

## THE CONCEPT AND DEVELOPMENT OF THE CIRCULAR ECONOMY

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**Abstract.** The current setting of the society on a linear economy is proving to be unsustainable in the long term. The solution to the situation is the circular economy (“CE”). The concept of CE has garnered attention not only in the public sector but also in the business environment and academic research in recent decades. It is young concept, what is reflected in its unclear theoretical foundations and the fact that the literature on this topic is not sufficiently explored. Understanding these theoretical foundations is crucial for shaping the concept of CE and its application in practice, as well as for combating negative phenomena such as greenwashing. This paper focuses on identifying key themes related to the theory of CE, including the definition of CE, scientific literature, the historical development of CE, theoretical framework, implementation forms of CE, and the R principles. Analysis of these themes provides a comprehensive overview of the current state of knowledge in the field of CE and serves as a basis for further research and discussions in this area.

**Keywords:** Circular economy, Circular economy definition, Theoretical aspects, Development of Circular economy, Implementation forms of Circular economy, R principles.

**JEL Classification:** N5, Q50, Q56.

### 1. Introduction

The concept of CE isn’t new (Winans et al., 2017), but it has attracted the interest of policy makers (Murray et al., 2015) and corporations (Blomsma & Brennan, 2017) in recent decades, particularly in Europe and China.

We can say that the development of this concept is largely supported by the interest of the EU and China in it. The CE is becoming more important in Europe thanks to the EU, which has decided to transition to this mode of economy in 2015 by Circular economy action plan. EU sees numerous opportunities in it, whether in terms of waste reduction and environmental conservation or as a source of job opportunities and a way to reduce dependence on primary resources (European Parliament, 2023).

This concept brings a range of benefits. As Kirchherr et al. (2023) state, it continues to interest both scholars and practitioners, CE grows in popularity. It is evidenced by the number of documents on this topic – in late 2021 Scopus includes more than 13,000 documents containing the term CE, with 7800 appeared in 2020 or 2021. For comparison, in 2006, according to Alcalde-Calonge

et al. (2022), there were just three relevant papers available on this topic, all three dealing with the concept of CE within the context of China’s government activities. This concept began to attract increased attention only after 2008 when China adopted the “Law on the Promotion of the Circular Economy,” the first national law on CE. Of course, number of literature to this concept has extremely increased but CE still lacks conceptual clarity (Lazarevic & Valve, 2020; Dzhengiz et al., 2023). The literature on this concept is still unclear and largely unexplored; no general overview has been published yet (Korhonen et al., 2018; Alcalde-Calonge et al., 2022). Friant et al. (2020) pointed out that CE is still a relatively recent idea and it’s crucial to establish its theoretical basis. Otherwise, it runs the risk of lacking systemic validity and critical social relevance, making its claims and proposals unachievable on a scale necessary to address the socio-ecological challenges of the 21st century effectively.

The aim of this study is therefore to contribute to this new research area through thematic analysis, which allows for the exploration of the CE theory, to identify the main themes, patterns, and concepts contained within them.

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## 2. Methods

In this section we explain methodological approach to obtaining information important for the processing of this paper. First, we search term “circular economy theory” through google scholar and identified the most cited papers. In the second stage, snow-ball method was used to identify additional articles complying with the time- and topic-wise criteria. We focused on literature published after 2015 for relevance. However, since one of the areas of interest was also the historical development of this concept and its background, we also refer to relevant sources from older periods in the paper.

We use thematic analysis to explore the theory of CE. Documents addressing this concept were systematically analysed to identify the main themes, patterns, and concepts contained within them. We review these texts and highlighting all relevant information related to CE. Subsequently, this information was categorized according to common themes and concepts present in them.

Thematic analysis allowed us to identify the most important areas addressed by the scientific literature concerning the fundamental theoretical foundations of CE. In this way, we identified six main areas of interest. These include the definition of CE concept, relevant scientific literature addressing the topic of CE, the history of CE development, theoretical concepts on which CE is based and relies, levels of CE implementation, and the fundamental principles of CE in the form of the R.

