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Decoupling or 'Decaffing'? The Underlying Conceptualization of Circular Economy in the European Union Monitoring Framework

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Abstract: In recent years, the shift to a circular economy (CE) has become an increasingly important component of the European Union's development strategy. However, no consensus has yet been reached on the depth of the transformation this implies, nor on the most appropriate strategy for its measurement. In 2018, the European Commission presented a monitoring framework to evaluate the progress made in this transition, focused on the priority objectives of the European strategy for the CE. This article aims to discuss the conceptualization of the CE behind the selection and interpretation of the metrics proposed by the commission. It is argued that the chosen indicators are mostly concerned with material self-sufficiency and recycling, neglecting other dimensions of the concept more closely related to systemic change. Moreover, some issues that are relevant from a CE perspective, such as the disparate distribution of recyclable material flows among EU Member States in terms of value and environmental impact, are overlooked in the interpretation of the available information. Consequently, a more ambitious and diverse selection of metrics is suggested to reflect the wider socio-economic and environmental objectives of the CE, thus preventing the dissemination of a limited version of the concept.

Keywords: circular economy; monitoring framework; circularity metrics; trade in recyclable materials; secondary raw materials; systemic change

1. Introduction

In December 2015, the European Commission launched an action plan for the circular economy (CE). The plan consists of a list of actions through which the commission commits to support the transition to the CE, aiming to set "the right regulatory framework" for its development [1]. It includes various initiatives concerning "each step of the value chain", namely the stages of production, consumption, waste management, and secondary raw materials.

According to the plan, it is expected that Member States of the EU improve and converge towards the best practices and results regarding CE. To measure the degree of progress in these objectives, detect success factors, and evaluate whether enough actions were undertaken, in 2018, the European Commission prepared a monitoring framework for the CE (MFCE). This statistical tool relies on previously available data related to the four steps of the value chain and the priority areas highlighted in the action plan [2].

This article aims to discuss the conceptualization underlying the selection and analysis of the metrics proposed by the European Commission to assess progress towards a CE. It is argued that the selected indicators are overly concerned with the Commission's strategic priorities for material self-sufficiency and recycling, neglecting the more transformative systemic and social dimensions of the concept. This apparent bias in the metrics chosen to measure the degree of progress in the transition towards CE could contribute to distortion of the concept.

The next section presents the methodology and the theoretical approach behind the analysis. The third section examines the conceptualization of the CE underlying the selection of indicators for the MFCE. The fourth section offers an alternative analysis of the first results yielded by the available data, focusing on the trade of recyclable materials and employment. The fifth section discusses and contrasts the results with the existing literature on the subject. The last section summarizes the main conclusions and topics for further research.

2. Methods and Theoretical Approach

As many authors point out [3–7], most of the theoretical and practical literature on CE offers an uncritical analysis, focusing on its promotion rather than on the economic and social challenges of its implementation, such as the possible contradictions with the prevailing mode of production and consumption. The central objective of this study was to perform a critical analysis of the conceptualization of the CE assumed by the EU to guide and coordinate European policies on the subject. The MFCE has been conceived as a baseline for measuring the degree of compliance with the European targets of transition towards a CE, and therefore can provide an overview of the components of the concept that are most relevant to the European Commission. Therefore, both the method used, and the sources selected respond to the following double analytical goal:

(a) To compare the understanding of CE explicitly incorporated in the EU official documents with the main conceptualizations existing in the academic literature; and
(b) To contrast the correspondence of this official understanding of CE with the selection of indicators that integrate the MFCE.

First, a review was carried out regarding the documents of the European Commission and the European Environmental Agency (EEA) that reflect the main guidelines of the European strategy for a CE, which in turn includes the elaboration of the MFCE (Table 1). These were selected and compiled from the communications and reports that make up the Final Circular Economy Package, the 2018 Circular Economy Package, the EU Action Plan for the Circular Economy, and the previous proposal for the CE, all of which are available on the website of the Directorate-General for Environment of the European Commission. Also, the EEA's document repository was consulted.

Table 1. Main documents on the European CE strategy. Source: [1,2,8–10].

Document	Focus
European Commission's communication COM (2014) 398 final [8]	Decision to go beyond resource efficiency objectives and move towards the more ambitious goal of achieving a CE.
European Commission's communication COM (2015) 614 final [1]	EU action plan for the CE.
European Environmental Agency Report Nº2/2016 [9]	Review of the current knowledge base for the transition to a CE in Europe.
European Commission's communication COM (2018) 29 final [2]	Presentation of a monitoring framework for the CE in Europe.
European Commission's staff working document SWD (2018) 17 final [10]	Methodology used for the selection and analytical description of the indicators of the CE monitoring framework.

Secondly, a selective review was conducted on the most relevant academic literature devoted to the systematization of the multiple existing definitions of the concept of a CE. Preference was given to studies that applied a systematic approach and analyzed the largest possible number of definitions, as an exhaustive review of the definitions was not part of the scope of this article.

In the third place, other CE measurement initiatives were studied in the search for metrics that could be incorporated to, and are currently missing from, the MFCE. While some work has already been done regarding the development of indicators to quantify the CE [11–13], macro-level assessment frameworks are not common outside of China [13,14], and in most cases are still at the development and/or proposal stage. In this regard, apart from China's national CE indicator system [15], we took into consideration three monitoring framework proposals at the national level in the EU (France, Spain, and the Netherlands) [16–18], and a proposal for tracking CE progress at the regional level in Poland [14]. These were chosen for their relevance as they were developed in EU-28 member countries and rely mainly on metrics at the meso and macroeconomic levels. Especially, the Spanish [17] and Dutch [18] proposals were found to be of greatest relevance for sharing a systemic approach to CE analysis.

Finally, the first results of the MFCE were re-examined from a broad CE-specific perspective, attending to environmental and social components that are currently not present in the interpretation provided by the European Commission, which, we argue, is biased by the mainstream economics approach, focusing on market and economic growth and neglecting more ambitious contributions from ecological economics.

3. Defining and Measuring Circular Economy

Even though CE has been gaining prominence in the public and academic debate for many years, there is still a lack of statistical indicators to analyze and monitor the diffusion of this new productive paradigm. Among the reasons that hinder the elaboration of such metrics is the absence of a consensus on the very definition of a CE. As a concept still under development, CE integrates different components that come from multiple sources, such as "sustainable development", "cradle-to-cradle" (C2C), "functional economy", "industrial ecology", "blue economy", "life cycle thinking", "eco-design", and "eco-innovation", among others [19–21].

Several reviews of the recent literature show the multiplicity of definitions currently in use [22–26]. To identify a common conceptualization among such diversity, some authors have suggested comprehensive definitions based on a synthesis of the manifold existing ones. For example, [24] analyzed 114 definitions and developed a coding framework according to three dimensions (core principles, aims, and enabler of CE); [27] presented a "consensus-based" framework for CE based on 175 explicit definitions of the concept; and [28] also suggested a systemic typology to synthesize the most common R-imperatives of the CE.

Among the hundreds of diverse conceptualizations, one of the more far-reaching and influential definitions of CE was provided by the Ellen MacArthur Foundation (EMF) [19] (p. 7):

> "[CE is] an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models."

