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Circular Economy Public Policies: A Systematic Literature Review

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Abstract

The traditional form of production is called linear economy, which consists of extracting, transforming, producing, consuming and discarding, and is threatened by a series of factors. Among them, we can list the increase in the world population, which went from 3.3 billion people in 1965 to 7.79 billion in 2020, which will consequently lead to an increase in the consumer class. One of the philosophies for meeting this challenge is the Circular Economy (CE), which provides the economic system with an alternative flow model. CE is seen as a new form of sustainability and has gained popularity in the scarcity of resources, the circulation of materials and the facilitation of the reuse and recycling paradigm. Some countries, concerned about the impact of the linear economy on the environment, have proposed specific laws that address the shift from the traditional mode of production to a circular approach. Germany and Japan were pioneers in promoting CE in concrete policies. Followed by China in 2008. Given this scenario, this study aimed to raise which public policies were objects of study in the period 2017 to 2021 and which tools were used to analyze the policies. A systematic review of the literature was carried out, with articles searched in the ScienceDirect and WoS databases, using the descriptors: Circular Economy and Policies. The Sample consisted of 29 articles. The study identified an increase in initiatives to seek circularity through the formulation of public policies. Many countries are demanding more sustainable production processes, with an emphasis on energy savings and fewer carbon emissions. For this, a waste treatment policy is an initial step to seek greater degrees of circularity. The most used tool to study these policies was Framework 9R. Because with it you have an idea of what initial stage the country is in and what stage can be pursued in the future.

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1. Introduction

The constant changes in a more competitive world, industries are required to have a new way of producing. New skills are required, such as dynamism, proactivity, and the ability to make decisions. The traditional form of production is called linear economy, which consists of extracting, transforming, producing, consuming, and discarding [1], [2].

This model is beginning to be threatened by several factors. Among them we can list the increase in the world population, which went from 3.3 billion people in 1965 to 7.79 billion in 2020, which will consequently lead to an increase in the consumer class, according to the Organization for Cooperation and Development Economic (OECD), there is a forecast that this class, with disposable income, will swell from 1.8 billion, in 2010, to almost 5 billion, in 2030 [3]. The linear production flow caused serious environmental damage that resulted in irrational waste and scarcity of resources such as land, materials, energy, and water [4].

Thus, the challenge of expanding supply to meet future demand is unprecedented, as the linear economy is threatened by increased demand, increased use of natural resources and the use of finite spaces in the capacity to assimilate pollution generated by this economy [5]. One of the philosophies for meeting this challenge is the Circular Economy (CE), which provides the economic system with an alternative flow model. Although linearity is dominant in today's capitalism, the idea of material cycles has been around since the beginning of industrialization. The idea has also been put into practice accompanied by the argument of reducing negative environmental impacts and stimulating new business opportunities [1], [6].

CE is seen as a new form of sustainability and has gained popularity in the scarcity of resources, the circulation of materials and the facilitation of the reuse and recycling paradigm. Consequently, due to the consumer's lifestyle, the growth of manufacturing industries has made carbon emissions and waste generation increasingly present [7]. Some countries, concerned about the impact of the linear economy on the environment, have proposed specific laws that address the shift from the traditional mode of production to a circular approach. Germany and Japan were pioneers in promoting CE in concrete policies [8], followed by China [6], [9], [10].

In 2015, the European Union (EU) approved an action plan to implement the CE across the union and member states [11]. In 2018, the European Commission (EC) proposed a CE monitoring framework [12] and a strategy for the use of plastics [13]. In Great Britain, the British Standards Institution (BSI) developed and launched a new CE standardization in 2017, called "BS 8001:2017 – Framework for implementing the principles of the circular economy in organizations − Guide" [14]. In Latin America there is an absence of a defined concept for CE implementation, which coincides with what was stated by the director of the Sustainable Development Foundation of the Americas, when participating in the First Latin American Forum held in Montevideo [15], he said that o "The biggest challenge facing Latin America in terms of transition is knowing what the CE concept is for project implementation" [16].