## 3. Results

The articles we analysed on the topic of CE led us to six main areas addressed by the authors: CE and its definition, scientific literature, the history of CE development, theoretical concepts on which CE is based and relies, levels of CE implementation, and the fundamental principles of CE in the form of the R.

### 3.1. The CE and its Definition

One of the important areas addressed by the analysed articles was precisely the definition of the concept CE, what is important. As Nobre and Tavares (2021) state, the absence of definition can ultimately lead to the weakening of the significance of CE and to the use of new jargon for old concepts; moreover, it fosters greenwashing, as many companies exploit the ambiguity of this term.

Linguistically, term “circular economy” stands in direct opposition to the “linear economy” (Murray et al., 2015). The linear economy can be characterized like a transformation of natural resources into waste through production processes. Waste generation like this degrades the environment by two keyways: depleting natural capital (e.g., extraction or unsustainable harvesting practices) and diminishing the value of natural capital through pollution and waste accumulation. It is a one-way system economy, which was described by Boulding (1966) as the “cowboy economy”. The CE is presented

as an alternative model of production and consumption that enables the “de-coupling” of resource use from economic growth, thereby contributing to sustainability (Reike et al., 2018). Ghisellini et al. (2015) emphasize, prospects for the CE are “enormous and attractive”.

According to Murray et al. (2015), the term “CE” is linked to various meanings and associations depending on the authors, but they all share the concept of a cyclical closed-loop system. Kirchherr et al. (2017) further illustrate this diversity of definitions, noting that out of 114 different definitions examined, as many as 95 were distinct, with only three definitions recurring more than once. The reason for this diversity is also the fact that it is a young research area, which, as Murray et al. (2015) emphasize, requires a thorough definition. Kirchherr et al. (2017) advocate for the definition provided by Van Buren et al. (2016), citing its clarity as the primary reason for their recommendation. The most utilized definition of CE is from the Ellen MacArthur Foundation, dating back to 2012 (Goyal, 2021; Kirchherr et al., 2017; Schut et al., 2015), which is a prominent non-profit organization dedicated to CE in the UK.

In essence, the primary objective of CE is to diminish the inputs of primary materials and energy in production and consumption processes, as well as to decrease the outputs of waste and emissions (physical throughput), achieved through the implementation of material cycles and energy cascades grounded on renewable energy sources. The economic objective of this concept is to reduce the quantity of utilized raw materials and expenses related to energy, waste management, and emission control, along with mitigating risks associated with environmental taxation/legislation and public perception. Additionally, it aims to foster innovation in new product designs and market opportunities for businesses. Its social goal encompasses fostering a shared economy, promoting participatory democratic decision-making, enhancing employment opportunities, and optimizing the utilization of existing material capacities through community engagement (Korhonen et al., 2018).

A literature review and analysis of definitions conducted by Suárez-Eiroa et al. (2019) identified three common theoretical strategies: (i) minimizing the input of raw materials and the output of waste and emissions, (ii) retaining the value of resources within the system for as long as possible, and (iii) reintegrating products reaching end-of-life back into productive cycles (e.g., Ghisellini et al., 2015; Kalmykova et al., 2018).

### 3.2. Scientific Literature

At the centre of attention in the analysed articles is also a significant amount of scholarly literature on the subject. As mentioned earlier, the global concept of the CE has only recently been revived, which is also reflected in the main sources of information on the CE (Reike, 2018; Kalmykova et al., 2018). Kalmykova et al. (2018) state, that CE was before 2012 mainly explored in documents describing developments in China because of its earlier

adoption of CE as a national strategy. Consequently, scientific literature on the CE remains limited, with ongoing conceptual discussions and the emergence of practical implementation strategies, as noted by Kohronen et al. (2018).

The process of developing CE is taking place in EU right now, what is reflected fact, the most relevant literature about CE has form of documents and initiatives from GOs and NGOs. The fact that CE is a “young field” is also evidenced by the number of documents on this topic –in late 2021 Scopus includes more than 13,000 documents containing the term CE, with 7800 appeared in 2020 or 2021, while in 2006 there were just three relevant papers available on this topic (Kirchherr et al., 2023; Alcalde-Calonge et al., 2022).

