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Transitioning towards a circular economy under a multicriteria and the new institutional theory perspective: A comparison between Italy and Brazil

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ABSTRACT

The obligations arising from legislation and other instruments affect the macro-level decision-making related to the transition toward a circular economy (CE), which is a multifaceted topic since it tries to aggregate the interests of different stakeholders. In this context, this paper aims to analyse the current policies, strategies and initiatives related to the CE transition from a multicriteria perspective and under the lens of NIT (New Institutional Theory). This is the first approach that analyses which CE strategies and related practices boost the transition from a macro-level perspective, using a multicriteria method and considering developed and emerging economies. For this reason, this paper can be helpful for researchers and practitioners involved in implementing strategy and policymaking aimed at the transition toward a CE. It also contributes to the discussion on the global transition to the CE by identifying differences and similarities between countries. The proposed methodology has been applied to compare the realities in Italy and Brazil. The perceptions of several stakeholders from the two countries have been gathered through a questionnaire to evaluate numerous strategies against several social, environmental, economic, and technical criteria. The main results are: Italy presents a proactive behaviour, a higher level of institutionalisation, and a coercive isomorphism related to European regulations and strategies. In contrast, Brazil has reactive behaviour, a lower level of institutionalisation, and is impelled by mimetic isomorphism. Although it is possible to observe several advances in the last years in Brazil, the transition to a CE is still in the early stages compared to Italy.

1. Introduction

Considering the scarcity of resources and the consequent social and environmental impacts resulting from the present linear economy, new models of production and consumption covering the social, environmental and economic dimensions of sustainability have appeared. The circular economy (CE) is one of these models. However, even if issues related to natural resource scrcity, environmental preservation, waste management, and reverse logistics have obtained even more attention worldwide, the transition to CE is still characterized by several open challenges (Oliveira et al., 2021; Bouzon et al., 2015; Ferri et al., 2015). In particular, although several recent studies on CE have been published (Merli et al., 2018; Guarnieri and Kremer, 2019; Mhatre et al., 2020; Morales and Zartha Sossa, 2020), some gaps persist (Korhonen et al., 2018) in terms of:

(i) approaching the macro-level (countries, regions, and cities); (ii) investigation into how the stakeholders perceive the transition to CE and how the roles of partners is essential; and (iii) involving developing countries, also considering the regional differences, to understand what strategies can be adopted to boost the CE transition. The highlighted points are described as follows:

(i) To enable an effective transition toward a CE and a low-carbon economy, at the macro political environment, it is possible to

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establish the direction to enable the private sector to implement circular innovation. In the context of macro transition, bottom-up strategies implemented by federal and regional governments create a conducive environment for the implementation of meso and micro-level strategies. Thus, bottom-up strategies can generate a favourable environmentcombining economic regeneration, better societal outcomes, and climate change ambitions to boost meso and micro strategies. One example of an instrument that aims to achieve this objective is the Green Deal in Europe, which is pressing member countries of European countries to adopt several changes in their political environments, starting internal movements toward the transition in each specific country. In the academic literature, several studies approached CE transition. Guarnieri et al. (2020) analysed Brazil's shift towards a CE, considering a recent sectoral agreement related to the packaging sector. Sani et al. (2021) analysed the transition to a CE in Emilia-Romagna Region (Italy), considering technological, legal-regulatory and financial points of view through a case study. In general, the main focus of these studies is on a micro-level transition to a CE. At the meso-level, Japan is prominent, considering the industrial eco-parks (Guarnieri and Kremer, 2019; Roos Lindgreen et al., 2020; Cerqueira-Streit et al., 2021). However, studies regarding the macro-level (countries, regions and cities) are still scarce. Moreover, no study consolidated organisation theories lens to discuss the results.

(ii) According to Silva and Morais (2021), who analysed a craft brewery in a North Eastern Brazilian city, considering the perspectives of several stakeholders in the transition to a circular model is fundamental. In the República Portuguesa analysis (2017), it emerges that the involvement of top-down and bottom-up stakeholders is critical. Groups of stakeholders have been constituted to stimulate the discussion on the transition toward a CE (United Nations Environment Programme – UNEP, 2022). van Langen et al. (2021) focused on the perception of CE by some stakeholders, such as administrators, economists and academics. Lüdeke-Freund et al. (2019) highlighted the importance of considering different actors' perspectives in Circular Economy Business Models - CEBMs starting from the consumers.

(iii) In countries such as China, Japan and European Union (EU), the CE is already part of discussions. Undoubtedly, the emergence of the global climatic crisis and the role of non-governmental organisations, such as the Ellen MacArthur foundation acting as lobbyists, contributed to this. Still, also, the increasing interest by managers from public and private organisations, researchers, and legislators has boosted many changes in the production and consumption patterns aimed at environmental protection and resources for future generations (Reike et al., 2018; Ibanescu et al., 2018). In contrast, in developing countries, except for China (Bleischwitz et al., 2022), practices and policies related to CE are still incipient (Sasaki and Araki, 2013; Abdulrahman et al., 2014; Bouzon et al., 2015; Ferri et al., 2015). Understanding CE's similarities and disparities in various geographies can also speed up the global transition to CE (Ghisellini et al., 2016; Agyemang et al., 2019). More recently, Cramer (2022) conducted a study comparing the governance of the CE in sixteen different countries. The author argued that two forms of governance are required to deal with the transition toward a CE, public and network governance, and proposed models for developing CE considering diverse socio-cultural and political contexts.

Nevertheless, most existing studies often refer to developed countries, mainly EU countries, while China is the only case of developing countries.

Since strategies and related practices make the transition from a linear to a circular economy feasible in macro-level environments. Whetherthe perceptions of all stakeholders are considered, it is possible to identify the priorities of the countries implementing them. and Thus it is assumed that some isomorphic mechanisms and environments in which countries are situated can also enable this transition or not. The research questions of this paper are three-fold:

RQ1. - Which are the main strategies worldwide, that enable the transition towards the circular economy at the macro-level and which are the technical, social, environmental and economic dimensions they should meet?

RQ2. – How do different countries prioritize the strategies aimed at circular economy transition?

RQ3. – Did these countries prioritize more proactive or reactive strategies in the transition process?

Considering this context, this paper proposes a methodology to respond to the three research questions previously informed. Then, it is possible to analyse the current policies, strategies and initiatives related to the CE transition in Brazil and Italy, comparing the two realities from a multicriteria perspective and under the lens of the New Institutional Theory (NIT). This paper, differently from previous literature (Cramer, 2022), does not focus on governance structures and sociocultural and political contexts. Still, despite the limitations of the majority of responses from the Academy and Consultancy, it gathers the opinion of several stakeholders involved in the transition process from several acting sectors. These stakeholders analysed to the 24 strategies adopted in their countries, aggregating them in a multicriteria perspective, which is multidimensional by nature.

This paperdoes not have the purpose to generalise the findings. However, it provides a sample of the results derived by the proposed methodology, focused on the prioritisation of CE transition strategies and public policies for the regions/countries, deeply analysed under the lens of NIT. The authors gathered the perceptions of 96 stakeholders from Italy and Brazil through a questionnaire to evaluate the 24 identified strategies against 10 criteria. The criteria are related to social (Adaptability to current legislation, Social acceptance, and Jobs creation), environmental (Reduction of incorrect disposal of waste and Prevention of the environment), economic (Investment cost and Operational and Maintenance Cost), and technical (Technical difficulty, Adaptability to local conditions, and Functionality) dimensions. The technical dimension was included, considering that although sustainability should be a priority for countries, regions and cities, we should assess the feasibility of implementing and maintaining some technical strategies (Fernandes et al., 2021).

The multicriteria decision aid approach, precisely the Electre IV method, has been used to generate a ranking based on prioritising the strategies. The lens of NIT, was chosen to discuss the results considering that organisations are inserted in social and political environments, which can urge them to assume similar practices. Based on the NIT, generating a more favourable environment at the macro-level is supposed to enable the adoption of strategies related to the CE at the meso and micro-level (cities, organisations). The choice by Brazil and Italy occurred considering their differences in the stages of the transition. The Green Deal has been implemented in Europe, which implies changes for all 27 member countries, in which Italy is covered. On the other side, Brazil is part of Mercosul, which has no policy related to the CE yet. Comparing a developed and a developing country related to differences to be considered by the stakeholders when conducting the strategies to transition.

The contributions of this paper are twofold: i) The gathering of information related to the main strategies aimed at the transition towards a CE that can be used in several countries, and ii) The analysis of the practices, strategies and initiatives of the circular economy transition in Italy and Brazil under a multicriteria perspective, which can be helpful for decision-makers and policymakers involved in the discussions and initiatives related to the transition towards a more resilient, circular, and low-carbon economic model.

This paper is organised as follows. Section 2 presents a theoretical background on CE transition. Section 3 describes methods, and technical procedures. Section 4 presents the results. Section 5 discusses the findings, and section 6 concludes the paper.

2. Contextual background

2.1. Circular economy in the international context

The CE has received increasing attention in the last decades; consequently, several countries are promoting the circular model as a means of ecological and social transition of the economy and, for this purpose, have implemented policies and guidelines, besides creating some related legislation (Reike et al., 2018).

The Ellen MacArthur Foundation has worked a lot to disseminate the concept of CE, which was very important in the EU, to draw the attention of actors and politicians. Thereby, the Foundation influenced governments and intergovernmental agencies at the local, regional, national and international levels (Geissdoerfer et al., 2017).

The CE practices, based on the recognition of the scarcity and finitude of resources and the proposition of new production and consumption patterns, are able to bring environmental, social and economic benefits. These benefits are aligned with the proposals of the United Nations Agenda 2030 for Sustainable Development, primarily related to Sustainable Development Goals - SDGs 9 and 12. SDGs 9 and 12 aim to enable resilient infrastructures, promote inclusive and sustainable industrialisation, foster innovation, and ensure sustainable production and consumption patterns (United Nations, 2015). However, transitioning to a new economic model is not a fast and easy process; instead, it requires a systemic and cross-sectional approach to various components and stakeholders. Thus, it should combine top-down (Government) and bottom-up (users, businesses, companies, administrations) stakeholders (República Portuguesa, 2017).

After the publication of a series of materials, including a book by Webster (2021) and reports (EMF, 2017, 2013a, 2013b), the Ellen MacArthur Foundation acted as a collaborative hub for businesses, policymakers, and scholars (Geissdoerfer et al., 2017). For example, Latin America and Caribbean countries have also the Ellen MacArthur Foundation with other institutions, such as the strategic partners in the brand-new (launched in February 2021) coalition for the transition to a CE. The coalition has among the partners non-governmental organisations, research institutes, academia, intergovernmental organisations, regional and international organisations, development banks and UN agencies (Circular Economy Coalition Latin America and the Caribbean, 2022). Other well-known lobbying groups for the environment, such as World Wildlife Fund - WWF and Greenpeace, have also exerted some pressure on government agencies and companies.