The purpose of this article will be to raise which public policies were studied in the period from 2017 to 2021 and which tools were used to analyze the policies, followed by item 2 with the literature review, item 3 presenting the methodology, item 4 with the results, and lastly, item 5 with the conclusion.

2. Literature Review

2.1. Sustainability and Sustainable Development

The terms sustainable, sustainability and sustainable development, although used in scientific literature, in the private sector and in public policies, do not yet have a consensus in terms of concept. In the literature, there is a vast diversity of concepts, predominantly related to sustainable development [17]. Despite the lack of consensus on the concepts, there is acceptance in relation to the search for balance between the needs of human beings and the environment, and in understanding their complex interaction dynamics, to deepen and broaden their meaning [18]. Another aspect of consensus about the terms is that they represent something positive and good [19]. The various discussions linked to the terms sustainable, sustainability and sustainable development took place with a view to achieving long-term human well-being through the management of the human environmental system [20], [21].

The driving forces behind the emergence of the idea of sustainability, according to [22], were essentially the energy system crises since antiquity. [23] add that this emergence is linked to the improvement of environmental aspects with negative impacts, with positive effects on the economy and society. It is noted that sustainability gained space and visibility due to discussions on energy sources and natural resources those related to the relationship between humans and the environment, and to problems of deterioration in the relationship between global ecology and economic development. Thus, sustainability can be understood as a solution to the scarcity of natural resources linked to energy issues and resource use. It originated from the deterioration between global ecology and economic development. It encompasses sustainability and sustainable development and is concerned with the future of natural resources and human life [24]. Sustainability is a term that expresses the concern with the quality of a system that concerns the inseparable integration (environmental and human), and evaluates its properties and characteristics, covering environmental, social, and economic aspects.

The term sustainability was first used in the context of development in 1974 in a series of conferences on forest issues [25]. However, [18] point out that the origin and concept of sustainability in this context are unknown. They point out, however, that one of the first definitions arose in World War I, as described by Lester Brown in the mid-1980s. [26], on the other hand, point out that sustainable development as a definition has its roots in the publication by Silent Spring. Therefore, the idea of sustainable development is that the current generation can satisfy their needs without compromising the survival chances of future generations. The concept has two key issues, the idea of the essential needs of the poor, especially in developing or underdeveloped countries; and the limitations imposed by technologies and social organizations regarding the environment's ability to meet basic present and future needs. Therefore, there is a dynamic tension between poverty and environmental concern, considering the continuation of the life of human beings within certain environmental restrictions [27].

Furthermore, this concept does not indicate only saving the environment or a particular species, but human survival [28]. It also points to a clear statement that the human-environmental system comprises a single inseparable system, because, when mentioning "generations", it refers to generations - past, present, and future - related to the human environment, since they are inseparable. This idea refers to keeping the planet's natural resources in common with other species and humans, in past, present, and future generations. Thus, sustainable development aims at economic growth without human-environmental aggression. A long-term vision for future generations, encompassing the environmental, economic, and social aspects in mutual balance. It proposes a change in the behavior of humanity materialized through strategies involving processes and practices [24].

Another very common aspect to conceptualize sustainable development was the idea of three dimensions of sustainability, which are: environmental, social, and economic. The IUCN 2005-8 Program, adopted in 2005, used the dimension model to demonstrate that they need to be better integrated, with action to correct the balance between them [20].

2.2. Circular Economy

In research carried out by [10] the origin of CE emerged in the works of Ecological Economist Kenneth Boulding, in which his idea of the economy was of a circular system where it was seen as a prerequisite for maintaining the sustainability of human life in Earth (a closed system with practically no exchange of matter with the external environment). The roots of CE are found in General Systems Theory (GST) and Industrial Ecology (IE).