### 3.3. Development of the CE

Another area that received attention in the analyzed articles is the history of CE. As noted by Reike et al. (2018), an examination of the history of CE reveals that it is not entirely a novel or transformative concept. Certain degrees of circularity have already been institutionalized in various forms across different geographical areas.

Several authors, including Murray et al. (2015), have traced the origins of CE back to Quesnay’s *Tableau Économique* (1758). Quesnay introduced the concept of the “circular flow of income,” drawing inspiration from the research of Harvey (1628) and Malpighi (1661) on blood circulation, which served as a metaphor for cash flow within the economy.

Further examples of material cycles (“loops”) came from the 19th century, we can find them in the work of P. L. Simmonds (1814–1897) (Reike et al., 2018). Murray et al. (2015) state, idea of industrial metabolism emerged during this period, according to which industry does not function like a set of independent inputs and outputs, but like larger “organism” for which garbage is food. Furthermore, there are economic sectors that have emerged from the utilization of waste and by-products, as exemplified using dyes in petrochemicals (Ayres & Ayres, 1996). The situation became more urgent after the Second World War, when the world economy accelerated, so waste management became a problem, which need to be regulated (Carter, 2001).

Reike et al. (2018) discuss 3 phases of development of CE. The first phase took place from 1970 to 1990 and is associated with waste management, with the roots of the CE lying precisely in this phase.

This era marks a period of increasing attention to environmental movements and the 3R concept (reduce, reuse, recycle). Much of the regulation during these decades is primarily focused on “outputs,” particularly waste management. It is based on the idea that waste cannot be prevented, but pollution can be reduced by principles as “polluter pays” and “end-of-pip”. Growing global media connectivity fosters awareness that local and world problems are interconnected and can affect also strong economic states.

China held its first National Environmental Protection Conference in 1973, where have been formulated environmental protection policies and guidelines. This marked the inception of an ambitious development plan that aimed to integrate economic growth, social equity, and environmental conservation, commonly referred to as CE (Geng et al., 2012). In Europe, CE first emerged in Germany in early 1976 with the implementation of the Waste Disposal Act. However, at the EU level, the formal recognition and promotion of CE came later with the introduction of the Waste Framework Directive 2008/98/EC (Ghisellini et al., 2015).

According to Reike et al. (2018), the second phase took place from 1990 to 2010. In this phase, the focus shifted from outputs in the form of waste to a combination of outputs and preventive measures. Environmental problems were increasingly seen as an economic opportunity: corporates could benefit from increased efficiency and reputation (Blomsma & Brennan, 2017). Scientific evidence of global warming, water scarcity and biodiversity loss created a new sense of need at the beginning of the 21<sup>st</sup> century. The advancement of digitalization and the internet facilitated the rapid sharing of information, thereby enabling the linkage of local and global environmental issues. Although CE concept was created in 1960s, it slowly came to the fore just now (Murray et al., 2015). The first academic papers appeared in 1990s, but significant increase of papers didn’t occur until around 2000.

In 2009 entered into force the “Circular Economy Promotion Law” in China. It was designed to affect behaviour at micro level – to encourage companies to get involved in eco-design and cleaner production. At the meso level, it promotes the establishment of eco-industrial parks aimed at bolstering regional development and environmental preservation (Yuan et al., 2006). At the macro or national level, CE advocates for the creation of eco-cities and, ultimately, champions sustainable production and consumption practices, with the goal of cultivating a recycling-oriented society (Geng et al., 2012). Although China led the way in implementing CE in practice, its adoption has also been noted in Western economies. According to Hill (2015), what initially began as a theoretical concept is gradually evolving into an idea embraced by certain businesses and policymakers in Europe. This adoption reflects a desire to optimize the economic utilization of resources over prolonged periods. Japan embraced CE in 1991 with the introduction of the Law for Effective Utilization of Recyclables (Ghisellini et al., 2015). Therefore, while Japan and China were among the initial prominent Asian economies to officially enact CE policies at the national level, in Europe, numerous countries have primarily adopted CE initiatives, policies, and pilot programs. Most of these efforts are concentrated in the Netherlands, Denmark, Germany, and the United Kingdom. At supranational level, it is the EU (Reike et al., 2018).