The basic idea behind this notion is to separate technical materials (plastics, metal, composites, etc.) from the biological ones (food, plants, etc.) and to define specific processes to extend the life of products and/or revalorize them as secondary resources. It is based in the C2C principles, which consider that "waste equals food", prioritizing resource "up-grading" to resource "down-cycling" [29]. The proposals that attempt to synthesize the existing definitions capture most of these elements, specifying certain aspects and emphasizing some issues more than others. For example, the conceptualization suggested by [24] (p. 229) revolves around material cycles:

> "[We defined CE] 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. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the

aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers."

The formulation of [27] is similar, although it also highlights the notion of closed material and energy loops. The same can be said about the definition "based on the current knowledge" proposed by [26] (p. 547):

> "CE is a sustainable development initiative with the objective of reducing the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system."

These efforts to give coherence to the concept face the challenge that most of the definitions they attempt to synthesize focus only on certain elements of CE and leave other aspects unattended. As pointed out by [26], CE is an "essentially contested concept", which involves numerous and diverse stakeholders and interests. In particular, the components of CE that are most frequently ignored are those which imply a profound systemic change and/or contradict the growth imperative of the current linear productive paradigm [24,28]. Thus, the concept of CE is often deprived of its environmental and social dimensions, which are precisely those that define the limits within which economic activity can be sustainable. Therefore, the potential contribution of the CE paradigm to sustainability requires avoiding these restrictive and narrow conceptualizations. In particular, it has to include respect of the planet's natural limits. As the authors of [7] (p. 39) state in their own definition of CE:

> "Circular economy limits the throughput flow to a level that nature tolerates and utilizes ecosystems cycles in economic cycles by respecting their natural reproduction rates."

The propagation of this conceptual bias is also reflected on the metrics that are generally suggested in the literature for measuring progress towards a CE [13,15,30]. For instance, as a result of a multiple correspondence analysis of 63 different indicators used to assess the CE, [13] concluded that the most prevailing approach was related to resource and recycling efficiency, waste disposal, and secondary vs. primary use. On the other hand, metrics that inquire into the conservation of value from a systemic perspective are less frequent (longevity, value change and retention, system stability and sharing, among others).

The authors of [11] compared 15 CE assessment methodologies and found that all the indicators involved were connected either to the use of recyclable resources or to the input of raw materials, while only one addressed value conservation issues, such as material loss and product lifetime reduction. Besides, most of the evaluations were found to be one-dimensional, and did not consider energy utilization and emissions, key systemic variables linked to value conservation and the transportation of products, materials, and waste.

Therefore, the selection of an exhaustive set of indicators to measure CE is hindered by the lack of a theoretical consensus regarding the precise set of elements that make up the concept. In this context, it is worthwhile to study the conceptual framework that underlies the meaning of CE in the EU circular strategy and in the MFCE. While no explicit definition can be found in the EU action plan for the CE, in the two subsequent reports on its implementation or in the MFCE, it is still possible to identify a few direct references to what the European Commission mainly understands as CE.

3.1. European Commission's Conceptualization of Circular Economy

When seeking to investigate the understanding of a concept, the compilation of written definitions is usually considered the most appropriate method, since it implies a certain degree of deliberation on the part of those who define [24]. This approach, well suited for working with scientific literature, presents some practical difficulties when applied to an investigation into the comprehension of a concept by a non-academic body or institution, such as the European Commission. Most of the documents produced by this kind of entity are intended for political and informative dissemination, which requires technical complexity but does not necessarily imply scientific accuracy. Definitions of concepts are not always explicit, can differ from those most generally coined by scientific sources, and, on some occasions, may even be inconsistent in time and between different agencies within the same institution.

The case of the European Commission regarding CE is no exception. Despite the numerous documents that make up the European strategy for the CE, plain definitions are scarce and do not usually answer the expected questions "what is a circular economy?" or "how is a circular economy defined?". Instead, they refer to what happens in a CE, or what would be the outcomes if such an economy were to be achieved.

This is illustrated, for example, in [8] (p. 2):

> "Circular economy systems keep the added value in products for as long as possible and eliminates waste. They keep resources within the economy when a product has reached the end of its life, so that they can be productively used again and again and hence create further value. Transition to a more circular economy requires changes throughout value chains, from product design to new business and market models, from new ways of turning waste into a resource to new modes of consumer behavior. This implies full systemic change, and innovation not only in technologies, but also in organization, society, finance methods and policies."

That document could be considered the first official statement by the European Commission regarding its decision to go beyond resource efficiency and move towards the more ambitious goal of achieving a CE. A CE is referred to there as (a number of) "systems" that involve a complete transformation in all the production phases, from design to consumption and disposal, but also in finance, society, and public policy. However, this notion of "full systemic change" seems to have lost ground in subsequent communications, shifting to the less disruptive goals of job creation and promotion of competitive advantages and product innovation. At the same time, the rather utopian but concrete objective of eliminating waste has mutated into the imprecise notion of "waste minimizing". This is reflected in the conceptualization present in [1] (p. 1):

> "The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. (. . .) The circular economy will boost the EU's competitiveness by protecting businesses against scarcity of resources and volatile prices, helping to create new business opportunities and innovative, more efficient ways of producing and consuming. It will create local jobs at all skills levels and opportunities for social integration and cohesion. At the same time, it will save energy and help avoid the irreversible damages caused by using up resources at a rate that exceeds the Earth's capacity to renew them in terms of climate and biodiversity, air, soil, and water pollution."

Besides the search for explicit definitions, the priorities set out by the commission in the action plan can also provide an approach to its conception with respect to CE. The plan is structured around four aspects of CE linked to the production phase, consumption, waste management, and reuse of resources. It defines five priority sectors to focus the actions: Plastics, food waste, critical raw materials, construction and demolition, and bio-based products, together with horizontal measures concerning innovation and investment.

Regarding the production phase, emphasis is placed on the promotion of eco-design and process efficiency to reduce the use of raw materials and the generation of waste. Matters, such as product reparability, updatability, durability, and recyclability, are mentioned and addressed mainly through the development of new design requirements. As for consumption, proposed actions are linked to ensure the availability of information on the durability and reparability of products (eco-labelling), the promotion of reuse and sharing (collaborative economy), the detection of planned obsolescence practices, the enforcement of the effective application of guarantees, and an emphasis on circular public provision. The internalization of environmental costs through taxing is also mentioned, albeit not addressed by any specific measure.

The initiatives of waste management are based on the logic of waste hierarchy, which establishes the following order of priority: Prevention, preparation for reuse, recycling, energy recovery, and disposal. The low share of recycled materials in the total demand for materials in the EU is intended to be addressed through the construction of a secondary raw materials market. This involves the development of quality standards, harmonization of environmental regulations and standards, and removal of bureaucratic barriers.

Finally, the plan also proposes the development of a monitoring framework to measure progress towards its main objectives. The choice of indicators, though logically limited by the availability of information, offer another approximation to the conceptualization of CE on which the commission relies.

3.2. The Commissions' Monitoring Framework for the Circular Economy

The MFCE is based on two tables of indicators previously elaborated to assess the progress towards its priority goals on the environment [31,32]. The criterion that guided the preparation of the framework was to avoid higher administrative costs, together with "relevance, acceptance, credibility, ease of use and robustness" of data [2] (p. 5). The MFCE consists of a set of 10 indicators grouped into four stages, related to the priorities pointed out by the Commission in the CE action plan (Table 2).