The contemporary evolution of CE and its practical applications to economic systems and industrial processes have evolved to incorporate different features and contributions from a variety of concepts that share the idea of closed loops [1], [2]. Some of the most relevant theoretical influences are cradle-to-cradle [29], laws of ecology [30], loop economy and performance [31], regenerative design [32], ecology industrial [33], biomimicry [34] and the blue economy [35]. All these concepts form the foundations of CE and, consequently, the policies that sought the transition from linear to a circular economy. The term CE has therefore been linked with a range of meanings and associations by different authors, but what they generally have in common is the concept of a closed-loop cyclical system [36].

The concept of CE is of great interest to academics and professionals because it is seen as an operationalization for companies to implement the much-discussed concept of sustainable development [10], [36]. Several reviews of CE literature were carried out [7], [10], [36]-[39]. For example, [7] point out that “there are several possibilities for defining CE”, while [9] write that “There is no commonly accepted definition of CE”.

To make this concept more transparent and resolve doubts, [40] distinguished between two types of fundamental principles: those that relate to the R frameworks, which means how to do CE, and the systems perspective, which shows where CE is being done. Based on the authors who performed the CE literature reviews, as shown in Table 1.

Table 1. Systems perspective of Circular Economy.

Perspective	Concept
Microsystem	Discussion around changes at the product level, companies and/or consumers and their preferences
Mesosystems	Discussion around CE at regional level and/or eco-industrial parks
Macrosystems	Discussion around CE at global and/or national level and/or general industry structure

From a systems perspective, while the macrosystems perspective emphasizes that it needs to adjust the industrial composition and structure of the entire economy, the mesosystems perspective generally focuses on eco-industrial parks as systems and this level is also called the "regional level" sometimes. Meanwhile, the microsystems perspective often considers products, individual companies, and what needs to happen to increase their circularity as consumers as well. The transition from a linear to a circular economy, on the other hand, is better understood with the application of the 9R Framework, where the R9 is the beginning of the linear output and the R0 is the apex to get close to circularity, as shown in Table 2.

Table 2. 9R Framework for pursuing the Circular Economy.

	Strategies	Concept
Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1 Rethink	Make product use more intensive e.g., by sharing product
	R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and material
Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product
	R4 Repair	Repair and maintenance of defective product so it can used with its original function
	R5 Refurbish	Restore an old product and bring it up to date
	R6 Remanufacture	Use parts of discarded product in a new product with the same function
	R7 Repurpose	Use discarded product or its parts in a new product with a different function
Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9 Recover	Incineration of material with energy recovery

It is noticed that these concepts helped to understand that CE is an economic system based on the reuse of products and component products, recycling of materials and conservation of natural resources while seeking to create added value in all links of the system. Countries want to promote the transition through better closure of product and material chains [41]. For example, if a company already has a recycling project, it is in R8, where there is a useful application of materials, if it wants to be at a higher level of circularity in its factory, it must extend the useful life of the products and their parts, such as restoring an old product and upgrading it, or repairing and servicing defective products so they can be used with their original functions. The 9R framework is for checking how to do the CE and the systems perspective is for knowing where the CE is being implemented.

Finally, [7] suggest a simultaneous approach that operates through public institutions from the top down (Top-Down) and the industry from the bottom up (Bottom-up). The reason for proposing a simultaneous top-down and bottom-up approach contains the assumption that there are inverse motivations among CE stakeholders that need to

be aligned and converged. Government bodies and policymakers advocate for a collective awareness of environmental issues, as well as the social benefit of industrial activities. Therefore, there is a notion of maximizing environmental benefits through strict control of industrial businesses.

2.3. Circular Economy Public Policies

In the past, government initiatives that addressed the foundations of CE, mainly from developed countries, have tried to direct the increasing flows of waste materials back to industry through recycling programs to close the materials loop. Sweden, Germany, and Japan are often cited in surveys as countries that have pushed legislation towards waste reduction and recycling programs [40]. Since the 1990s, various legislations around the world have conceived and implemented complex versions of the CE. Until 2015, China was the only country that adopted the Circular Economy as Law, in a unique perspective of "harmonious society", implementing it as a large-scale industrial ecology. Within Europe, a CE package was proposed in 2014 but was deactivated by the European Commission to prepare a more ambitious and tailor-made package, which should be presented to members throughout 2015 [6].