According to Reike et al. (2018), the third development phase of CE has been taking place from 2010 to the

present. It is characterized by the maximization of value retention in a period of resource depletion. While economic benefits are still emphasized, the ultimate threats to human survival and seemingly insurmountable sustainability challenges associated with population growth are leading to renewed attention to resource depletion and resource value retention. In this context, the CE is lauded for its potential to separate economic growth from resource consumption.

### 3.4. Theoretical Framework of CE

Clarifying CE theoretical framework is important for its understanding and subsequent application in practice. It's also reason, why analysed papers focus on this area. The CE has its predecessors in broader historical, economic, and ecological areas (Murray et al., 2015; Kalmykova et al., 2018). The CE is rooted in a broad array of ideas drawn from various scientific fields, including emerging and semi scientific domains (Korhonen et al., 2018). Simultaneously, it is connected to the acknowledgment of the finite nature of Earth's resources (Kalmykova et al., 2018).

According to a thorough examination of worldwide literature by Ghisellini et al. (2015), it is demonstrated that CE is deeply entrenched in diverse theoretical frameworks, including ecological economics, environmental economics, and industrial ecology. In European literature, CE is situated within environmental economics, a subset of neoclassical economics (Naustdalsslid, 2014). Conversely, in China, it is associated with ecological economics (Xia & Yang, 2007; Zhu & Wu, 2007).

We can only concur that there remains a lack of consensus on the theoretical framework of CE (Kirchherr et al., 2018). According to Murray et al. (2015), there is still a debate about the origin of the term "CE". This concept has undoubtedly endured for an extensive period, as illustrated by the segment of our article dedicated to tracing its historical evolution. "The idea of material cycles has been around since the dawn of industrialization" (Korhonen et al., 2018). Therefore, we can find different opinions in the literature. For example, Greyson (2007) argues that the term was originated by Boulding in 1966. Boulding's notion of the economy as a circular system is considered fundamental for ensuring the sustainability of human life on Earth. Liu et al. (2009) contend that CE is originated in China. Similarly, Yuan et al. (2006) also assert that this concept was initially introduced in China, drawing inspiration from Germany and Sweden, and stemming from the paradigm of industrial ecology.

According to Ghisellini et al. (2015) or Su et al. (2013), the CE has its roots in various schools of thought. Environmental economists Pearce and Turner (1989) are credited with introducing the notion of a circular economic system, building upon the earlier contributions of ecological economist Boulding (1966). Henry et al. (2021) also state in connection with the popularization of this term, besides Pearce and Turner, works by Ayres (1994) and Frosch and Gallopoulos (1989) as an important.

Several authors (Murray et al., 2015; Kohronen et al., 2018; Kalmykova et al., 2018) emphasize the importance of industrial ecology in this context (Frosch & Gallopoulos, 1989; Lifset & Graedel, 2001). Industrial ecology and the CE have a common line with a large overlap (Murray et al., 2015).

A distinct line of thought emerged in the early 1970s, catalysed by the oil crisis. It's crucial to highlight that research on implementing the CE predominantly centers on the concept of industrial ecology, which prioritizes analyzing benefits from the perspective of physical rather than monetary flows (Mathews & Tan, 2011). Industrial ecology assumes the integration of industrial ecosystems in a manner analogous to biological ecosystems (Frosch & Gallopoulos, 1989).

As per Kohronen et al. (2018), ecological economics serves as the appropriate starting point for delving into the scientific underpinnings of CE. Ecological economics, an established scientific discipline, boasts a lengthy tradition in addressing recycling and associated topics (Georgescu-Roegen, 1971; Ring, 1997; Ayres, 1999).