EU has constantly promoted actions to aid the transition (Moraga et al., 2019). The European Commission adopted an action plan in 2015 to "accelerate the transition towards a CE, boost global competitiveness, promote sustainable economic growth and generate new jobs" (European Comission, 2022). The action plan defined 54 measures for this purpose, and the European Circular Economy Stakeholder Platform – ECESP has had annual meetings since 2017 (European Comission, 2022). In March 2020, a new Circular Economy Action Plan was adopted as one of the main elements of the European Green Deal for sustainable growth (European Comission, 2022).

In particular, as mentioned previously, Italy has created the ICESP, mirroring the European initiative. ICESP was designed to enable initiatives, experiences, and the discussion of critical issues and perspectives and to promote specific dedicated actions related to the transition towards a CE. It has set up six working groups, which meet periodically to draw up reviews, technical reports and studies on the topics covered in the course of their activities, as well as to map out good CE practices in connection with European Circular Economy Stakeholder Platform - ECESP (ICESP, 2020).

The primary public policy instruments related to a CE that has been adopted in the world consist of i) Regulatory instruments; ii) Tax actions; iii) Measures to support research, education and information; iv) Collaborative platforms; v) Financial aid; vi) Investment in infrastructure, and vii) Business grants (Confederation of Brazilian Industries – CBI, 2019).

Although the public awareness related to the CE in the Southern Region of Poland (Malopolska) is high, more than 80% of respondents consider the full implementation and transition of the CE still need strong efforts in a long-term perspective (Smol et al., 2018). Vanhamaki et al. (2019) studied the macro-level transition CE of several countries in Europe. They found that actions implemented in national and regional strategies play an essential role, even considering their difference, scale, and accuracy. Considering three groups of stakeholders (researchers, administrators and economists) mainly from Naples, Italy (Parthenope), van Langen et al. (2021) found that the CE is still far from its implementation and transition and that it will always coexist with the linear economy for a long-time.

The CE transition can be analysed at three levels aimed at reaching sustainable development (environmental quality, economic prosperity and social equity): (i) macro: global, regional; (ii) meso eco-industrial parks; and (iii) micro: company, product, citizens and consumers (Kirchherr et al., 2017). The macro-level efforts refer to policy changes on national and regional levels and the industry sector as a whole, which is the focus of this study. It is necessary to adjust the industrial composition and structure of the entire economy, according to Kirchherr et al. (2017). It involves economic, political, cultural, and technological factors, also considering the business opportunities and threats. When national and regional strategies towards the macro-level transition of several countries from Europe were analysed, national and regional policies and their implementations are diverse considering scale and accuracy. They also pointed out that CE strategies and mechanisms should be widely understood to allow that CE to become an essential piece of national and regional policies. At the same time, actions on the different scales are needed in the regions, considering their particularities (Vanhamaki et al., 2019).

From those mentioned above, it is possible to infer that we will hardly have a full CE worldwide shortly, and efforts are needed to make this process feasible. These efforts can be understood as strategies and related practices to enable the transition, firstly at the macro-level, then at the meso and micro-level, requiring the consideration of the interests of several stakeholders, which sometimes have conflicting interests to aggregate. The strategies developed countries adopt can serve as an example for developing countries to outline a guiding system to achieve the CE transition. However, regional differences and development should be taken into account. Several countries are preparing and implementing initiatives toward the CE transition. Some present more proactive and disruptive strategies related to the complete changes associated with consumption, production and urban planning. On the other hand, other countries have a more reactive approach aimed at sorting out the consequences of the linear economy, focusing on waste management, recycling and others. Moreover, some recognised the CE in legislation related to waste, water and energy. In contrast, others defined some strategies and planned to prepare stakeholders and several sectors of society to implement circular initiatives (Guarnieri et al., 2020).

It is possible to observe that economic groups have urged the member countries to implement some changes, which is the case of the European Union, as mentioned by Cramer (2022). These differences can conduct different levels of institutionalisation of the CE. The main strategies for a CE worldwide, analysing guidelines, legislation, Action plans, directives, scientific papers, reports and other documents, can be seen in Appendix 1, based on previous studies, we can categorise the following strategies as strategic: eco-innovation and eco-design; eco-cities or circular cities; industrial symbiosis; sustainable product policy; partnerships with organisations of R&D; sharing economy; sustainable

or green purchasing; energy efficiency; closed-loop; incentives aimed to small and medium companies; financial incentives and support and fiscal measures (Ellen MacArthur Foundation, 2013, 2015; Amui et al., 2017; Sehnem et al., 2019). These strategies alter how commodities are produced and consumed, businesses are managed, and cities are planned. It involves capabilities related to voluntary sustainability initiatives (Amui et al., 2017). Furthermore, it necessitates the awareness of all stakeholders involved to change the idea and the logic with which products are designed. Moreover, it requires a new planning of the purchasing of the component materials, the way of doing business and the origin of the suppliers and materials (Micro and Meso-level), as well as a complete restructuring of the urban planning in the cities, regions, and countries (macro-level).

On the other hand, reactive strategies aim to resolve the current issues caused by the linear production model based on the extract-manufacture-consume-discard concept. Landfills and structures to deal with waste generated at the end of the process are required. In the medium and short-term, strategies including waste management directives, water reuse, food wastes and losses, construction & demolition (C&D) waste management, reverse logistics, socio-productive inclusion (vulnerable population), and creation of jobs are used (Ellen MacArthur Foundation, 2013; 2015; Guarnieri et al., 2020a, 2020b).

2.2. Context of the main initiatives on circular economy transition in Italy and Brazil

Regarding the main differences between the two countries analysed in this study, we consider it essential to present an overview of the main initiatives related to the circular economy in Italy and Brazil.

The main initiatives of the circular economy in Italy, gathered by the Enea Working Group (2019), were presented in the Report on Circular Economy Italy published in 2019 (Guarnieri et al., 2020). The strategies are mainly related to Production, Energy, Index of total socio-economic benefits, Waste management, Eco-innovation, Sharing economy, Textile/Fashion industry, Electronics industry, Investments and employment.

Sani et al. (2021) studied the efforts related to the transition toward a circular economy in the Italian region of Emilia-Romagna, the first region to enact legislation pertaining to the circular economy. The study considered technological, legal–regulatory, and financial points of view under a market orientation and had as unit analysis the ART-ER, entitled "*Accelerare la transizione verso l'economia circolare in Emilia-Romagna: Uno studio sullo stato dell'arte, le competenze e i bisogni tecnologici e finanziari*". The authors pointed out the needs of productive sectors in the Emilia-Romagna Region and the initiatives and areas of interest related to the circular economy. The study also highlighted that knowledge and awareness of the benefits of the circular economy transition are essential to boost this process. The existing barriers and the demand for investments, mainly in the Plastic and the Textile sectors were also highlighted in this study.

In the case of Brazil, the main initiatives are related to sectoral agreements in action, which can, in the long term, enable the circular economy transition. The ongoing sectoral agreements are Plastic Packaging of Lubricating Oils, Sodium Vapor Fluorescent Lamps and Mercury and Mixed Light, General packaging, Electronics products and their components, and Medicines (Guarnieri et al., 2020). However, the initiatives are still at an earlier stage; it is impossible to present consolidated results, as well is a scarcity of reliable and publicised data reporting the results. Guarnieri et al. (2016) studied the sectoral agreement of electronic waste and highlighted that there are still many barriers to implementing the concept, mainly related to culture, environmental education and awareness and lack of incentives in terms of taxes from the Government and infrastructure.

Also, Guarnieri, Cerqueira-Streit and Batista (2020) conducted a study focused on the sectorial agreement of general packaging. The results demonstrated that the sectorial agreement considered circular economycircular economy principles, with reverse logistics as the main instrument. Moreover, the authors recognised the limitations of their study, which is mainly related to the recycling approach of the circular economy, enabled by the Reverse Logistics systems and sectoral agreements.

The Confederation of Brazilian Industries – CBI, in 2019, evaluated the knowledge and implementation of circular economy (CE) concepts in Brazilian Industries. According to Confederation of Brazilian Industries – CBI (2019), 76.4% of the country's industries develop some circular economy activity, considering CE as a modality that encompasses actions aimed at increasing the useful life of products and materials from the most efficient use of natural resources. 60% of industries understand that CE practices can contribute to job creation in the company or the sector's production chain. However, 73% believe that the transition to CE should be a shared responsibility between Government, consumers and the private sector (Confederation of Brazilian Industries – CBI, 2019). Considering the results, it is possible to verify that Brazilian Industries are more centrecentred on CE-related reactive strategies.

2.3. New institutional theory (NIT)

According to the New Institutional Theory (NIT), organisations are inserted in social and political environments, urging them to assume similar practices, such as the transition towards implementing the CE concept. These practices are often reflections or responses to rules, beliefs and conventions incorporated into the wider environment Powell and Colyvas (2007). A central idea at NIT is the isomorphism, which deals with influencing the organisation's environment (DiMaggio and Powell, 1983).

There are primarily three mechanisms to differentiate isomorphic institutional changes, according to DiMaggio and Powell (1983), which are: i) coercive isomorphism: which derives from political influences that force organisations to adopt measures or change behaviours; ii) mimetic isomorphism: the tendency to homogenisation arising from standardised responses to uncertainty, usually considering the best practices and, iii) normative isomorphism: arises from professionalisation projects, motivated to respect obligations arising and charged by society. However, it is essential to consider that these three types of mechanisms are not pure; they are not usually exclusive but interactive.

The new institutionalism in organisational analysis has sociological characteristics in the view of some authors. In the sociological perspective of the new institutionalism, according to DiMaggio (1991), how the action is structured stands out and affirms that order is possible through standard rules that simultaneously limit the tendency and ability of the actors to optimise systems and, in turn, favour some groups whose interests are guaranteed by the prevailing sanctions and rewards. In contrast, institutionalisation can represent a particular set of social reproductive processes. In general, while the institution represents order or social standard that has reached a particular state or property, institutionalisation indicates the process of achieving it (Greenwood and Hinings, 1996).

Considering the perspective of the new institutionalism, the environment penetrates the organisation, creating the lens through which the actors contemplate the world and the categories of structure, action and thought (DiMaggio, 1991). For example, Scott and Meyer (1994) provided more explicit criteria for distinguishing these two types of environments. Technical environments manifest production control over organisations which seek efficiency. In institutional settings, organisations seek legitimacy and are rewarded for establishing structures and processes adapted to the environment. In this sense, the technical environment is characterised by the exchange of goods and services, while the institutional environment leads to the establishment and diffusion of performance standards necessary to achieve organisational legitimacy (DiMaggio and Powell, 1983; Scott and Meyer, 1994).