Despite its European origins, CE has only very recently become prominent at the highest levels of European policymaking. Following concerns about high commodity prices, the European Commission (EC) launched a flagship initiative on resource efficiency, which was first operationalized through the Roadmap to a Resource Efficient Europe [42]. This was followed by the announcement of a series of policy measures collectively known as the Circular Economy Package. It was later replaced by Closing the Loop - An Action Plan for the Circular Economy [11].

In 2015, CE has been adopted as a guiding principle in the policies of many countries, which have approached its implementation in different ways [43]. While China adopted a top-down approach, other countries supported CE development with bottom-up policies [10]. China incorporated CE as a central objective of the 11 and 12 five-year plans for National Economic and Social Development, and in 2009 issued the “Circular Economy Promotion Law” [44], in which CE is defined as " a general term for the activity of reduction, reuse and recycling in production, circulation and consumption" [45]. The European Union published in 2014 the Communication “Towards a circular economy: a zero-waste program for Europe” and in 2015 the Communication “Closing the cycle and an EU action plan for the circular economy”, which is part of the Package [46], [47]. CE is defined by the European institutions as an economy “where the value of products, materials and resources is kept in the economy for as long as possible, and the generation of waste is minimized”.

The CE concept in China was introduced in the 1990s. It had its origins in cleaner production, industrial ecology and ecological modernization thinking and was inspired by examples of implementation in Europe, the United States and Japan. The concept was formally accepted in 2002 by the central government as a new development strategy. China's main national framework for pursuing circularity was the Circular Economy Promotion Act, which entered into force in 2009. Several action plans were followed, which provide more detail for specific sectors and provide clarity on the implementation of the law's provisions of CE promotion. More details on China's political framework have been provided in a few publications in recent years [48].

Despite its European origins, CE has only very recently become prominent at the highest levels of European policymaking. Following concerns about high commodity prices, the EC launched a flagship initiative on resource efficiency, which was first operationalized through the Roadmap to a Resource Efficient Europe [42]. This was followed by the announcement of a series of policy measures collectively known as the Circular Economy Package. It was later replaced by Closing the Loop - An Action Plan for the Circular Economy [11]. In both China and the EU, CE can be seen as an embodiment of ecological modernization - the idea that conflicts between environment and economy can be overcome through technical as well as social innovation (e.g., new business models). There are strong parallels in both regions, reflecting the common underlying conceptual core of the CE idea: Both describe them as a new model for reconciling economic and environmental imperatives. However, within this broad framework, there are differences [38].

3. Methodology

The research is characterized by being descriptive, qualitative, and exploratory in nature due to the selection of literature on the subject. The technique applied was the Systematic Literature Review (SLR), based on the work of

[49] who, to delimit the field to be studied, uses bibliographic research using search technology resources as an instrument to carry out the research. A systematic review can be explained as a research method, or a process for identifying or critically evaluating relevant research, as well as for collecting and analyzing data from that research [50]. The purpose of a systematic review is to identify all empirical evidence that fits the pre-specified inclusion criteria to answer a particular research question or hypothesis [51]. The chosen theme was Public Policies of Circular Economy. Two databases were used. The first was from ScienceDirect and the second was from Web of Science - WoS. The keywords "Circular Economy AND Polic*" were used in the databases and delimited the title field.

After that, we delimited the research base year from 2017 to 2021 and peer-reviewed articles. In the first base, there was also the delimitation of the areas of Social Sciences and Engineering. Thus, in ScienceDirect it resulted in 271 works and in WoS 71 works. The Literature Review had the following steps: (1) search for abstracts, (2) select articles for inclusion through a relevance ranking process, (3) classify and evaluate selected articles, and (4) synthesize and validate [52]. We intend to ensure a broad capture of CE Policy studies and then identify a final set of high-quality and most relevant articles through a consensus screening of abstracts and a selection of articles. Fig. 1 shows the flow used to perform the SRL.