In contrast, the NGO Ellen MacArthur Foundation (2013) attributes significant contributions to the ongoing development and enhancement of the CE to newer theories such as regenerative design, performance economy, cradle to cradle (Braungart et al., 2007; McDonough & Braungart, 2003), biomimicry (Benyus, 2003), and the blue economy. Additionally, other noteworthy mentions include the performance economy (Stahel, 2010), natural capitalism (Hawken et al., 2008), the zero emissions concept (Pauli, 2010), among others.

An interesting differentiation between the circular economy and most sustainability schools of thought is that the circular economy primarily emerged from legislation, notably apparent in the Chinese context, rather than being primarily propelled by a group of academics (Murray et al., 2015).

### 3.5. Levels of Implementation of the CE

Another area that received attention in the analysed articles is the implementation of CE. China stands as a global pioneer in implementing and developing the CE, having instituted a comprehensive program for its application (Zhou et al., 2014; Murray et al., 2015). The objective of this program was to promote sustainable urban development in China and to attain equilibrium between rural and urban populations. Strategies such as waste elimination and resource redistribution were viewed as effective means to incentivize rural populations to remain in rural areas (Kalmykova et al., 2018). In a study on China's CE strategy by Yuan et al. (2006), they elaborate that the aim was to establish closed energy and material cycles, inspired by practices observed in Germany and Sweden. Ghisellini et al. (2015) found that wide variety of policies and economic instruments are used at the political level around the world to implement the CE (taxes, environmental permits, financial subsidies).



As stated by Kalmykova et al. (2018), the literature on CE theory and policy delineates two primary directions of implementation: i) systemic economy-wide implementation, enacted at various scales (local, regional, national, and transnational) and ii) implementation focused on specific groups, sectors, products, materials, and substances. Systemic economy-wide implementation across the entire economy at three levels took place in China, at the macro level (city, province, and state), meso level (symbiotic association) and micro level (facilities) (Su et al., 2013). Regional and local manifestations of systemic implementation frequently center on industrial parks, particularly eco-industrial parks. These parks operate on principles of industrial symbiosis, facilitating resource sharing and waste recycling across diverse industries. Denmark's Kalundborg Park, with over 40 years of successful operation, is a classic example, with other notable parks found in China (Ghisellini et al., 2015).

Yet another approach to implementing CE involves concentrating efforts on specific groups of sectors, products, materials, or substances. For example, EU's New Circular Economy Action Plan includes legislative proposals for initiatives throughout the product lifecycle, focuses on how products are designed, supports CE processes, promotes sustainable consumption, and aims to prevent waste generation and keep resources in use for as long as possible (Kalmykova et al., 2018).

Suárez-Eiroa et al. (2019) underscore scientific consensus regarding three implementation CE levels: micro, meso, and macro.

- The micro level centres on implementing CE within individual businesses (Franco, 2017).
- The meso level focuses on interactions within inter-firm networks (Zhu et al., 2010), which may foster industrial symbiosis (Chertow, 2000).
- At the macro level, the focus lies on the implementation of CE in society, cities, regions, nations, and the international community (de Jesus et al., 2018).

Ghisellini et al. (2015) emphasizes that in China, CE is promoted as a national policy goal from the top down, whereas in other countries such as the EU, Japan, and the USA, it is regarded as a tool driven from the bottom up. The implementation of the CE around the world appears to still be in its early stages, with a predominant focus on recycling rather than reuse. Unlike in Europe, the USA, and Japan, in China, the implementation of CE is supported within the framework of a national program, as it is considered a broader aspect of socio-economic transformation and development policy aimed at ensuring harmony between society and the environment (Naustdalslid, 2014).

### 3.6. R principles

The concept of CE is centred on the so-called R principles (Su et al. 2013; Murray et al., 2015; Ghisellini et al., 2015; Reike et al., 2018). The R principles represent the fundamental principles upon which the CE is based. In the literature, we encounter various numbers of these

principles, most commonly referred to 3R. The 3R principles represent "Reduce", "Reuse" and "Recycle", which are the three main activities through which the CE appears in the literature. It stands as a widely recognized waste management principle favored by experts in China (Reike et al., 2018).