Organisations seeking legitimacy and social acceptance seek to adapt their actions, structures, and practices to socially correct standards

(Scott, 1991). However, in some situations, organisational responses to institutional pressures show a dissociation of formal policies from daily practices of the organisation's internal technical core (Meyer and Rowan, 1977). According to these authors, this dissociation between politics and organisational practices is called decoupling.

This study analyses the current policies, strategies and initiatives related to the CE transition, comparing the realities in Brazil and Italy from a multicriteria perspective and under the lens of NIT through the isomorphism mechanisms. institutionalisation. Other theories, such as the stakeholder's theory (Freeman and Reed, 1983), are often used as an accessory theory to explain an organisation's relationship with its environment. This theory could be used in the context of the transition to a circular economy at micro and meso levels to explain organisations' behaviour and the level of influence of the stakeholders in some decisions or policies, which can be a venue for further studies.

In section 4, the Italian and Brazilian prioritisation of strategies toward the circular economy transition will be analysed from the perspective of NIT. We specifically focused on the three mechanisms through which isomorphic institutional changes occur, as proposed by DiMaggio and Powell (1983). By analysing the circular initiative based on a theory, we intend to fill the gap pointed out by Korhonen et al. (2018).

3. Methods and technical procedures

The proposed method is classified as applied, descriptive, and quantitative. The technical procedures used in this study include a literature review, elicitation process, and multicriteria modelling. The elicitation and multicriteria modelling approaches from the Operational Research field are commonly used in Engineering (Bertrand and Fransoo, 2002; Guarnieri and Trojan, 2019). This study uses a model with three steps, as shown in Fig. 1.

The first step comprehended a literature review based on secondary and scientific materials to identify the main strategies for facilitating the global transition to the circular economy and the criteria for evaluating these strategies using a multicriteria decision aid perspective. We used criteria to include and exclude materials: a) The search mechanism Google Scholar, which recovers several types of educational materials (conference papers, journal papers, thesis, editorials, books and chapters and grey literature) from several scientifical databases. We also considered European Union websites and government websites to have access to legislations and plans of action by countries; b) we did not limit the type of materials, so we considered conference and journal papers, books and chapters, legislation, plans of action and grey literature for our analysis; c) we did not limit the period of the beginning of publications, we considered materials published until March 2021, when we finished the search; d) the keywords used for the search was "circular economy" AND transition OR strategies OR practices; e) the language considered were Portuguese (Brazil and Portugal) and English; e) we

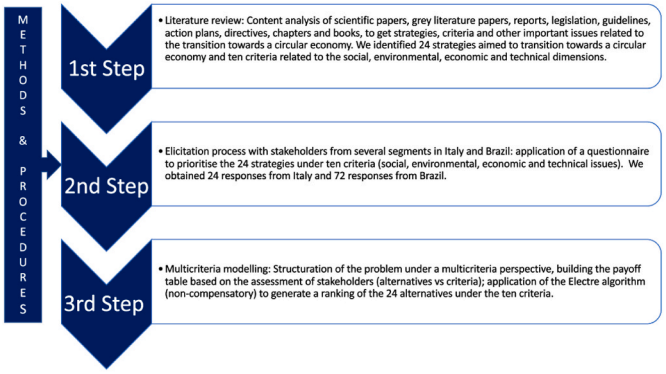


Fig. 1. Structure of the study.

eliminated materials not adherent with these criteria, and those which presented dissociated keywords, such as circular but not the economy, circular economy without strategies OR practices OR transition. We analysed the materials and elaborated the Appendix 1. We categorised the strategies from this appendix in Table 1 (section 4.2) and Table 2 (Section 4.3). The analysis of materials was carried out following the Bardin (1977) protocol for categorical content analysis, which includes three steps: (i) pre-analysis, (ii) exploration of the material, and (iii) treatment of results, inference, and interpretation. From the literature, we gathered 24 strategies, listed in Table 1 (section 4.2) and ten criteria, listed in Table 2 (section 4.3). The strategies and criteria based on the development of the questionnaire in the second step are as follows.

In the second step, we developed a questionnaire based on the strategies and criteria gathered from literature (step 1). In the questionnaire we used ordinal scales from 1 to 5, with 1 being the lowest degree of evaluation and 5 representing the highest level of assessment. This scale enables the elicitation process (asking decision-makers to express their preferences). Traditional elicitation techniques include data collection such as questionnaires and surveys, interviews, and analysis of existing documentation (Nuseibeh and Easterbrook, 2000). The ordinal scale was used to rank and order data without determining the degree of variance between the levels. We proposed the scale to assess the 24 alternatives under the same set of ten criteria (Tables 1 and 2).

In the third step, we applied the MCDA algorithm to rank the strategies prioritised by stakeholders from Italy and Brazil to transition to the circular economy, considering the environmental, social, economic, and technical criteria. We used the *É Limination et Choix Traduisant la Realité* - ELECTRE IV. This method from the outranking approach considers non-compensatory rationality, meaning that trade-offs between criteria are not accepted (Guarnieri and Trojan, 2019; Guarnieri, 2015). In decision problems involving sustainability dimensions, it is not recommended that a bad performance in the environmental criteria is compensated by a good performance in the economic measures, requiring balanced solutions (Guarnieri and Trojan, 2019).

The questionnaire was developed based on the literature review (24 strategies and ten criteria) to collect data through elicitation. We validated the questionnaire by nine Circular Economy experts in Brazil, Italy and the United Kingdom. The experts hold master's and doctorate degrees and work as professors and consultants in the areas of Operations, Sustainability and Circular Economy. The questionnaire is available in three languages (Brazilian Portuguese, Italian and English). The experts evaluated the strategies' clarity, readability, relevance and scale items. Experts' recommendations were incorporated into a revised and refined version of the questionnaire to refine the instrument.

One of some experts' suggestions was to reduce the number of strategies from 24 to less because of the questionnaire's size, which could demotivate respondents according to him. However, as we intended to analyse which of the 24 strategies would be prioritised by each respondent from the countries studied, we considered it arbitrary to exclude an alternative. Thus, we decided to maintain the questionnaire with 24 alternatives evaluated by the same ten criteria. Besides that, being arbitrary to exclude any strategy from those gathered from the literature, maintaining all of them allowed us to prepare a payoff matrix (alternatives *vs* criteria) to apply the MCDA method. Future studies may suggest that the best-ranked options are the focus of further studies or that two scales be developed, one intended to cover the more proactive strategies and the other the reactive ones. Posteriorly, the questionnaire was widely disseminated via social media platforms (LinkedIn, Instagram, Facebook, ResearchGate, WhatsApp, and e-mail), inviting stakeholders from several segments to participate using snowball sampling. Data was collected entirely over the internet from September 2020 to May 2021.

The questionnaire data collection captured the experts' opinions in both countries. A misunderstanding of concepts impacted the primary and secondary sectors, with fewer respondents according to the sample

Table 1
Main strategies (alternatives) bottom-up to enable the transition to a circular economy.

Actions/Strategies	Description	Source
Inter-firm collaboration	Arrange collaboration and business relations. Rules are needed because interdependencies increase and become more specific compared to collaboration in linear systems.	Sanz-Menéndez, García and Alvárez (1998); Fischer and Pascucci (2017); OECD (2021); Guarnieri and Gomes (2019).
Waste Management Directives	Provides a general framework of waste management requirements and sets the primary waste management definitions, identifying actors, responsibilities, rules, guidelines, principles, instruments and other relevant information.	Brazil (2010); EU Union (2015); EU Union COM (2015); ICESP (2018); Nuñez-Cacho et al. (2018); Organisation for Economic Co-operation & Development—OECD (2021); EU Comission (2022).
Reverse Logistics	"Process of moving goods from their typical final destination to recapture value, or proper disposal'' (Rogers et al., 1999, p.2)	Brazil (2010); Julianelli et al. (2020).
Closed loop (Reuse, Repair, Reconditioning, Remanufacturing, Recycling)	Reusing goods means extending the utilisation period through designing long-life goods and introducing service loops to extend an existing product's life, including reuse, repair, reconditioning, technical upgrading, and a combination. The result of the reuse of goods is a slowdown of the flow of materials from production to recycling (Stahel et al., 2008).	McDonough and Braungart (2013); European Commission (2015, 2019, 2020); Jurgilevich et al. (2016); Elia et al. (2017); Bouzon et al. (2015); Diekmann and Germelmann (2021); Bockholt et al. (2020); Julianelli et al. (2020).
Sectorial Agreements	Sectorial agreements are acts of a contractual nature, signed between the Government and the value chains (manufacturers, importers, distributors or traders), aiming at the implementation of shared responsibility for the product's life cycle. Its main objective is to guarantee the competitiveness of an economic sector to reduce the values and benefits sharing (Brazil, 2010).	Brazil (2010); Fischer and Pascucci (2017); European Comission (2015, 2019, 2020); ICESP (2018).
Social inclusion	Social inclusion is the act of including in society groups historically excluded from the socialisation process, given their race, colour, sex, language, religion, political or other opinions. As well as those in situations of socioeconomic vulnerability, such as homeless people, immigrants and low-income people (Universal Declaration of Human Rights, 1948).	Brazil (2010); Organisation for Economic Co-operation & Development—OECD (2021); Diekmann and Germelmann (2021); European Comission (2019, 2020).
Financial incentives and Support and Fiscal measures	Financial incentives can be considered monetary rewards to promote the take-back and recycling activities, in general, aimed at consumers. Financial support refers to grants, subsidies, direct and Indirect investments, and public-private partnerships through which city governments can enable city development towards a circular economy. The funds may draw on existing budgets and revenues or be raised in addition and specifically to support circular economy initiatives. Fiscal measures, such as taxes, penalties, and charges, can help incentivise or discourage behaviours (EMF, 2019).	Stahel et al. (2008); Fischer and Pascucci (2017); Climate-KIC (2018); EMF, 2019); Diekmann and Germelmann (2021); European Comission (2020); OECD (2021).
Stakeholders involvement	Stakeholder engagement is crucial to developing effective circular economy roadmaps and policy strategies (EMF, 2019).	Stahel et al. (2008); Brazil (2010); EU Union COM (2015); Jurgilevich et al. (2016); ICESP (2018); Organisation for Economic Co-operation & Development—OECD (2021); EMF (2019); Diekmann and Germelmann (2021); European Comission (2020).
Industrial symbiosis	A process-orientated solution, concerned with using residual outputs from one process as feedstock for another process, benefits from the geographical proximity of businesses (Bocken et al., 2016).	Bocken et al., 2016; Organisation for Economic Co-operation & Development—OECD (2021); European Comission (2020).
Partnerships with research and Industry	Partnerships can help build capacity for innovation and the scaling of circular economy practices to expand access to various contributors who otherwise risk being excluded from the innovation process. (EMF, 2019; Organisation for Economic Co-operation & Development—OECD, 2021).	Organisation for Economic Co-operation & Development—OECD (2021); Guarnieri and Gomes (2019); European Comission (2020).
Circular economy roadmap	Roadmaps can provide overarching direction by setting strategic goals and a path and informing the development of other policies, standards, or material and waste classifications and regulations (EMF, 2019).	EMF (2019).
Ecocities	Livable, resilient cities that are regenerative by design. By embedding circular economy principles into urban policy levers, cities can change the use and management of materials in cities. Urban priorities around access to housing, mobility, and economic development can also be met in a way that supports prosperity, jobs, health, and communities. Changes to material choices, use and	United Nations Environment Programme – UNEP (2019)