Table 2. Indicators included in the MFCE. Source: [2].

No.	Name	Relevance
	Production and consumption	
1	EU self-sufficiency for raw materials	The circular economy should help to address the supply risks for raw materials, in particular critical raw materials.
2	Green public procurement*	Public procurement accounts for a large share of consumption and can drive the circular economy.
3a-c	Waste generation	In a circular economy waste generation is minimized.
4	Food waste*	Discarding food has negative environmental, climate and economic impacts.
	Waste management	
5a-b	Overall recycling rates	Increasing recycling is part of the transition to a circular economy.
6a-f	Recycling rates for specific waste streams	This reflects the progress in recycling key waste streams.
	Secondary raw materials	
7a-b	Contribution of recycled materials to raw materials demand	In a circular economy, secondary raw materials are commonly used to make new products.
8	Trade in recyclable raw materials	Trade in recyclables reflects the importance of the internal market and global participation in the circular economy.
	Competitiveness and innovation	
9a-c	Private investments, jobs and gross value added	This reflects the contribution of the circular economy to the creation of jobs and growth.
10	Patents	Innovative technologies related to the circular economy boost the EU's global competitiveness.

* Indicators under development.

The chosen indicators seem to corroborate the idea that the commission shifted away from the notion of transition to CE as a complete systemic change. Besides, the MFCE leaves several of the action plan's priority issues unaddressed. As noted by [33], the disregard of key issues related to the use of energy, production (design, remanufacturing, materials change, reuse, resource use reduction), and consumption (repair, sharing) evidences a less ambitious approach to CE. In contrast, metrics are focused on the old perspective of waste reduction and recycling as an alternative source of materials for what basically continues to be the current linear system [34].

The selection of metrics of the MFCE is consistent with the guidelines expressed in the report "Circular Economy in Europe: Developing the knowledge basis" issued by the European Environmental Agency (EEA). After referring to the broader definition of CE proposed by the EMF, which involves materials, energy, and emissions, the report makes explicit that, however, the focus will be placed "on the material side of the circular economy" [9] (p. 22). This questionable decision would seem to rest on an even more debatable conceptual justification: The document states that CE "does not fully address preservation of natural capital and prevention of environmental risks to human health and well-being", but rather these dimensions are considered to be embedded in a wider "green economy perspective" [9] (p. 31).

3.3. What the MFCE Leaves Out

In this respect, it is worth establishing a contrast with other initiatives of CE assessment schemes, such as the framework developed in China [15], and the proposals issued in France [16], Spain [17], the Netherlands [18], and, at the regional level, in Poland [14].

Based on the 3R principles (reduction, reduce, and recycling), China's national CE indicator system relies on the material flow analysis (MFA) method, complemented by eco-efficiency indicators, such as water and energy use per unit of GDP [15]. While most of the metrics refer to materials' recycling and waste generation, the main difference with respect to the MFCE is that the Chinese framework also includes indicators of energy and water use.

The French framework proposal consists of 10 indicators, the most significant of which are those relating to the initial phases of the product cycle (number of eco-label holders and industrial and territorial ecology projects) and to sustainable consumption (car-sharing and household spending in product repair and maintenance). The last two metrics are innovative in terms of recognizing in some way the relevance of measuring the potential change in social practices.

The proposal developed in Spain includes an environmentally broader set of metrics, such as energy efficiency, use of renewable energy and water sources, carbon intensity, waste taxes, and tax incentives for sub-products. The Dutch initiative aims to measure not only the current state of CE but also the policy actions undertaken by the government and the transition dynamics that yielded the observed effects. The transition dynamics are mainly based on the innovation process entailed by the shift to CE [18]. The indicators are also divided according to their link with inputs (e.g., number of researchers), throughputs (e.g., number of awareness campaigns), outputs (e.g., number of new CE products), and core achievements (e.g., circularity strategies).

Finally, the regional proposal for Poland includes, in addition to metrics related to zero-waste, eco-efficiency, low-carbon, and eco-innovation, a set of socio-economic indicators that are intended to capture different dimensions of prosperity (or lack of it) that can be affected by (or interfere with) the transition to CE (e.g., average life expectancy, unemployment rate, at-risk-of-poverty rate, households with PC/connection to internet, urbanization rates) [14].

While these four proposals contain some indicators that are not yet developed or available at the EU level, they involve a broader and more systemic approach to CE from which the European framework could benefit greatly. In this regard, the following are some of the key issues identified in the national- and regional-level suggested frameworks that have been left out of the MFCE and whose incorporation is proposed for further discussion.

3.3.1. Earth, Water, Air, and Energy Are Also Valuable Resources

Considering the emphasis on preserving the value of all resources in the conceptualization of CE expressed at the beginning of the EU action plan, it is striking that the MFCE only focuses on materials and neglects land, water, air, and energy. All the more so when in most cases indicators are available in the Eurostat's database, for example, among those related to the Europe 2020 targets or the sustainable development goals.

These include metrics regarding energy productivity, share of renewable energies, carbon intensity, and built-up land. Greenhouse gas emissions per capita, pollutant emissions from transport, and productivity of artificial land are also available from the Eurostat's database, while water abstraction, productivity and exploitation indexes are accessible as well (yet not for every EU Member State). The reason behind these omissions cannot be to avoid duplications, as many other multidimensional indicators can be found in several different thematic axes within Eurostat's database if their scope and definition require so.

The incorporation of the existing metrics about land, water, emissions, and energy in the MFCE could contribute to the dissemination of a broader notion of CE without incurring extra costs. Furthermore, a comprehensive assessment of the level of circularity of the European economy cannot fail to take into account its effects on other territories. In this sense, indicators of the water footprint, land, and emissions should be included in the statistics as well.

3.3.2. An Innovation System for System Innovation

As highlighted in [18], the socio-institutional and productive change involved in the transition to CE requires the support of an appropriate innovation system. In terms of metrics, this translates into the need to measure not only the environmental and social effects but also the actions and resources set in motion to promote circular innovations. In this sense, efforts should be done to develop indicators, such as the number and share of CE researchers, investments and projects (inputs and throughputs), as well as new CE products, business models, start-ups, and publications (outputs).

The MFCE currently includes a metric about the number of patents related to recycling and secondary raw materials, thus recognizing the relevance of innovation activities for the transition to CE. Yet, the scope of the indicator is again limited to waste treatment and materials, while focusing only on the outputs of the innovation process.

Institutional drivers, such as the regulatory framework and tax structure, are also critical to generate the right incentives and conditions for innovation in CE. Data about current legal enablers and barriers for the transition should be taken into consideration in the assessment, along with taxation to resource extraction and waste generation, and subsidies to R + D + i in CE, sub-products, reuse, and circular activities in general.

3.3.3. Was not CE About Making Things Last Longer?

Products' lifespan is a key dimension for a system approach to CE, as it depends and impacts on every phase of the value chain and has a direct effect on both the rate of extraction of natural resources and the level of waste generation. Still, metrics concerning this matter are among the least frequent, as pointed out by [11,13]. It is therefore vital for a comprehensive MFCE to develop indicators to track the average durability of products, together with its main determinants, such as the extent of eco-design, repair, reuse, and collaborative consumption activities.