Of course, as previously stated, in addition to these 3R, we can find different numbers of these R principles in the literature. For example, Alcalde-Calogne et al. (2022) refers to the 4R, which also include "recovery" according to European Union Waste Framework, which places it at its core. De Pascale et al. (2021) finds that while 3R are frequently employed in CE literature, 5R dominate in waste management and environmental sciences. In the management of closed-loop supply chains and the design of products, 4R, 5R, or 6R are commonly utilized. Essentially, the principles of 4R and 6R, as well as 5R, are well-established and follow a clear hierarchy. Conversely, principles beyond 7R to 10R are used to a much lesser extent. Roos Lindgreen et al. (2020) adds that the higher the R is in the hierarchy, the more significant it is for transitioning to CE, as it is more beneficial from both ecological and economic perspectives.

The term "reduce" can be employed in three ways: it can be consumer-oriented, producer-oriented, or used in a general context (Reike et al., 2018). According to Ghisellini et al. (2015), the "reduce" principle seeks to minimize the input of primary energy, raw materials, and waste by improving production efficiency, known as eco-efficiency, and consumption practices. This entails embracing advanced technologies, creating more compact and lightweight products, streamlining packaging, designing more efficient household appliances, and advocating for simpler lifestyles, among other strategies (Feng & Yan, 2007; Su et al., 2013).

The term "Reuse" can be applied to consumers, collectors, retailers, and producers (Reike et al., 2018). According to Ghisellini et al. (2015), this principle pertains to any operation in which products or components not classified as waste are reused for the same purpose for which they were initially created. Reusing products offers notable environmental advantages, as it demands fewer resources, less energy, and reduced labor compared to manufacturing new products from virgin materials (Castellani et al., 2015), or even recycling or disposal. Castellani et al. (2015) illustrated that reusing products effectively curtails emissions of harmful substances and alleviates various environmental impacts across a spectrum of items such as clothing, books, furniture, glass, and cutlery. Scaling up reuse efforts requires bolstering consumer demand for reused and refurbished products, designing durable products intended for multiple cycles of use, and incentivizing companies to prioritize product take-back and refurbishment (Prendeville et al., 2014).

According to Murray et al. (2015), recycling has long been recognized as a crucial component of sustainable practices and serves as a cornerstone of the CE. The CE is fundamentally about resource cycling. As per Reike

et al. (2018), “recycling” denotes any approach aimed at circumventing the utilization of new virgin materials or resources (Ayres & Ayres, 1996; Ghisellini et al., 2015). This usually entails processing mixed streams, such as post-consumer products or post-production waste streams, utilizing advanced technological equipment such as crushing, melting, and other processes to recover (near) pure materials. Recycled materials undergo a process where they lose their original structure and can be reused in various applications (Graedel et al., 2011). Hence, materials that undergo recycling are also termed “secondary” materials (Worrell & Reuter, 2014).

#### 4. Conclusions

In conclusion, despite the relatively young age of CE concept, its significance in today’s society is undeniable. Over the past decade, CE has gained attention not only in scientific and academic circles but also in the public sector and business environment. However, despite becoming the subject of extensive discussion, its theoretical foundations remain insufficiently explored and unclear, with literature on it still inadequately researched.

The importance of further research lies in a deeper understanding of the theoretical aspects of CE, which could lead to better practical applicability. Based on the thematic analysis of the articles we examined, it is evident that the majority focus on the definition of the CE concept, relevant scientific literature addressing the topic of CE, the history of CE development, theoretical concepts on which CE is based and relies, levels of CE implementation, and the fundamental principles of CE in the form of the Rs. Analysis of these themes provides a comprehensive overview of the current state of knowledge in the field of CE and serves as a basis for further research and discussions in this area.

In conclusion, it is important to note that thematic analysis can only provide a simplified view of complex topics, and a limitation is also the subjective interpretation of authors, which we clearly consider as limitations of our research. Similarly, a limitation of the study is the limited scope of the literature used.

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