefore the results cannot be unconditionally generalized. Second, it does not focus on the economic opportunities associated with the green economy and circular economy in Romania. Third, this research considers Romania's economy and its particularities and therefore it would be difficult to try to extrapolate the results for other countries. We take into account creating in the future a study on multiple East-European states.

Overall, this study provides a valuable contribution to the understanding of the circular economy and its potential benefits for

Romania. The findings of this study can be used to inform policy development, business decision-making, and public awareness campaigns in support of the transition to a more sustainable future.

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