3.3.4. Socio-Economic Change Is Not Without Conflict

The general lack of indicators on the socio-economic implications of the shift towards CE [12,14] is also noticeable in the MFCE. The role of citizens is present only through the amount of waste generated by their consumption, while the only essentially social variable measured is employment in "circular economy sectors", disregarding the net effects on total employment and the working conditions of the jobs involved (this discussion will be taken up in depth in the fifth section). Moreover, the choice of metrics regarding the share of circular sectors in the economy are based on the rather voluntarist assumption that growth in such activities necessarily reflects an improvement in the overall levels of competitiveness and innovation. Possible unintended outcomes that have already been pointed out by several studies, such as the rebound effect [35] or the potential net destruction of jobs [9], are not taken into consideration.

In this sense, the incorporation of socio-economic indicators, such as those present in the "economic prosperity economy" and "smart economy" dimensions of the proposal by [14], would be of great interest. Work should also be done on the elaboration of metrics on the qualitative aspects of jobs linked to CE, not only in waste collection, recycling, and repair sectors, but also in the economy as a whole, with a special emphasis on the new type of flexible labor relations associated with the expansion of the so-called collaborative economy [36].

4. First Results of the Monitoring Framework

The first results of the MFCE are expected to serve as a baseline for measuring the progress of the EU towards CE [2]. Regardless of the mentioned limitations in relation to the availability and selection of indicators, the interpretation of the data requires an approach according to the specific objectives of CE. In this section, we present the main results highlighted by the Commission, followed by an alternative analysis that attempts to make a further inquiry about what the data show in terms of value retention and environmental impact reduction.

4.1. Results Highlighted by the European Commission

According to the 2018 European Commission's communication introducing the MFCE, the largest developments towards CE so far have been made in waste management, i.e., recycling activities [2]. A more recent press release highlights that record recycling rates were achieved in 2016, with the highest ratios observed in construction materials and packaging (Figure 1) [37]. However, the use of secondary (recycled) raw materials is reported to be low, as they only account for 12% of the overall materials demand. The Commission also shows great concern about the high degree of dependency of the EU on imports of key raw materials.

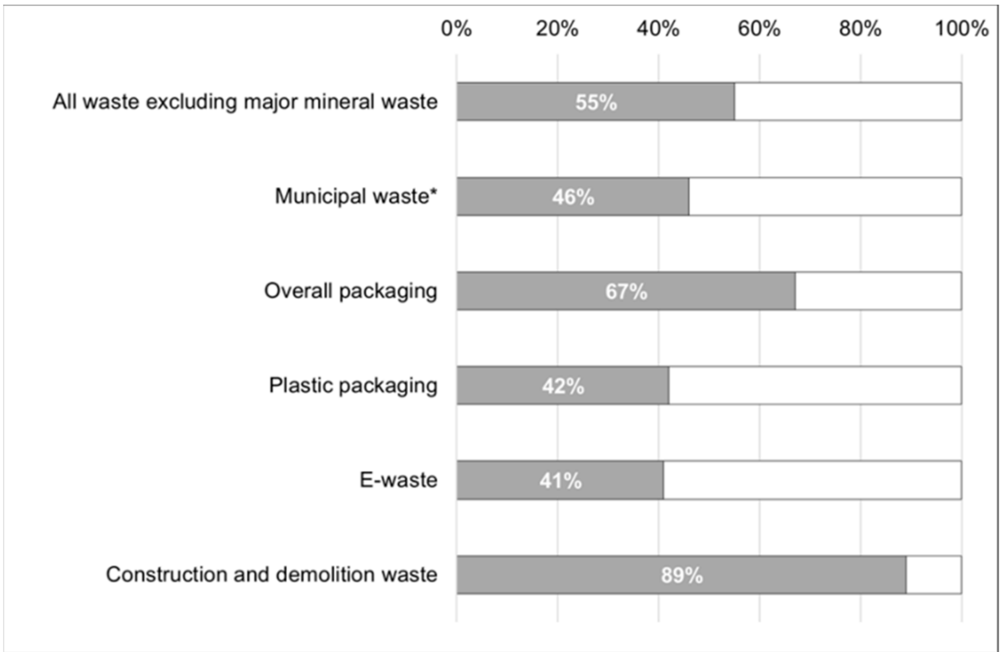

Figure 1. Recycling rates of priority waste streams. EU-28. 2016. * Value for 2017. Source: [37].

A fall in the generation of both municipal waste and total waste between 2006 and 2016 (−8% and −11%, respectively) is presented as a sign of general progress towards CE. Nevertheless, the communication also mentions great differences between Member States and a certain correlation with per capita GDP.

Regarding extra-EU trade in secondary raw materials, data for the period 2004–2016 show a large surplus, both in value and volume, while intra-EU trade experienced a remarkable increase in the same time frame. These results are presumed to be positive, as the description of the indicator made in the Commission's Staff Working Document (SWD) suggests that higher levels of trade of secondary raw materials could signal the presence of a dynamic internal market and an optimal use of the EU's recycling capacities [10].

Finally, the contribution of CE to overall competitiveness and innovation is measured based on the number of jobs, added value, private investments, and patents developed in companies of economic sectors that are considered especially relevant to the CE. These involve recycling, repairing, and reuse activities [10]. In this sense, it is outlined that the level of circularity of European economies is very low. Yet, to fully assess the actual impact of CE, it should be necessary to also take into consideration the circular developments made throughout all the economic sectors.

Currently available data shows that both circular employment and value added increased between 2012 and 2014. The number of patents related to recycling and secondary raw materials grew steadily between 2000 and 2013, with 44% of the total global amount of glass recycling patents occurring in the EU [2].

4.2. Further Analysis of the First Results

Beyond the results presented in the Commission's documents, the databases displayed at Eurostat's website allow complementary analyses concerning the situation of CE in the EU and its Member States to be conducted. In this sense, an attempt to review the available data from the theoretical approach of CE, thus focusing on resource and value preservation rather than on economic growth and value exchange, led to a different interpretation of some of the results.

4.2.1. Production and Consumption: Eco-Efficiency or Eco-Profitability?

Municipal waste per capita represents nearly 10% of the total amount of waste generated in the EU (30% excluding major mineral waste). Thus, its evolution can offer an approximate idea about possible changes in consumption patterns [10]. The commission's SWD points out that between 2005 and 2016, waste generation of this type decreased by 4% in absolute terms, and almost 7% per capita, which is considered progress in terms of CE. However, if the recent great depression is taken into account, the interpretation changes dramatically.

Between 2005 and 2008, in a context of 6% real per capita GDP growth, generation of municipal waste per capita increased by 1.2%. A similar evolution was observed between 2013 and 2016 (expansion of 5.4% and 0.8%, respectively). The decrease of municipal waste generation (−8.3%) occurred entirely in the period 2008–2013, during which real per capita GDP fell 2.3% (Figure 2). Consequently, municipal waste generation data seem to reflect a fall in household consumption derived from the financial crisis, rather than a change in consumption patterns towards greater sustainability. It is remarkable that this basic notion is completely overlooked in the Commission's analysis.