(continued on next page)

Table 1 (*continued*)

Actions/Strategies	Description	Source
	management, can also open up local production opportunities (EMF, 2019).	
Incentives to SMEs	Small and medium-sized enterprises (SMEs) and entrepreneurship are economical and social well-being drivers. SMEs are vital for delivering sustainable and inclusive economic growth, representing 99% of all businesses, generating about 60% of employment and between 50% and 60% of value added in the OECD area (Organisation for Economic Co-operation & Development—OECD, 2021). Examples: Incentives for SMEs to hire or buy expertise through mentor networks; financial assistance programme for SMEs, cross-industry SME market development programme, expanding assistance to SME exporters and facilitating contacts between SMEs and overseas buyers; online and physical desks for helping SMEs; unique lines of credits to SMEs; calls of public Procurement aimed to SMEs, incubator Programme; reduction of taxes rate, etc. (Organisation for Economic Co-operation & Development—OECD, 2021).	Organisation for Economic Co-operation & Development—OECD (2021); Guarnieri and Gomes (2019); European Comission (2020).
Digitalisation	Digitalisation can enhance the circular economy's transparency, efficiency, and convenience. Digital technologies will be instrumental in developing the circular business as they enable better monitoring of product life-cycle and consumption (e.g automation, remote sensing, big data), brokering goods, materials, and related services (e.g. online marketplaces), and peer-to-peer sharing leg, private car and home-sharing), delivering utility virtually (e.g. books) or reducing the use of old materials (e g. 3D printing) (Organisation for Economic Co-operation & Development—OECD, 2021)	Stahel et al. (2008); Climate-KIC (2018); EMF (2019); European Comission (2020); Organisation for Economic Co-operation & Development—OECD (2021); Julianelli et al. (2020).
Product Policy	Widen the Ecodesign Directive beyond energy-related products to make the Ecodesign framework applicable to the broadest possible range of products and deliver on circularity.	European Comission (2020).

Table 1 (*continued*)

Actions/Strategies	Description	Source
Green or Sustainable Procurement	The inclusion of circular economy principles and requirements in Green Procurement and/or Sustainable Procurement, mainly in the public context.	EMF (2019); Guarnieri and Gomes (2019); European Comission (2020).
Regulation	Legislation and regulation are a core domain of Government and can play an essential role in shaping markets, influencing behaviour, and removing barriers that inhibit progress (EMF, 2019). Regulations can affect the transition from linear to circular for a specific material or end-of-life product (Diekmann and Germelmann, 2021).	EMF (2019); European Comission (2020); Diekmann and Germelmann (2021).
Getting value out of biomass	Biomass refers to the mass of living organisms, including plants, animals, and microorganisms, or, from a biochemical perspective, cellulose, lignin, sugars, fats, and proteins. Biomass includes both the above- and below-ground tissues of plants, for example, leaves, twigs, branches, boles, and roots of trees and rhizomes of grasses. Biomass has been used as a fuel source (Hsu and Hu, 2009).	European Comission (2020).
Construction & demolition (C&D) waste	Proper management of C&D waste and recycled materials – including the correct handling of hazardous waste - can have significant benefits in terms of sustainability and quality of life (European Comission, 2020).	Stahel et al. (2008); Nuñez-Cacho et al. (2018); EMF (2019); European Comission (2020).
Water reuse	The potential role of treated wastewater reuse as an alternative source of water supply is now well acknowledged and embedded within international, European and national strategies. UN Sustainable Development Goal on Water (SDG 6) targets a substantial increase in global recycling and safe reuse by 2030 (European Comission, 2020).	Elia et al. (2017); Nuñez-Cacho et al. (2018); EMF (2019); European Comission (2020).
Energy efficiency	Energy efficiency means using less energy to perform the same task –eliminating energy waste. Energy efficiency brings various benefits: reducing greenhouse gas emissions, reducing demand for energy imports, and lowering our costs on a household and economy-wide level (Environmental and Energy Study Institute - EESI, 2020).	Elia et al. (2017); Nuñez-Cacho et al. (2018); EMF (2019); European Comission (2020).

(*continued on next page*)

Table 1 (*continued*)

Actions/Strategies	Description	Source
Reduction of food waste	Preventing and reducing food waste, from those who produce and process foods (farmers, food manufacturers and processors) to those who make foods available for consumption (hospitality sector, retailers) and, ultimately, consumers themselves (European Comission, 2020).	Jurgilevich et al. (2016); EMF (2019); European Comission (2020).
Eco-innovation and eco-design	Eco-innovation is a critical factor in the shifting from a linear to a CE. Eco-design is considered a catalyst to switch from linear to circular economies. Products must be designed for circular loops and revenue generation (Bocken et al., 2016).	McDonough and Braungart (2013); Bouzon et al. (2015); De Jesus and Mendonça (2018); Ellen MacArthur Foundation – (2019); Organisation for Economic Co-operation & Development—OECD (2021); Diekmann and Germelmann (2021); European Comission (2020).
Creation/Generation of Jobs	Potential to generate Jobs at the local level, aimed at citizens and vulnerable populations social-productive inclusion.	Brazil (2010); Ili and Nikoli (2016); Schiller et al. (2017); ICESP (2018); European Comission (2020).
Sharing economy	Providing the capability or services to satisfy user needs without owning a physical product (Bocken et al., 2016).	Bouzon et al. (2015); ICESP (2018); Ellen MacArthur Foundation – (2019).

Source: Research data (2022)

definition. Mainly in Brazil, the experts from primary and secondary sectors have not been motivated by enterprises to research the sectors, which justifies a significant sample from academia in this country. In this case, the academia is more connected with understanding the circular economy concepts than the experts from sectors. A more expansive data collection could not represent the proper knowledge from non-opinions. Due to time limitations for conducting the study and the availability to respond to the questionnaire, data for 96 respondents from more than 800 randomly sent questionnaires were obtained, resulting in around 12% responses. Considering the difficulty of conducting such an application in the region, this sample can be considered satisfactory (Cavalcanti et al., 2015; Lima et al., 2014). It is important to emphasise that it is not our intention, and not the nature of the multi-criteria decision aid studies, to generalise the findings of our research. Although we have an apparent concentration of respondents from the Academia and Consultancy sectors, which should be recognised as a limitation, it does not invalidate our study. On the other hand, it demonstrates a trend of responses, considering the broad knowledge of these people and the need of the respondents from the Industrial sectors to be more collaborative with Academia to enable more reliable results.

Although the population could not be determined, the target audience consisted of experts working in sustainability and circular economy in the primary, secondary, tertiary, quaternary, and quinary sectors, the sample was non-probabilistic. The criteria of accessibility and representativeness were used to determine the sample for this study, which means that participants of the study covered people possessing the information required and available to participate in the survey. However, the percentage of return is determined by the availability of the respondents to answer the questionnaire. The data collection was disseminated widely and postponed several times to get more responses. However, the industrial sector still did not participate. We suggest that future studies focus on the industrial sector to overcome this limitation.

Table 2
Set of criteria to evaluate the strategies.

Category	Criterion		Description	Direction
Social	C1	Adaptability to current legislation.	The degree to which the circular economy strategy helps to comply with regional and national regulations.	Maximise
	C2	Social acceptance	The degree to which the alternative helps to increase public acceptance of circular economy strategies.	Maximise
	C3	Jobs creation	The absorption potential of the regional/national workforce according to the requirements that the strategy application will create.	Maximise
Environmental	C4	Reduction of incorrect disposal of waste	The degree to which this alternative increases the amount of waste collected and prevents it from being disposed of incorrectly.	Maximise
	C5	Prevention of the environment	Reduction of negative impact on the environment (e.g. reduction of water use, energy, pollution, fossil fuel reduction, and landfills).	Maximise
Economic	C6	Investment cost	The total amount of cost incurred to implement the strategy.	Minimise
	C7	Operational and Maintenance Cost	The cost incurred to maintain this strategy operational and to guarantee its maintenance.	Minimise
Technical	C8	Technical difficulty	Difficulty level to implement a given action due to the knowledge, technologies and solutions required.	Minimise
	C9	Adaptability to local conditions	The degree to which this alternative can be applied without obstacles is based on the particular characteristics of the region/country.	Maximise
	C10	Functionality	The degree to which this option has the potential to remain constant and smooth, such as having the maintenance requirements for specialised personnel and simplicity of operation.	Maximise

Source: Research data (2022)

Considering the differences between the developed and emerging countries, we choose Italy and Brazil to compare the level of institutionalisation of circular economy strategies and related practices. The choice by Brazil and Italy occurred considering their differences in the consolidation and institutionalisation of waste management and circular economy practices. Italy has consolidated legislation related to waste management (Bianchini et al., 2011). However, despite having more consolidated practices related to waste management compared to Brazil, Italy also faces challenges related to the planning of waste management,

non-compliant landfills and a decrease in recycling rates in the last years, depending on the regions (Ibanescu et al., 2018; Cárcel-Carrasco et al., 2021). Regarding the circular economy, Italy has created the Italian Circular Economy Stakeholder Platform – ICESP, initiated by Energia Nucleare ed Energia Alternative (ENEA), mirroring the European initiative (ECESP). Besides thatthe region of Emilia-Romagna enacted the first law on the circular economy in Italy (Sani et al., 2021).