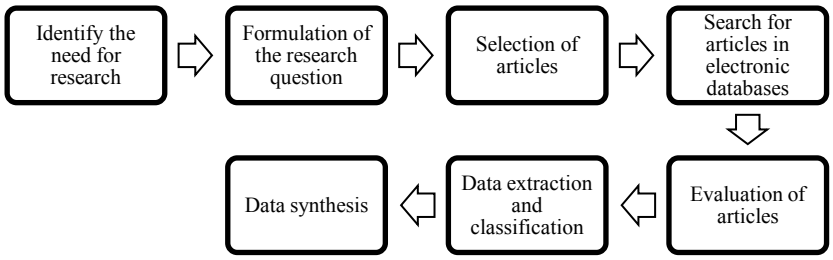


Fig. 1. SLR flow.

4. Results

The articles were selected in September 2021, using the terms mentioned in the previous section in the databases informed. In the first base, the readings of the abstracts were carried out to detect which CE policies, tools and practices were appreciated. For example, if the policy was at the National, Regional or Municipal level, the year of enactment, their objectives, how countries implemented the Laws for the transition to CE. The Table 3 below shows the search result.

Table 3. Article search results.

Base	Refined by	Result	Selected publications
Science Direct	Revised articles from the fields of social sciences or engineering published between 2017 to 2021	271 articles	[53], [54], [55], [56], [57], [58], [59], [60].
Web of Science	Revised articles published between 2017 to 2021	71 articles	[61], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [77], [78], [79], [80], [81].

The review selected 8 articles in SD and 21 articles in WoS. Three articles appeared in the 2 databases, "Assessing environmental sustainability of local waste management policies in Italy from a circular economy perspective. An overview of existing tools"; the "Transitioning China to a circular economy through remanufacturing: A comprehensive review of the management institutions and policy system" and the "Unlocking circular economy for prevention of marine plastic pollution: An exploration of G20 policy and initiatives". We chose to place these articles in the SD database. The areas (region) that were analyzed in the selected articles are Asia (60, Europe (15), Global (8) and South America (1).

Although we selected 30 articles in both databases, one article was inserted in Asia and Europe, which was the "Potential Impacts of the European Union's Circular Economy Policy on Japanese Manufacturers", which dealt with the European Union and Japan. the highest incidence of studies was Europe, representing 51.72%, followed by Asia, which obtained 20.69%. Eight articles talked about policies from various regions, representing 27.59%. Finally, South America had only one document. The policies that were the object of study, from the perspective of mesosystems and/or macrosystems, by the articles selected in the databases, as shown in Table 4.

Table 4. Policies related to CE issue.

Policy	Country
National Solid Waste Policy	Brazil
Circular Economy Promotion Law	China
Green Growth Mission	Colombia
National Strategy for the Circular Economy	Denmark
Waste Management Plan for England	England
A new circular economy plan for a cleaner and more competitive Europe; Circular Economy Package (CEP); EU Green Deal at the regional level; European regional development policies; European Union's Circular Economy Action Plan.	Europe Union
Leading the cycle: Finnish road map to a circular economy 2016-2025	Finland
Circular Economy Roadmap of France: 50 measures for a 100% circular economy	France
National Circular Economy Strategy	Greece
Japan's Circular Economy Policy Framework	Japan
Circular Economy Programme	Netherlands
Delivering Resource Efficiency	Northern Ireland
Roadmap towards a Transition to Circular Economy in Poland	Poland
Green Growth Commitment	Portugal
Strategy for the long-term development of Russia with low greenhouse gas emissions until 2050	Russia
Scotland's Zero Waste Plan	Scotland
Roadmap towards the Circular Economy in Slovenia	Slovenia
The basic Plan for resource circulation; Framework Act on Resource Circulation 2016	South Korea
Galician Circular Economy Strategy	Spain
Towards Zero Waste - One Wales: One Planet	Wales