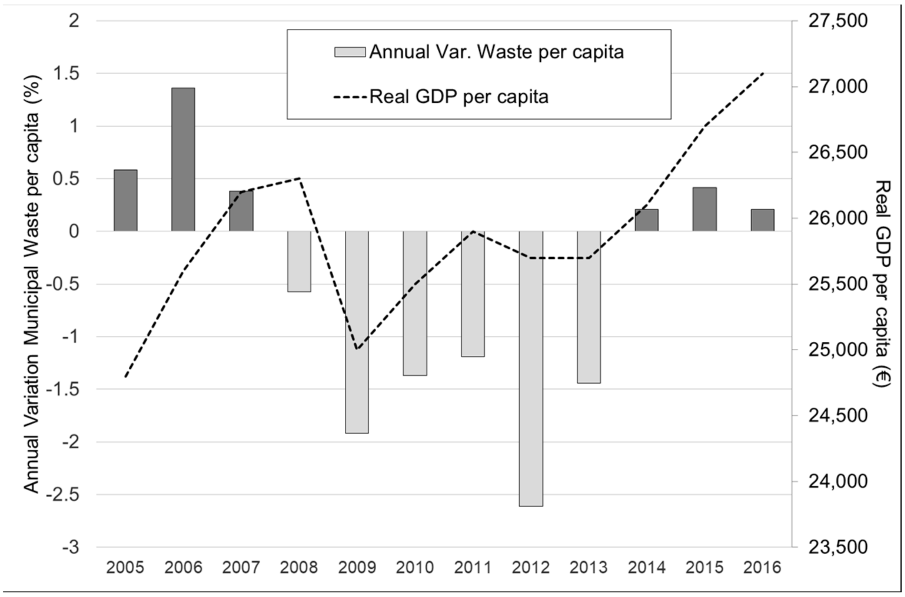

Figure 2. Generation of municipal waste per capita and GDP per capita. EU-28. Source: own elaboration based on [38].

Country-level data also show a positive correlation between per capita municipal waste generation and GDP (Figure 3). Although expected, these results draw special attention to the current growth paradigm in rich countries, as economic convergence (and social equity) will require that production, consumption, and household waste generation in low-income Member States continue to increase in the next years.

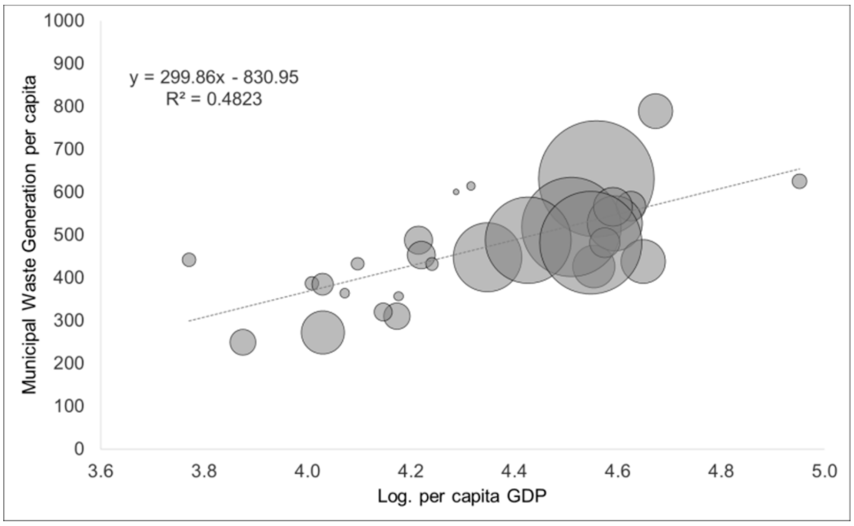

Figure 3. Generation of municipal waste per capita and GDP per capita. EU-28. 2014. The size of the bubbles indicates total GDP. Source: own elaboration based on [38].

The second indicator about waste generation refers to total generation of waste per unit of GDP (excluding major mineral waste). According to the commission's SWD, it is expected to offer a measure of the level of "eco-efficiency" or "decoupling" of waste from production. However, this metric may not be the most appropriate to compare the situation in different Member States, as it penalizes the countries with lower GDP per capita. This may be remedied to some extent if the generation of waste was presented in relation to a "physical" metric of economic activity (e.g., employment). Admittedly, an indicator such as waste generation per worker may also present a bias, in this case in favor of labor-intensive economies, though that sort of partiality would be consistent with the CE's theoretical framework, which deems labor-intensive activities as essentially more eco-efficient than resource-intensive ones [39].

Employment data of the European private sector can be obtained from the Structural Business Statistics (SBS) elaborated by Eurostat [40]. If total waste generation per person employed [41] is taken into consideration, the results vary significantly. Many countries regarded amongst the less eco-efficient from the GDP approach are instead much better positioned in terms of waste per worker. This is the case of Romania, Hungary, Lithuania, Latvia, Czech Republic, and Croatia. The opposite can be said about Belgium, Finland, the Netherlands and Italy, all of which are between the less eco-efficient countries in terms of waste per worker. Not surprisingly, Member States with higher (lower) income per capita present in general a worst (better) performance when it comes to this indicator. The only exceptions are Estonia and Greece, both with a high waste generation rate by worker and GDP, while Bulgaria remains amongst the less eco-efficient countries albeit with a remarkable relative improvement if values per worker are taken into consideration (Figure 4).

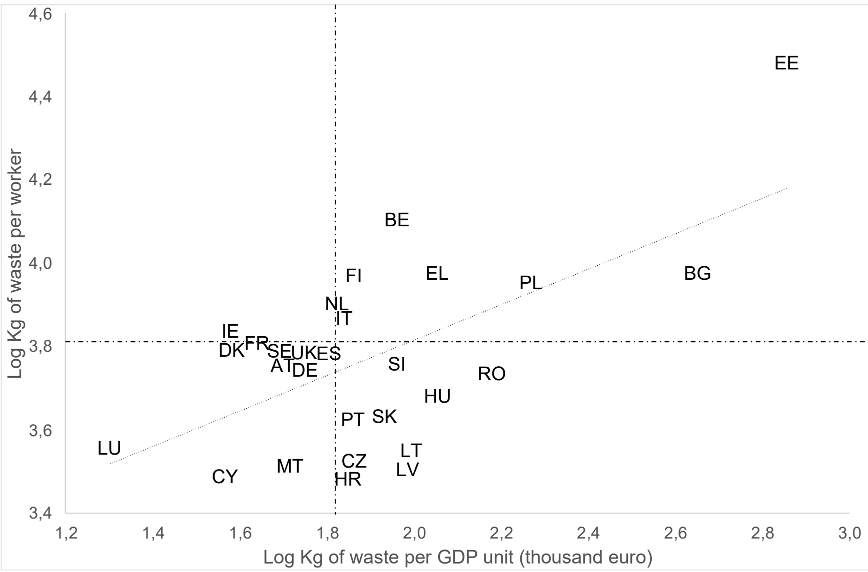

Figure 4. Generation of waste per worker and GDP unit. EU-28. 2014. Excluding major mineral waste. The dot dash lines indicate EU averages. Source: own elaboration based on [38].