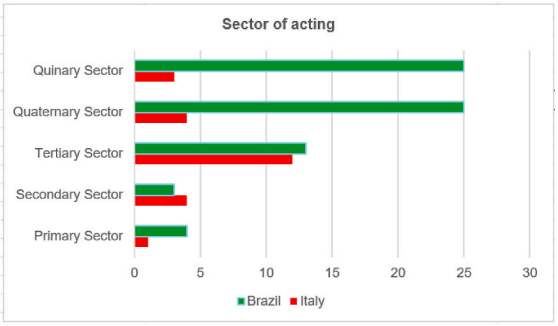
In contrast, in Brazil, after 20 years of discussion in the National Congress, the Brazilian Solid Waste Policy (BPSWM) act was passed in 2010. This law requires the implementation of waste management and reverse logistics of various types of waste, among other issues (Brazil, 2010). This legislation is considered one of the first steps to initiate the discussions on circular economy in this country, considering that the core principles are within the scope of circular economy (Guarnieri et al., 2020). Related to the circular economy, Brazil has joined a global initiative called CE100 by the Ellen MacArthur Foundation (2017), an innovation platform in which stakeholders collaborate to find waste management actions for the circular economy (Ellen MacArthur Foundation, 2018). Also, the Confederation of Brazilian Industries (CBI) has conducted studies (Confederation of Brazilian Industries – CBI, 2019). Therefore, no integrated initiative across the country or national legislation exists for this purpose. Brazil did not join the Coalition for the transition toward a circular economy of Latin America and Caribbean countries, launched in 2021.

We used an Informed Consent Agreement, explaining the purpose of the study and guaranteeing complete anonymity for respondents. We also explained that the results would be analysed in an aggregate way and that the guidelines to protect the respondents deriving from European and Brazilian recommendations would be respected. So, we asked if the respondents agreed to participate in the study and had the required knowledge to answer the questions. Some respondents refused to respond to the questionnaire because they could not understand the concepts according to the sample definition, so they did not respond. It is also important to highlight that this study was exempted from being subjected to the Ethical Committee of the universities coordinating this study. This fact was motivated because they understood that it did not involve any sensitive subject, no vulnerable population and did not conduct experiments with humans or animals, requiring just the opinions and perceptions of respondents related to the topic addressed in the study.

The results are used to demonstrate the constructs in the model. The model could be applied in other countries to analyse how the strategies related to the transition to a circular economy are prioritised, considering stakeholders' preferences regarding CE implementation at the macro level. Although the sample does not meet the representativeness of a statistical point of view, it does not undermine the results and the possibility of customising the model. The non-probabilistic sample and the high rate of non-response can increase the variability of the estimates and cause bias; we decided to consider this sample to obtain an approximation of the general picture, considering its exploratory nature, as already mentioned by van Langen et al. (2021). Despite this limitation, the results may still be relevant because they demonstrate the perceptions of many stakeholders in Italy and Brazil, which is considered enough for a multicriteria point of view. As previously mentioned, we obtained 24 responses from Italy and 72 from Brazil totalling 96 valid answers. The respondents are categorised into various sectors, as shown in Fig. 2.

As can be seen from Fig. 2, the quaternary and quinary sectors had more participants in Italy and Brazil. Given that the circular economy is a recent concept, with the first research publication around 2000, sectors based on intellectual activities were more confident in responding to the questions. They are usually knowledge-intensive and pioneers in discussing new concepts or strategies. Both in Italy and Brazil, the sectors with fewer respondents are the primary and secondary sectors.

Related to respondents from Italy, three stated that they do not work directly with a circular economy, 20 work directly, and one maybe.



Sectors	Description
Primary Sector	Involves the extraction and/or production of raw materials
Secondary Sector	Involves the transformation of raw materials into goods
Tertiary Sector	Involves trade and the provision of services to consumers and /or companies)
Quaternary Sector	Involves intellectual activities, such as information generation and sharing
Quinary Sector	Involves non-profit services such as health, education, culture, research (unpaid), police, firefighters, civil guard and non-governmental organisations

Fig. 2. Distribution of participants by sector of acting. Source: Research data (2022).

Related to Brazil, 26 do not work directly, 45 work directly, and one maybe. We can infer that stakeholders acting with the circular economy know more about it. Fig. 3 illustrates the respondent's level of knowledge concerning the circular economy.

Most respondents from both countries demonstrated a very high to a neutral level of knowledge of circular economy, representing 100% from Italy (in levels high and very high) and 73% from Brazil (we obtained the precentral summing of the high and neutral percentages). Fig. 4 illustrates the main segments of the acting of respondents. In Italy and Brazil, the sectors with the highest level of knowledge were quinary, quaternary and tertiary.

The most prominent segment to participate in the elicitation process, answering the questionnaire, was Academia, followed by consultancy, government, financial corporations and NGOs. The most prominent in Italy were Academia, Consultancy and Financial Corporations. In Brazil, the prominence of the four sectors (Academia, Consultancy, Government, NGOs) corroborates the information provided in Fig. 4 related to the acting sectors. These four segments are generally knowledge-intensive and pioneers in discussions about new approaches to be implemented later in primary, secondary, and tertiary sectors. The following section presents the MCDA approach and the ELECTRE IV methods used in this study.

3.1. Multicriteria decision aid (MCDA) approach

When decision-making involves at least two criteria and two

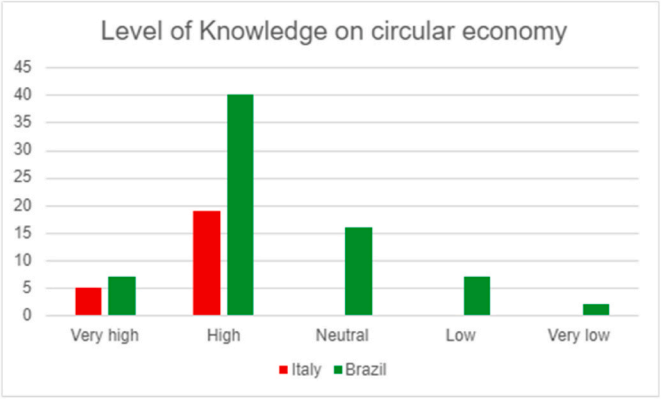


Fig. 3. Level of knowledge of respondents on circular economy. Source: Research data (2022).

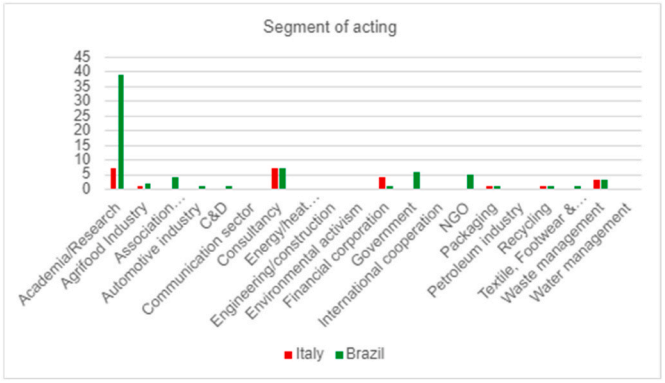


Fig. 4. Segments of acting of respondents. Source: Research data (2022).

alternatives to be chosen, the Multicriteria Decision Aid (MCDA) is often recommended. Itt generally covers conflicting objectives from several stakeholders in a multifaceted context.

Several methods from the MCDA approach can be applied to evaluate alternatives vs criteria, thus aggregating decision-maker preferences. These methods are usually beneficial and recommended when the decision context has qualitative and quantitative variables/criteria (Bozarth and Handfield, 2008). MCDA experts usually categorise these methods into three categories: (a) multi-attribute utility theory or single synthesis criterion theory, (b) outranking methods, and (c) interactive methods (Vincke, 1992; Roy, 1976).

There is no consensus among experts on the appropriate method to use because it depends on the problem and the context of the decision, the type of criteria involved (qualitative or quantitative), the rationality of decision-makers (compensatory or not), and the information provided (Guarnieri, 2015). The compensatory method accepts a trade-off between criteria, while the non-compensatory method requires a balance between the rates of all criteria to choose the more appropriate alternative. The non-compensatory methods from the outranking approach include techniques from the Promethée family, Electre family, and the Composition of Probabilistic Preferences – CPP method (Guarnieri, 2015; Sant'Anna, 2015; Vieira et al., 2020). Each method of Promethée and Electre families is designed to solve a specific problem (choice, ranking, or categorisation). The compensatory methods mainly include the Analytic Hierarchy Process – AHP, the Measuring attractiveness through a categorical-based evaluation technique – MACBETH, the Technique for Order Preference by Similarity to Ideal Solution – TOPSIS and Multi-Attribute Utility Theory – MAUT (Guarnieri, 2015).

3.2. ELECTRE IV method

The ELECTRE IV method was used to rank the circular economy strategies (Table 2) based on ten criteria (see Table 3). The respondents were treated as sub-criteria for the ELECTRE IV algorithm. These criteria are aimed at gathering information on the three dimensions of sustainability related to the circular economy, as shown in Table 3. The ELECTRE IV method generated an averaged ranking from the ascending and descending complete pre-order.

- The rankings were considered according to their directions.
- To Benefit [(n+1) – position] and
- To Cost [original position].

The ten primary criteria for the circular economy were ranked based on three consolidation techniques (median, mean, and geometric mean). In addition, the median was adopted, presenting more consistent results and proving to be more aligned with the study's objectives due to being less influenced by very high or very low values. This outranking method involves creating a set of a nested sequence of outranking relations without compensation between criteria. According to Vincke (1992) represents a more balanced set of solutions, considering a realistic context. The outranking methods are widely used in decision contexts involving sustainability issues; considering that it is not desirable to have, for example, a compensation between costs and environmental protection, it is required that all dimensions related to the alternatives (strategies) have an adequate performance to be set in the first position of the ranking. On the other hand, additive/compensatory methods hide the worst and best performances of some alternatives under the criteria because it considers the median of the performance. The second step employs an algorithm to rank a final partial pre-order that combines the two complete pre-orders.

Table 3
Ranking generated by Electre IV.