It appears that some policies in their titles have the term Circular Economy and others have the waste management of garbage. The lowest degree of circularity, according to the 9R framework, is the R9 Recover, where there is incineration with energy recovery. To reach the minimum level, the country must have at least one waste management policy enacted. So much that European policies and strategies have led to a significant reduction in waste and externalities in different EU contexts [64]. The 9R model is a valid tool for Korean companies and policymakers who want to verify its level of circularity, as well as to implement future improvements; "Recovery" is the lowest level, describing the linear economy [70].

In UK countries, most of the prevention terms counted generally referred to the need to reduce waste and reflected the terminology used by EU policy. While all four documents made some reference to activities associated with R0-R2 (Reduce, Reuse, Recycle), there was a much stronger emphasis on these imperatives in the Welsh document (particularly concerning product design and the use of recycled materials), and this was also the only strategy to observe the role of consumers (in buying less). Likewise, only Wales and Scotland included R3 (Reuse), and only Wales included business restoration and refurbishment [68]. Six articles used the R framework to analyze public policies [68]-[71], [80], [81]. Over 15 years from 2005 to 2020, China transformed CE from a concept to a state policy and national development strategy focusing on the 3Rs, with the central government taking the lead.

The transformational path towards achieving CE appears to be difficult for some countries (Russia), while Europe and some eastern countries have managed to advance. Therefore, there is a long way to go for the whole world to reach the desired welfare state by the sustainable development paradigm. However, if we want to save our planet, the achievement of CE is necessary for all of humanity [71]. Two articles talked about the importance of the Quintuple Helix Model – QHM [61,] [66]. Where the government should establish incentives for both businesses and consumers; companies must rethink and change their business models (industrial symbiosis, remanufacturing or product-service systems - PSS), along with setting strategic goals to close the loops and achieve higher levels of materials and energy use efficiency. Likewise, it implies the development of new and radical CE eco-innovations and the raising of social awareness to change consumer and producer behavior towards a more collaborative economy

5. Conclusion

The purpose of this article was to raise which public policies were studied in the period 2017 to 2021 and which tools were used to analyze the policies. The study identified an increase in initiatives to seek circularity through the formulation of public policies. Many countries are demanding more sustainable production processes, with an emphasis on energy savings and fewer carbon emissions. For this, a waste treatment policy is an initial step to seek greater degrees of circularity. For example, the 2021 survey by [67] identified some sample Circular Economy regulatory policy packages (CERPPs), including examples from China, Finland, Denmark, Netherlands, Portugal, Austria, Slovenia, Greece, France, and South Korea. The influence of Circular Economy principles on national strategic direction is a recent phenomenon.

Despite being a recent phenomenon, the most used tool to study these policies was the Framework 9R. Because with it, one has an idea of which initial stage the country is at, and which stage can be sought in the future. China was the first country to implement a specific Public Policy for Circular Economy focusing on the 3Rs, with the central government taking the lead [80]. Thus, to unlock the potential of CE in cities and regions implies going beyond the exclusively technical aspects. It requires the implementation of the necessary governance to create incentives (legal, financial), stimulates innovation (technical, social, institutional) and generates information (data, knowledge, capabilities) [61].

CE is a paradigm that offers an opportunity to rethink existing economic systems to increase resource efficiency, turn waste into resources, and implement new consumption and production approaches based on rent and lease instead of ownership. These actions should ultimately make economic systems less vulnerable, more sustainable, and competitive at the micro-level, the eco-industrial park level, and the macro level. The contribution of this work was to show that countries should be concerned with their Circular Economy legislation to adapt to this new way of producing. In addition to showing which tools can be used to initiate the circularity process.

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