Beyond the above mentioned, there is a clear need for differentiated indicators to assess the evolution of waste generation linked to consumption and production. Moreover, national-level data compiled in the MFCE do not discriminate between the impact of local consumption on the generation of industrial waste in other countries. Thus, a more systemic approach should be followed if the aim is to act on the focus of the problem in a coordinated manner, sharing responsibilities and efforts equitably. Regarding data, such an approach requires that waste generation is studied in close relation with other relevant variables, e.g., international trade flows of goods, services, and waste, along with the material footprint generated by them.

4.2.2. Extra-EU Trade in Recyclable Raw Materials: Efficient Markets or Materials Leakage?

It has been pointed out previously that trade in secondary raw materials is regarded by the Commission as an indicator of market dynamism and the level of efficiency in the use of the EU's recycling capabilities [10]. It was also mentioned that "secondary raw materials" is another way to refer to a variety of commodities that, though capable of being recycled, are still waste unless they receive the proper recovery treatment (waste of metal, paper, rubber, and plastic) [42]. This means as well that the final destination of these materials is unknown once they cross national borders, a fact that could mislead the interpretation of data if left out of the analysis.

Data show a wide gap between the EU's exports and imports of recyclable waste in every year of the available series (2004–2018). In terms of the balance of trade, this implies a remarkable and sustained commercial surplus that, in 2018 alone, reached €4.8 thousand million. However, from a CE approach, the same data could be interpreted as proof of a continuous leakage of potential secondary raw materials, which the EU lacks the capabilities to process and reuse within its boundaries. Waste trade data in terms of weight presents evidence in this direction.

In 2016, the EU generated 911 million tons of waste, excluding major minerals (if major mineral waste is taken into consideration, the total amount reaches 2.5 billion tons) [38]. According to Eurostat, up to 245 million tons correspond to "recyclable wastes", a wider category than the ad-hoc "secondary raw materials". Recyclable wastes include, in addition to metal, paper, rubber and plastic, also glass, wood, and textile residues. Considering that the EU's exports of secondary raw materials reached 35 million tons in 2016, this means that at least 14% of the total amount of recyclable waste is being exported (and 21% of metal, paper, rubber, and plastic waste).

Besides, in 2018, the amount of recyclable waste leaving the EU measured in tons exceeded more than five times the mass of those that were imported. This gap has remained relatively constant since 2010, when it peaked as a result of a 42% decrease in imports alongside with a 45% increase of exports between 2006 and 2009 (Figure 5). China's decision in 2018 to close plastic imports, after years of serving as the world's leading plastics recycler, will be crucial to understanding the future evolution of this indicator.

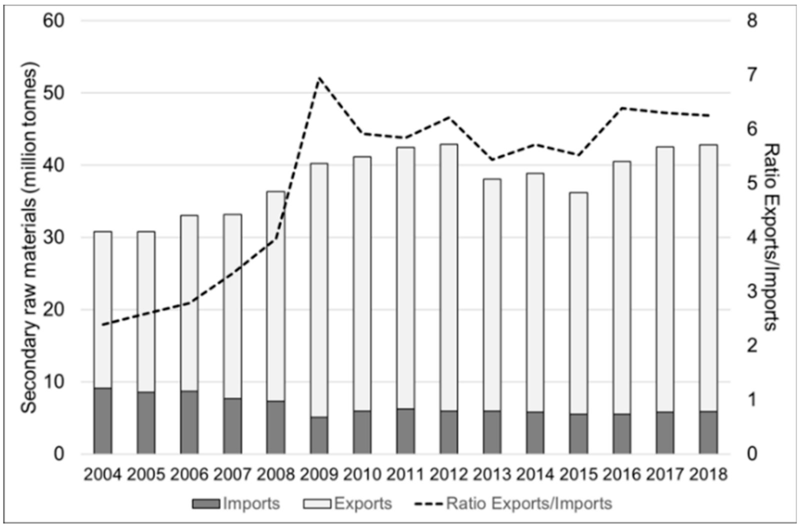

Figure 5. EU trade in secondary raw materials with non-EU countries. Total mass. Source: own elaboration based on [38].

The composition of the EU's trade flows also presents several differences in terms of market value per ton of waste, as the average price of imports has been more than three times that of exports since 2013. This can be partly explained by differences in the type of the materials traded. In 2018, the share of recyclable precious metals waste (the most valuable type of secondary raw material) in the EU's imports was 20 times greater than its participation in exports. Besides, the market value of imported recyclable waste of plastics, iron, steel, copper, aluminum, and nickel was in all cases between a third and 99% higher than that of the exported materials (Table 3).

Table 3. EU trade in secondary raw materials with non-EU countries by material type. 2018.

Type	Share (tonnes)			Avg. Value (€/tonne)		
	Exports (X)	Imports (M)	Ratio M/X	Exports (X)	Imports (M)	Ratio M/X
Total	100%	100%	1.0	379	1555	4.1
Plastics	8.0%	7.4%	0.9	183	364	2.0
Paper and cardboard	28.5%	26.7%	0.9	138	160	1.2
Iron and steel	58.5%	47.9%	0.8	296	434	1.5
Precious metals	0.1%	2.5%	23.8	47,533	33,193	0.7
Copper, aluminium and nickel	4.8%	15.6%	3.2	2090	2776	1.3

Source: own elaboration based on [38].

In conclusion, the currently available data show a potential lack of capabilities on the part of the EU to successfully close the cycle of many material flows. Moreover, EU-28 countries may also be relocating part of the negative environmental impacts of their low-value waste to other parts of the world trough international trade. Further analysis with a higher level of detail regarding the different material types should be conducted to contribute to the research on this matter. Some good examples of this are the studies by [43,44] on trade in WEEE.

4.2.3. Intra-EU Trade in Recyclable Raw Materials: Who Gets the Most Value?

In addition to the overall leakage of secondary raw materials through international trade, available data also evidence large disparities between Member States regarding their capacity to retain valuable materials. From a CE perspective, it could be assumed that a negative trade balance and "unfavorable" terms of trade for secondary raw materials should be regarded as a positive outcome, as they would reflect a greater inflow (or smaller outflow) of the most valuable materials.

According to this logic, it is possible to divide EU Member States into four groups considering the direction and average value of the flows of recyclable materials within the EU, as it is shown in Figure 6. The quadrants were obtained by combining the logarithmic representation of two proxy variables, "trade balance" and "terms of trade". The first variable was calculated by dividing the mass of exports over imports, in tons, while the terms of trade were estimated as the ratio between the average value of exports and imports, in euros per ton of material. Average annual data for the period 2010–2018 were used.