		Cr1	Cr2	Cr3	Cr4	Cr5	Cr6	Cr7	Cr8	Cr9	Cr10
1	Collaboration between companies	2,5	6,5	18,5	12,5	9,5	11,5	12,5	10,5	7,0	14,0
2	Waste management guidelines	22,0	8,5	11,5	20,5	20,0	2,5	15,5	7,5	6,0	18,0
3	Reverse logistics	3,5	17,5	11,0	12,5	10,5	7,5	4,0	4,0	4,0	12,5
4	Closed-loop strategies	6,0	23,0	22,5	23,5	24,0	4,0	2,0	6,0	11,0	20,0
5	Sectorial agreements	22,0	9,0	17,5	9,0	12,0	17,5	18,0	15,0	18,5	6,5
6	Socio-productive inclusion	9,5	9,0	23,0	3,5	3,5	18,0	20,5	21,5	18,5	15,0
7	Financial incentives, support and measures	12,0	10,5	16,0	14,5	7,0	14,0	2,0	18,0	13,0	7,5
8	Stakeholders engagement	7,5	16,0	13,5	11,5	5,5	20,5	16,0	20,5	20,5	10,5
9	Industrial symbiosis	5,0	8,0	20,0	18,0	15,0	3,5	13,0	8,5	3,0	22,0
10	Partnerships with research & development organisations	19,0	12,5	15,0	10,0	8,0	11,0	11,0	14,0	16,0	9,5
11	Roadmap for the circular economy	10,5	14,5	9,0	10,0	12,0	18,5	12,0	16,0	15,5	4,0
12	Ecocities or circular cities	5,5	24,0	21,0	16,5	22,5	1,0	1,0	1,5	2,0	22,5
13	Incentives to micro, small and medium companies	16,0	3,5	21,0	5,5	5,5	6,0	9,5	13,0	15,0	5,5
14	Sustainable product policy	13,5	20,5	19,0	18,0	20,5	10,5	8,0	3,0	16,0	17,5
15	Sustainable or green purchasing	23,0	21,5	9,0	17,5	19,5	15,5	13,0	13,0	8,5	19,0
16	Regulation	20,5	18,0	7,5	19,5	15,0	18,5	19,0	9,5	8,5	20,5
17	Eco-innovation and eco-design	19,0	14,5	11,0	21,0	18,0	3,0	3,0	1,5	15,0	11,5
18	Creation of jobs	12,0	10,0	24,0	5,5	6,5	12,0	10,0	20,5	17,5	4,0
19	Sharing economy	8,5	19,5	12,5	7,5	13,0	8,5	6,0	9,5	1,0	19,0
20	Obtaining value on biomass	16,0	7,5	10,5	14,0	16,0	9,5	9,0	11,5	10,5	16,0
21	Water reuse	17,5	5,5	6,5	8,0	22,5	13,0	5,0	4,0	6,0	23,5
22	Energy efficiency	24,0	12,0	10,5	5,5	16,0	14,5	15,0	19,5	20,5	8,5
23	Food waste and losses reduction	17,0	20,0	11,0	22,0	19,0	16,5	18,0	17,0	12,0	19,5
24	Construction & demolition waste management	15,0	3,5	19,5	21,0	21,0	6,0	14,0	5,0	5,0	21,5
		Benefit	Benefit	Benefit	Benefit	Benefit	Cost	Cost	Cost	Cost	Benefit

Source: Research data (2022)

The ELECTRE IV method is appropriate for cases in which the user is unable, unwilling, or unsure how to contribute information about the relative importance of the criteria. Thus, in the ELECTRE IV method, no weight (wj) is introduced, which is the importance given to a criterion. It does not mean each criterion has the same weight (Guarnieri and Trojan, 2019). For this reason, it is impossible to construct the concordance matrix. We propose to use the following outranking relations of the ELECTRE IV (Shanian and Savadogo, 2006) to identify the dominance relation in the extended ELECTRE IV. The outranking relations in the ELECTRE IV method are demonstrated as follows:

3.2.1. Quasi-dominance (sq)

$$bS_q a \leftrightarrow \begin{cases} n_p(a,b) + n_q(a,b) = 0 \\ n_i(a,b) < n_i(b,a) + n_p(b,a) + n_q(b,a) \end{cases} \quad (1)$$

The pair (*b, a*) verifies the relation of quasi-dominance if and only if:

- for every criterion, *b* is either preferred or indifferent to *a*, and
- the number of criteria for which the performance of *a* is better than the performance of *b* (*a* staying indifferent to *b*) is strictly lower than the number of criteria for which the performance of *b* is better than the performance of *a*.
- **Canonic-dominance (*Sc*):**

$$bS_c a \leftrightarrow \begin{cases} n_p(a,b) = 0 \\ n_q(a,b) \le n_q(b,a) \\ n_q(a,b) + n_i(a,b) < n_i(b,a) + n_q(b,a) + n_p(b,a) \end{cases} \quad (2)$$

The pair (*b, a*) verifies the relation of canonic-dominance if and only if:

- for no criterion, a is strictly preferred to *b*, and
- the number of criteria for which *a* is weakly preferred to *b* is lower than or equal to the number of criteria for which *b* is strictly preferred to *a*, and
- the number of criteria for which the performance of *a* is better than the performance of *b* is strictly lower than the number of criteria for which the performance of *b* is better than the performance of *a*.

$$\therefore S_q \complement S_c \left(S_c \text{ is richer than } S_q\right) and\ S_q = S_c \text{ if } \left\{j \in F \middle| aQ_j\ b\right\} = \varnothing, i.e.\ n_q(a,b) = 0$$

- **Pseudo-dominance (*Sp*):**

$$bS_p a \leftrightarrow \begin{cases} n_p(a,b) = 0 \\ n_q(a,b) \le n_q(b,a) + n_p(b,a) \end{cases} \quad (3)$$

The pair (*b, a*) verifies the relation of pseudo-dominance if and only if:

- for no criterion, *a* is strictly preferred to *b*, and
- the number of criteria for which *a* is weakly preferred to *b* is lower than or equal to the number of criteria for which *b* is strictly or weakly preferred to *a*.

$$\therefore S_c \complement S_p \left(S_p \text{ is richer than } S_c\right)$$

- **Sub-dominance (*Ss*):**

$$bS_s a \leftrightarrow n_p(a,b) = 0 \quad (4)$$

The pair (*b, a*) verifies the relation of sub-dominance if and only if for no criterion, *a* is strictly preferred to *b*.

$$\therefore S_c \complement S_s \left(S_s \text{ is richer than } S_p\right)$$

- **Veto-dominance (*Sv*):**

$$bS_v a \leftrightarrow n_p(a,b) = 0 \quad (5)$$

Or

$$bS_v a \leftrightarrow \begin{cases} n_p(a,b) = 1 \\ n_q(b,a) \ge \dfrac{n}{2} \\ g_j(b) + v_j\left(g_j(b)\right) \ge g_j(a), \forall j \in F \end{cases} \quad (6)$$

The pair (b, a) verifies the relation of veto-dominance if and only if:

- either for no criterion, *a* is strictly preferred to *b*, or
- *a* is strictly preferred to *b* for only one criterion. Still, this criterion does not veto the outranking of *a* over *b,* and furthermore, *b* is strictly preferred to *a* for at least half of the criteria.

$$\therefore S_s \complement S_v \left(S_v \text{ is richer than } S_s\right)$$

In the ELECTRE IV method, a concordance index *C* (*a,b*) is calculated as follows:

$$C(a,b) = \frac{\sum_{j=1}^{n} w_j C_j(a,b)}{\sum_{j=1}^{n} w_j} \quad (7)$$

And a discordance index *Dj* (*a,b*) is calculated as follows:

$$D_j(a,b) = \min\left\{1, max\ \left\{0, \frac{\left[g_j(b) - g_j(a) - p_j\left(g_j(a)\right)\right]}{v_j\left(g_j(a)\right) - p_j\left(g_j(a)\right)}\right\}\right\} \quad (8)$$

In ELECTRE IV, pseudo-criteria are used instead of the real criteria to determine the relations of the fuzzy binary outranking for the configurations. Thresholds can be calculated either in terms of the worst, also called direct, or best performance, called the inverse, of two compared alternatives. The worst performance is considered the smallest if the direction of the preference is increasing and is considered the greatest if the direction of the preference is decreasing.

The case of increasing preferences and direct thresholds was used in this work. After establishing all outranking relations between alternatives, we propose to use the increasing preferences and direct thresholds in this work to rank these alternatives.

4. Results

This section is presented according to the steps of MCDA modelling: 4.1) describing the problem, 4.2) identifying alternatives, 4.3) identifying criteria, 4.4) defining the MCDA method to be used, and 4.5) applying the method.

4.1. Describing the problem

Many countries have developed action plans, directives, and legislations for the circular economy. These action plans, directives, and legislations focus on choosing strategies to transition from linear to circular economies. The decision problem involved in this study is related to how different countries prioritize these strategies. Do they focus on proactive (disruptive) or reactive strategies for the CE transition? Changes in the design, production, distribution, and consumption of waste management can demonstrate this kind of behaviour in the countries investigated.

4.2. Identification of alternatives

Given the literature, a survey of the main strategies bottom-up in developed and developing countries was carried out (Appendix 1). Considering that this paper deals with the macro transition level, bottom-up strategies were addressed. It is understood that by defining

bottom-up strategies by governments (federal and regional), a favourable environment is created for meso and micro-level strategies to be implemented. This survey resulted in 24 main strategies, encompassing the entire product manufacture and consumption process, from design to waste disposal. These strategies, in the context of decision-making, are considered alternatives. The alternatives gathered from the literature are presented in Table 1.

4.3. Identification of the criteria

Based on a previous literature review (Fernandes et al., 2021), we selected a set of criteria, covering the three dimensions of sustainability (social, environmental, and economic) complemented by the technical dimension. We considered that more than achieve the environmental, social, and economic sustainability, based on the study of Fernandes et al. (2021), it is also essential that the strategies chosen to boost the transition towards a circular economy can be maintained over the years, so the technical dimension was inserted to complement the model. The technical difficulties, the adaptability of local conditions and the functionality of the strategies were considered by Rousis et al. (2008), Hsu and Hu (2009), Kuo et al. (2010) and, Lima Junior et al. (2018), as essential to maintain the operationalisation of the strategies and to allow the model chosen feasible.

The set of criteria used to evaluate the alternatives are presented in Table 2:

4.4. Definition of the MCDA method

This study uses a multicriteria approach based on the ELECTRE IV method to rank the 24 CE strategies given the ten criteria. The ELECTRE IV method generates an averaged ranking from an ascending and descending complete pre-order and deals with non-compensatory contexts with inherent subjectivity, such as those relating to sustainability issues. This decision-making framework assumes that environmental and social criteria will not be offset by economic ones, which frequently conflict with each other.

4.5. Application of the MCDA method

Table 3 shows the ranking of 24 strategies (alternatives) against ten criteria generated by ELECTRE IV. For the aggregation procedure, we used three options of ranking: The median, geometric, and arithmetic mean (average).

After analysing Table 4 and the three ranking possibilities (median, geometric, and average), we chose the median ranking because average values are not always the best approach to comprehend data analysis behaviour. The median provides a trade-off between extreme values. Outliers can skew average data, causing rankings to be unreliable. As a result, Table 4 shows the median ranking of the two countries (Italy and Brazil).

As shown in Table 4, the questionnaire assessed the respondents' perceptions of the strategies and their evaluations under social, environmental, economic, and technical criteria, indicating a balance between these dimensions of sustainability to appear in the first positions of the ranking. Table 5 compares the ranking of CE strategies in Italy and Brazil.

As we can see in Table 5, as some strategies are tied in the same position of the ranking (see 7th and 16th in Italy and 10th and 19th in Brazil), we did not have results for the positions 8th, 9th, 14th, 17th and 18th in Italy and, 3rd, 11th, 12th, 20th and 21st in Brazil, these cases were highlighted in grey in Table 5. In Italy, energy efficiency was evaluated at the first position in the ranking, while in Brazil, this alternative was assessed at the last (24th) position of the ranking. In Italy, the strategies 'Sustainable product policy', 'Sustainable or green purchasing', 'Incentives to micro, small and medium companies, 'Water reuse', and 'Closed-loop strategies' were set, respectively, in 2nd, 3rd, 4th, 5th and 6th positions, while in Brazil, respectively, in 10th, 9th, 13th and 16th and 14th positions. Only the reverse logistics strategy had the same priority by the participants from both countries in the 7th position. However, Italy also set the same position on the strategy 'Stakeholders engagement', which is related to the notion of shared responsibility and the strategy 'Financial incentives, support and measures maybe this result was influenced by the four respondents from Financial Organisations from Italy and the existence of policies related to this matter in the country. In Brazil, this strategy related to the 'Stakeholders engagement' was set in the 2nd position of the ranking, which is explained by the fact that the basic premise of Law 12,305/2010 related to the National Policy of Waste Management is 'shared responsibility, which involves all players engaged in producing and consuming a product. This issue is also related to the sectoral agreements, which can be considered an instrument to operationalise this engagement and shared responsibility between actors. Related to the strategy 'Financial incentives, support and measures', the stakeholders from Brazil set it in the 10th position of the ranking. It is important to emphasise that Brazil has no policy for this purpose until now, even considering reverse logistics or waste management, which are the object of the law.

The data from Italy did not result in any strategy set in the 8th and 9th positions, considering the tie of 3 strategies in the 7th position. In Brazil, the 8th position is related to the strategy of 'Sharing Economy', and the 9th is connected to 'Sustainable or green purchasing', which is essential to highlight that legislation enables this kind of strategy in Brazil. Italy has set this one at the beginning of the ranking.

The 'Collaboration between companies' was set by Italy in 10th position and Brazil at 17th position in the ranking. 'Food waste and losses reduction' was defined as the 11th priority in the Italian ranking, while in Brazil, it was defined as the first strategy to be prioritised. Maybe this result is associated with food insecurity in Brazil, which was aggravated in Brazil due to the economic crisis generated by the Covid-19 pandemic. Brazil has historically faced difficulties related to this issue, despite being one of the world's largest producers of cereals and other foods due to income inequality. With the pandemic,

Table 4
Median ranking.

Strategies	Median ITALY		Median BRAZIL	
	Vector	Rank	Vector	Rank
Collaboration between companies	13	10th	11	17th
Waste management guidelines	9	23rd	16	5th
Reverse logistics	14	7th	14	7th
Closed-loop strategies	15	6th	12	14th
Sectorial agreements	14	7th	11	15th
Socio-productive inclusion	11	19th	18	4th
Financial incentives, support and measures	14	7th	12	10th
Stakeholders engagement	12	18th	18	2nd
Industrial symbiosis	13	12th	12	10th
Partnerships with research & development organisations	12	13th	10	19th
Roadmap for the circular economy	12	16th	8	23rd
Ecocities or circular cities	10	22nd	10	19th
Incentives to micro, small and medium companies	15	4th	12	13th
Sustainable product policy	16	2nd	12	10th
Sustainable or green purchasing	16	3rd	14	9th
Regulation	12	16th	10	18th
Eco-innovation and eco-design	12	13th	10	22nd
Creation of jobs	11	21st	18	2nd
Sharing economy	12	15th	14	8th
Obtaining value on biomass	11	20th	10	19th
Water reuse	15	5th	11	16th
Energy efficiency	14	1st	6	24th
Food waste and losses reduction	13	11th	21	1st
Construction & demolition waste management	0	24th	15	6th

Source: Research data (2022)

Table 5
Median ranking.

Ranking	Strategies Italy	Strategies Brazil
1st	Energy efficiency	Food waste and losses reduction
2nd	Sustainable product policy	Stakeholders engagement Creation of jobs
3rd	Sustainable or green purchasing	
4th	Incentives to micro, small and medium companies	Socio-productive inclusion
5th	Water reuse	Waste management guidelines
6th	Closed-loop strategies	Construction & demolition waste management
7th	Reverse logistics Financial incentives, support and measures Sectorial agreements	Reverse logistics
8th		Sharing economy
9th		Sustainable or green purchasing
10th	Collaboration between companies	Industrial symbiosis Financial incentives, support and measures
11th	Food waste and losses reduction	
12th	Industrial symbiosis	
13th	Partnerships with research & development organisations Eco-innovation and eco-design	Incentives to micro, small and medium companies
14th		Closed-loop strategies
15th	Sharing economy	Sectorial agreements
16th	Regulation Roadmap for the circular economy	Water reuse
17th		Collaboration between companies
18th		Regulation
19th	Socio-productive inclusion	Ecocities or circular cities Obtaining value on biomass Partnerships with research & development organisations
20th	Obtaining value on biomass	
21st	Creation of jobs	
22nd	Ecocities or circular cities	Eco-innovation and eco-design
23rd	Waste management guidelines	Roadmap for the circular economy
24th	Construction & demolition waste management	Energy efficiency

Source: Research data (2022)

unemployment rates have increased considerably, and Brazil has reappeared on the hunger map as one of the countries with the most significant difficulties. The vulnerable population in Brazil is substantially larger than in Italy, where this share of the population has increased with the immigration of refugees.

The 'Industrial symbiosis' strategy was set in the Italian ranking at 12th, while Brazil ranked 10th. In Brazil, two strategies were placed in the 10th position, the 'Industrial Symbiosis' and 'Financial incentives, support and measures. Public policies in Brazil do not support both strategies. The 'Eco-innovation and eco-design was set in the 13th position in Italy while Brazil was in 22nd position at the end of the ranking. This strategy had a tie in Italy with 'Partnerships with research & development organisations, while this one was set at the 19th in the Brazilian ranking, also at the end. Italy has no one strategy at the 14th position; at the 15th is the 'Sharing Economy', which was set as 8th in the Brazilian ranking. Both 'Roadmap for the circular economy' and 'Regulation' were set at 16th position in the Italian ranking, while in Brazil, respectively, at the 22nd and 18th positions, at the end of the ranking. There is no strategy at the 17th position in the Italian ranking, and the 18th is the 'Stakeholder engagement', previously discussed.

In the 19th and 20th positions in the Italian ranking are, respectively, the 'Socio-productive inclusion' and 'Obtaining the value of biomass'; in the Brazilian ranking, these alternatives were set at 4th and 19th. The socio-productive inclusion is well-discussed in Brazil, considering avast, vulnerable population. The Brazilian legislation foresees the inclusion of waste pickers in the reverse logistics processes. In Brazil, this category of workers is responsible for collecting and recycling more than 90% of solid waste. A similar discussion is related to the 'Creation of jobs' in Brazil, which was set in the Italian ranking at 21st and Brazilian ranking at 2nd. Due to the amount of vulnerable population suffering from high levels of unemployment and food insecurity, this strategy was well valued by the Brazilian stakeholders. In Italy, this is not a priority at the moment of the questionnaire application. In Italy, there is no robust social inequality. Although there is a discussion related to creating jobs mainly aimed at the youngest population, and also aimed at refugees, this strategy was not pointed out as a priority.

The strategy 'Eco-cities or circular cities' was set at 22nd in the Italian Ranking and 19th in the Brazilian ranking. This is considered a disruptive and proactive strategy because it requires significant changes in urban planning, waste management, traffic and the city's way of life. This strategy was presented at the bottom of the ranking in both countries. The 'Waste management guidelines/directives' was set at the 23rd position in the Italian Ranking, while the Brazilian one was set at the 5th position. This disparity can be explained because, in Italy, the issue related to waste management is well consolidated, the related legislation has existed since 1997, the separate collection of waste works very well, the awareness related to the citizens is high. Several high specialised companies are working with waste management. In Brazil, this is a recently addressed issue. The legislation related to waste management was enacted 12 years ago. Unfortunately, very few initiatives have been implemented so far, such as the sectorial agreement for the implementation of reverse logistics of some waste categories, the inclusion of waste pickers, the selective collection of waste and the landfill's closure. However, in many cities, waste is still a considerable problem; for this reason, this is an essential priority for Brazil and not Italy. We can state the same for the 24th strategy in the Italian ranking, which was the 'Construction & demolition waste management', while in Brazil, it was set at 6th positioning the ranking. In Brazil, there are several occurrences of illegal and incorrect disposal of this kind of residue, while in Italy, this problem was already equated.

5. Discussion

5.1. Proactive and reactive strategies

Countries' strategies for the transition to the circular economy can be divided into proactive and reactive. Proactive strategies require long-term planning and implementation and are more strategic and disruptive, involving robust and innovative changes in product design, business model, and city and regional planning. These strategies are not dependent on legislation or institutional guidelines to be adopted. On the other hand, the reactive strategies are more tactical and operational, require medium and short-term planning and execution, aim to solve the current problems and depend on legislation or institutional guidelines to be adopted.

As mentioned in section 2.3, proactive and reactive strategies differ regarding the deadlines required for implementing the strategies and the efforts and measures are taken. Considering the ranking generated, based on the perceptions of the stakeholders from Italy and Brazil, it is possible to observe that Italy has more proactive strategies at the top of the ranking, which means that these strategies are more prioritised to the detriment of more reactive ones, related to waste reduction and management. The implementation of reverse logistics was in the same position in both countries. Regarding the proactive eco-cities strategy, which requires a replanning of cities, Italy has also not prioritised it, perhaps considering the context of its historic cities and cultural heritage, which does not allow for many changes to more eco-sustainable city models. In the case of Brazil, more reactive strategies are at the top of the ranking, which is understandable, when we analyse the context of implementing the requirements for the BPSWM, a recent law related to the management of waste and reverse logistics implementation.

This result shows that Brazil has a reactive behaviour then changing

the logic of production and consumption requiring a proactive behaviour. However, it is essential to consider that developed countries often transfer their waste to developing countries in Africa, China, Pakistan, India, and others (Kitt, 1994; Sonak et al., 2008; Liu et al., 2018). Developed countries have consolidated legislation related to waste management, while developing countries are still dealing with waste management. Few of them have strict environmental legislation.