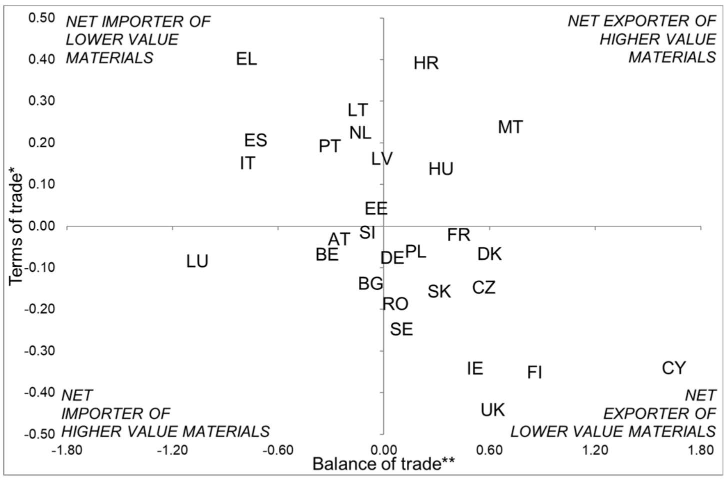

Figure 6. Balance and terms of trade in secondary raw materials. Intra EU-28. Average values 2010–2018. * Log(€ per ton exports/€ per ton imports) ** Log(ton exports/ton imports). Source: own elaboration based on [38].

From a CE point of view, the most favorable situation would correspond to the lower left quadrant, in which Luxembourg, Belgium, Austria, Bulgaria, and Slovenia are located. The opposite could be said of the upper right quadrant, comprising Malta, Croatia, and Hungary, all of which are net exporters of recyclable materials with a higher average value than that of those they import.

Most countries fall in the two remaining quadrants, in an intermediate situation that, however, also has relevant implications. On the one hand, there is a large group of net exporters of recyclables that, at the same time, attract the most valuable materials. This is the case of the UK, Cyprus, Finland, and Ireland, among others. On the other, several Member States, such as Greece, Spain, Italy, and Portugal, are net importers of the least valuable materials from the rest of the EU.

These results seem to suggest an uneven distribution of the metabolism system of recyclable materials across the EU. In addition, the significant differences in value of the materials processed in each Member State appear to reproduce, in some cases, the existing disparities in terms of development and complexity of their productive structure.

4.2.4. CE Generates Work... or Is It the Other Way Around?

The last group of indicators of the MFCE, which are included within the "competitiveness and innovation" stage, aim to measure the participation of CE in terms of employment, value added, investments, and number of patents developed. The framework considers the recycling, repair, and reuse sectors as proxies of the extent of CE participation in the economy. Although this methodological decision is not without problems, it allows information to be gathered on activities that in one way or another contribute to the general level of circularity of the EU's productive structure. Yet, the limitations of these metrics should be kept in mind when analyzing the results obtained.

In this sense, the Commission's interpretation of both the expected scope and the results yielded by these metrics may raise some controversial questions. The rationale behind the inclusion of these indicators is based on the initial assumption that through repair, recycling, and reuse activities, CE contributes to the overall competitiveness of economies basically by generating employment, investment, innovation, and value added. In this sense, the relation between the number of new patents and innovation in CE is straightforward, even though only developments linked to material recycling and secondary raw materials are considered. Yet, in the case of the rest of the variables, the link with overall competitiveness and circularity might not be so plain.

As desirable as the increase on the participation of value-retaining activities may be, a higher share of repair, reuse, and recycling sectors does not necessarily reflect a higher level of concern about the environment and value preservation. It might as well be a consequence of structural imbalances leading to the lack of competitiveness on value-generating sectors. It should not be overlooked that in most cases, these are still marginal economic activities with a relatively low level of productivity and remunerations.

When considering the weight in terms of employment of the CE-related sectors in the different EU Member States, it becomes evident that countries with higher levels of per capita income present in general a lower participation of these activities (Figure 7). Nevertheless, even if the lower share of employment of these sectors in the richer countries can be explained by higher productivity levels, the large differences in terms of economic structure among Member States still call into question the rather optimistic interpretation that is given to these indicators.

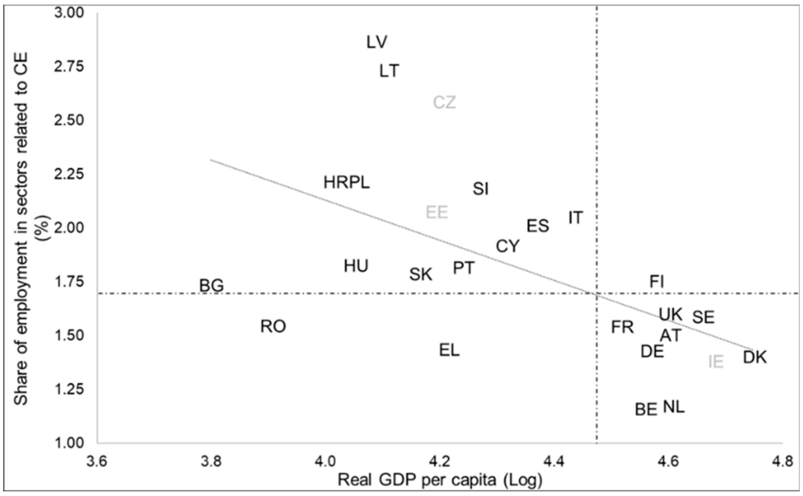

Figure 7. Share of employment in sectors related to the CE and real GDP per capita. EU-28. (Malta and Luxembourg were not included due to lack of information. Employment values for the Czech Republic, Estonia, and Ireland were estimated based on available data for the year 2014). The dot dash lines indicate EU averages. 2015. Source: own elaboration based on [38].

Finally, there is another conceptual issue that has a significant influence on both the choice and interpretation of CE-related employment indicators. It is assumed that CE contributes to general wellbeing by promoting value-retaining activities that also happen to be labor-intensive. This approach neglects that, conversely, it is these sectors that contribute to CE precisely because they are based on the workforce rather than on resource extraction and waste generation [39].

This may seem only a semantic minutia, but it has certain practical consequences for the interpretation of data. If work is deemed to be a contribution, that is, something that CE provides to society, any raise in the share of employment in value-retaining activities should be considered an improvement both in circularity and wellness, regardless the causes of this shift. However, such an increase may as well be based on the creation of jobs with lower wages and/or poorer working and health conditions.

The share of employment in CE activities only reflects the proportion of the total labor force that is dedicated to activities related to value-retention. To be able to assess whether progress towards circularity is contributing to general wellness, it is necessary to know if the labor conditions of the jobs created are better or worse than those in the rest of the economy. This is mentioned in passing in the EEA report [9] but not taken into consideration again. However, it would provide evidence of whether the proper incentives are being set in CE-related activities to attract labor force from other productive sectors, beyond just providing an option in the face of unemployment.

5. Discussion

CE can be considered as an attempt to operationalize a new sustainable productive paradigm. The elaboration of a MFCE is a valuable contribution in this sense for two main reasons. First of all, because it provides systematic information on the current level of development of CE in the EU. Secondly, it promotes circular objectives by assessing the degree of progress in the selected dimensions, which in turn allows for national governments to set and commit to specific goals and performance targets. This dual purpose gives the MFCE paramount importance in defining the EU's path towards the CE, as it determines the range of priorities for action. As [13] points out, the choice of metrics is crucial in the future shaping of a concept that is still in construction. Consequently, any bias in the selection of indicators both reflects and conditions the orientation and ambition of the European CE strategy.

The difficulties to define an appropriate monitoring framework are certainly numerous. In the first place, the choice of the most adequate metrics for each dimension is not always straightforward, as their aim and interpretation regarding the CE principles are often unclear [12]. Secondly, as noted by [12,24,26,28], there is a great diversity of CE definitions and still no consensus on the scope of the concept. Third, the required information may not be available, especially as coverage and comparability at the European level is necessary, while resource and time constraints often force many aspects to be neglected. However, this should not imply a reduction in the scope of the concept that is being measured. Limiting the assessment of CE only to some of its components, leaving aside several key elements, could lead to the eventual distortion of its meaning and provide a misguided message to public and private actors.

In this sense, it has been argued that several topics that reflect the more comprehensive, systemic, and global character of CE are currently absent from the MFCE. This is the case of the use of energy, land and water, greenhouse gas emissions, environmental footprints, products lifespan, institutional drivers, and socio-economic implications of the of change towards CE, or the impact of activities linked to eco-design, reuse, and collaborative consumption. The decision to leave these aspects aside and focus solely on the materials dimension of CE is found to be contradictory not only with the critical literature [3,4,7,24,26,33,34,36] but also with the mainstream position expressed by the EMF [19] and the very same priorities set by the European Commission [1]. In some cases, the required information does not yet exist, which points to the necessity of developing new data sources. In others, metrics are already available, and therefore their exclusion evidences a bias in the conceptualization of CE that underlies the current composition of the MFCE.

In this sense, the absence in the MFCE of actual socio-economic indicators is consistent with an extended lack of acknowledgement of the social implications entailed in the transition to CE, previously noted by several studies, such as [4,15,25,26,36]. The authors of [4] point out that the shift towards CE has mostly been addressed as an issue of technical innovation, industrial systems, economic incentives, and reformulated business models, neglecting its socio-political consequences together with the possibility of exploring other possible "transformative pathways". In the same vein, it has also been stated that the promotion of the CE within the EU is based on the neoclassical economic theory of the environment [3], thus depicting society as a set of rational individuals whose main contribution to the CE is to voluntarily minimize their waste production while continuing to maximize their consumption.

The crucial role of political narratives in shaping expectations on the future potential of CE and limiting the choice between the currently available pathways has been highlighted by [3,5,6]. Referring to the EU action plan for the CE, the authors of [5] (p. 26) note that "the conventional forms of worth to justify a future orientation towards CE are framed through general understandings of, on the one hand, profit maximization and competition (market order) and on the other productivity, efficiency and instrumentality (industrial order)", while the ecological order of worth remains absent. This would seem to be reflected in the lack in the MFCE of indicators on the environmental impact of the economic activity on land, water, and air/climate. The restricted selection of metrics also evidences a contrast between "idealized visions of the CE" related to "industrial symbiosis" and "products designed for extended lifetimes" [5], and the "policy reality" focused mainly on "enhanced, post-consumer waste management" [3,5].

Besides, the emphasis placed on the growth of intra-European trade in secondary materials mirrors the primacy within government policy commitments of the need to create new markets, together with a growing understanding of the green economy as a source of new business opportunities [3]. Such a narrative revolting around the notion of free-market as the main driving force for the change towards sustainability is supported in the neoliberal paradigm, which understands nature mainly as a source of resources for the making of economic profit though the application of technology and knowledge [45]. Thus, the environmental issue of waste generation is reduced to a matter of removing the normative barriers that prevent the commodification of wastes though the creation of a European secondary materials market.

Regarding the interpretation of the available data, the results diverge significantly when the analysis focus on value conservation rather than value added. This applies especially to the analysis of international flows of secondary materials. The increase in the volume of trade in recyclable waste together with the large surplus reflected in the EU aggregate data may not necessarily imply good news from the point of view of value preservation and global sustainability. On the contrary, it could be evidencing a deficit in the capability to retain the value of recyclable materials within EU economies, which has been pointed out by authors like [3]. Besides, the treatment that the exported secondary materials receive at the destination is unknown, so they may be ending as waste in countries with less strict legislation [46]. In any case, it should be acknowledged that the environmental impacts of the European economy do not end at the EU border. As [7] explain, a reported issue regarding spatial systems boundaries is that high eco-efficiencies can be achieved locally though the shift of negative environmental impacts to other territories, by means of exports (waste trade and difficulties in the end-management phases) and imports (disregard of biodiversity in primary resource exporting countries). Moreover, data about trade flows of secondary materials within the EU show that the "dynamic internal market and optimal use of EU recycling capacities" projected by the European Commission [28] (p. 37) may in fact be determining the emergence of winners and losers within European boundaries in terms of value retention and potential environmental impacts.

Another controversial aspect of the interpretation of the data has to do with the relationship between CE, economic activity, and employment. In the first place, the identification of CE with the recycling, repair, and reuse sectors is not only reductionist but also misguided. Although these activities are undoubtedly relevant, a proper assessment of the progress made in the transition towards CE needs to consider the diffusion of circular practices throughout the entire productive system and in all the economic activities. Besides, to estimate the real impact of CE-related employment on general well-being, it is crucial to take into consideration the net effect on general employment and the quality of the created jobs, for instance, by comparing wages and working conditions with those in the rest of the economy. Once we assume that labor contributes to the CE by being essentially a renewable source of value, the challenge becomes to provide incentives not only for job creation but also for the improvement of labor conditions on value-preservation activities.

6. Conclusions

This article aimed to reflect critically on the conceptualization behind the European strategy for the CE. To do so, it focused on the theoretical implications behind the choice and interpretation of the indicators proposed by the European Commission to measure progress towards CE in the EU. Although a detailed review of the entire body of documentation on the evolution of the European CE narrative was outside the objectives of this study, the comparative analysis of the main guidelines outlined in the European CE action plan and the metrics selected to form part of the MFCE corroborated some notions previously noted by the critical literature on CE. Several relevant aspects related to the environmental and social dimensions of the concept were found to be missing. At the same time, both the selection of metrics and the understanding of the first results reflect a bias towards the neoclassical environmental approach, which prioritizes growth and markets over reducing the detrimental impacts of economic activity on nature.

The development of a monitoring framework for the transition towards CE represents a unique opportunity to reinforce the most comprehensive and systemic meaning of the concept, in order to assess its real contribution to sustainability. It is therefore recommended to incorporate the indicators on energy, land and water use, and emissions, which are already included in other European policy areas. Also, efforts should be made to develop indicators to track the average durability of products, together with its main determinants, such as the extent of eco-design, repair, reuse, and collaborative consumption activities.

A systemic approach will in turn demand the development of new metrics and incorporation of dimensions, such as the institutional drivers required for transition to CE. This involves, among other things, an assessment of the evolution of legal and fiscal enablers and barriers to CE-related innovation, together with the resources and actions put in motion by UE innovation system to that end.

The lack of critical studies on the socio-economic implications of the shift towards CE promotes the diffusion of "win-win" non-conflict scenarios that lead to what has been depicted as "weak policy instruments and easily co-opted discourses of green capitalism and consumerism" [4] (p. 90). Therefore, more in-depth research should be done on the effect of the CE on net employment and the qualitative analysis of new jobs and forms of public collaboration and engagement that emerge from the shift of paradigm in production and consumption. Also, the socio-economic consequences of international commerce of recyclable waste should be examined critically, paying special attention to the potential creation of "waste havens" [46] and the uneven distribution of the social and environmental benefits of CE through the different territories.

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