There is a discussion about the significant differences between developed and developing countries related to the transition toward a circular economy. Some studies stated that there is a lack of proactivity in more disruptive actions associated with the circular economy in developing countries, which focuses their strategies on the solution of waste management. Guarnieri et al. (2020a,b) analysed the transition to the circular economy by comparing Brazil and Italy. They found that some disruptive strategies aimed at a circular economy in Italy are more often motivated by European Action Plans, Green Deal, and legislation. While in Brazil, the actions are more related to waste management and reverse logistics practices, which are motivated mainly by the Brazilian Policy of Solid Waste in 2010. Sehnem et al. (2019) analysed the critical success factors for adopting the circular economy using focal companies from Brazil and Scotland. They found that organisations more proactive in their approach to the circular economy better manage the critical success factors. In contrast, less proactive people tend to face challenges and tensions.

Silva and Morais (2021) corroborate the importance of considering the perspectives of several stakeholders in the transition to a circular model. However, they analysed the transition on a micro-level. Mishra et al. (2019) found that multi-stakeholder collaboration/engagement is crucial in implementing circular economy practices, particularly in developing countries.

5.2. Comparison between Italian and Brazilian strategies under the NIT

Considering that DiMaggio and Powell (1983) introduced the idea that organisations are influenced by their institutional context. In this context, this normative framework's policies, plans and institutions provide a set of social understandings. These understandings materialized in rules, norms and ideologies, configuring rationalised myths insofar as they are recognised and assumed by the parties involved in society (Greenwood, 2008). The consequent homogenisation occurs through isomorphic processes that impels organisations to resemble each other, as pointed out by DiMaggio and Powell (1983). Thus, isomorphism mechanisms could mean the restrictive process that compels an individual or an organisation to mirror other individuals or organisations subjected to the same environmental conditions.

As mentioned previously, we have three types of isomorphism in the context of NIT: i) coercive isomorphism; ii) mimetic isomorphism iii) normative isomorphism, but as mentioned by DiMaggio and Powell (1983), these three types of mechanisms are not pure; they are not usually exclusive but interactive. As we already expected, considering the context of Italian initiatives presented previously, we observed that the initiatives related to a circular economy are more consolidated than Brazilian ones. Italy is a member of the European Union, which is a pioneer reference in the policies and practices related to the circular economy. Thus, the environment in the European Union can be considered as strongly favourable for Italy to create more targeted policies, which also is recognised as an institutional pressure, not just for Italy, but for all the 27 country members of the European Union. Thus, it can be observed that the mechanism of coercive isomorphism impels Italy to mirror the practices and strategies adopted by the other countries of the European Union. The pressure exerted by the European Community can impel Italy and other member countries to enact legislation, as the Emilia-Romagna region law, to accelerate the transition. In Italy, ICESP represents a significant advance toward circular economy transition because it has formal working groups involving representatives of all stakeholders, which could boost CE implementation of CE in the following years. ICESP is another initiative mirroring the European one. The Italian Circular Economy Stakeholders Platform is the branch of the European Circular Economy Stakeholders Platform.

The issues discussed in the working groups are selected based on suggestions from the members of the ICESP and it is provided for all interested people, some reviews, technical reports and studies on the topics covered in their activities, as well as the mapping of circular economy practices. Nevertheless, although national legislation or policy was created by the Italian Government, some politicians have cited the circular economy as a priority. This fact can denote a positive and favourable environment for future policies related to the circular economy transition. Some regions, such as Emilia-Romagna, in Italy, pioneer in recognising the circular economy in legal instruments as stated by Sani et al. (2021).

It is essential to highlight that there are still some regional differences in Italy that should be recognised, for example, North regions are more developed in terms of circular economy transition than South regions, because of the concentration of industries. We can observe that, firstly, the coercive mechanism occurred from the European Community in relation to Italy and, consequently, a similar movement will occur now, arising from Italy in relation to its regions.

As demonstrated in the study from Cárcel-Carrasco et al. (2021) there are differences in the case of waste management, showing the case of C&D. The authors compared Lombardia, Valle D'Aosta and Molise, and stated that the territory and development of each zone, the response to the economic situation has been driven by the industrial development of each region. Sani et al. (2021) demonstrated a difference considering the pioneering acting of the Emilia-Romagna region, which has the first legislation concerning circular economy in Italy. In Brazil we found a similar situation (Santos and Rovaris, 2017); the South and South East regions are more developed than the North and North East regions in the context of waste management and the structure to correct disposal and waste collection. However, in Brazil and Italy, more studies are necessary to confirm this empiric observation, comparing regions, mainly in the case of the transition toward a circular economy.

Otherwise, it is possible to perceive that CE is still in infancy in Brazil. The Brazilian political-legal environment has relevant regulatory instruments defined by the BPSWM (Brazil, 2010; Rebehy et al., 2019). However, this instrument is focused on waste management and not the circular economy. Although some authors recognise that the main principles of this instrument are consistent and aligned with those observed in developed countries, namely cooperation between different governmental spheres, the business sector and other segments of society; shared responsibility for the product lifecycle (Rebehy et al., 2019; Guarnieri et al., 2020), there is still a need to national aligned guidelines and strategies.

In addition, Brazil lacks regulation and inspection mechanisms regarding compliance with the provisions of sectoral agreements and the closure of open-air dumps. In some regions, the selective collection has not even been implemented despite the legislation. The normative pressures haveve impelled Brazil to adopt waste management and reverse logistics strategies, which can positively affect the transition to circular economy. However, no one national guideline is implemented related to the circular economy. Some ministries are discussing initiatives associated with the circular economy, such as the Ministry of Education (development of learning skills on the circular economy), the Ministry of Science and Technology (bioeconomy) and the Ministry of Regional Development (circular agriculture).

Nevertheless, Brazil has no integrated discussion or initiative to guide and enable the transition. Brazil did not adhere to the Coalition for the transition toward a circular economy in Latin America and Caribbean countries. Some advancements and alignment with the coalition from the new government are expected to be initiated in 2023.

Despite the fact there are Brazilian studies, such as the survey carried out by Confederation of Brazilian Industries – CBI (2019), stating that 76.4% of the country's industries develop some circular economy

activity, it is essential to point out that most practices are focused on recycling and reverse logistics, which are the focus of the Brazilian legislation. Also, the ideal circular model is not yet put into practice in Brazil, considering the entire life cycle of the product, but is strongly related to the last stages, involving just the concepts of recycling and reverse logistics, as pointed out by Guarnieri et al. (2020). The social and economic issues need to be further explored in the transition to a circular economy in Brazil, and it is essential to point out that political aspects, such as the creation of incentives and regulations, interfere and should be considered to enable the transition towards CE in Brazil (Ferri et al., 2015).

In general, the authors agree that Brazil still faces difficulties in implementing the CE, considering that even the BPSWM, when trying to create an environment conducive to the growth of a sustainable economy, is facing some barriers. Although Latin America and the Caribbean countries launched a circular economy coalition in 2021, Brazil did not join this movement, maybe due to the non-prioritisation of environmental protection by the present government. Brazil could benefit from joining this movement, because the priorities cover plastics management, tourism, cities and construction, electronics, food and agriculture, industrial symbiosis and others. BPSWM already covers some of these segments.

Therefore, compared with the New Institutional Theory (NIT), it is verified that Italy has implemented some initiatives considering the mechanism of coercive isomorphism, mainly due to the formal pressure exerted on countries members of the European Union. Is expected that the organisations acting in the European Union, on which they depend, and by the cultural expectations of the Society in which organisations operate, should implement some practices considering the EU action plan for the circular economy- COM (2015) 614, which is enabled by the European Circular Economy Stakeholder Platform- ECESP.

On the other hand, Brazil's process is based on a mimetic isomorphism due to the tendency to homogenise and standardise processes and strategies, considering the best practices ofdeveloped countries. Indeed, the discussion on CE in Brazil is enabled by the recent enaction of the BPSWM, which focused on waste management. Although this legislation does not formally mention the circular economy, it has some principles and instruments that can enable the circular economy in the long-term horizon. Even though the ideal concept of the circular economy is still far away from being implemented in Brazil, because it covers the entire sustainable planning of a good or service throughout its life cycle, there are some initiatives from industrial sectors. In this context, it is possible to find initiatives in the stages of product design, extraction of raw materials, manufacture and commercialisation, distribution, reuse (reuse, reconditioning, remanufacturing, recycling) and, in the last case, the final disposal of waste in an environmentally correct manner. It (Reike et al., 2018).

In this matter, Brazil, which already has good relations with Italy, could benefit from partnerships and joint programmes related to the circular economy transition, mainly those aimed to share the best practices from Italy, which can be resembled in Brazil. However, to make this idea a reality, efforts and commitment from both governments are needed, besides a willingness to collaborate, dialogue, financial support from funding agencies, government agencies and economic development, in addition to the involvement of researchers and various stakeholders involved in the circular economy transition efforts. Undoubtedly, cooperation between Italy and Brazil would be fruitful and helpful. However, for the transition to the circular economy to be a priority in Brazil, it is necessary to materialize the pressures in the form of laws, regulations and action plans. We can infer, based on literature, that demands coming from European trading partners may also impel Brazil to adapt, as many suppliers from developed countries have already restricted the purchase of Brazilian products due to non-compliance with good environmental and social practices. As mentioned by Cramer (2022) EU policies have an impact on the behaviour of Brazilian companies exporting to European countries. Future studies can use the stakeholders theory to analyse how the relationships between Brazilian and Italian Governments, and even European countries and other stakeholders tend to boost or restrict this cooperation.

Cramer (2022) evaluated the receptivity to network governance, specified by seven cultural dimensions under the perspective of circular economy transition. Concerning involvement of stakeholders in this process, the industry involvement in all countries demonstrated a low to medium level. Despite this study including Brazil and Italy among the sixteen countries analysed, different elements were assessed. In Italy, the involvement of industry, start-ups, scale-ups, local government was medium and civil society and NGOs low. In the case of Brazil, it was observed a low involvement of all mentioned stakeholders. Concerning the waste disposal, the Italy demonstrated medium rates of recycling, repair, second hand, disposal in landfills and no national policy on circular economy (just regional). In contrast, in Brazil the rates are low, and there is no regional or federal policy related to circular economy.

While the study of Cramer (2022) analysed the transition toward a circular economy considering the present situation regarding waste management and network governance, our study analysed what strategies should be prioritised considering a future transition toward a circular economy. More specifically, our study analysed under the lens of New Institutional theory, more specifically, how the isomorphism mechanisms enable or not the movement of transition of the countries. Also, we analysed 24 strategies aimed at the transition, asking stakeholders from different sectors to prioritize the strategies under the environmental, social, economic and technical dimensions. The opinions of stakeholders were corroborated by the type of isomorphism encountered in each country, which conducts to the understanding that regional, national or still economic and political union policies can be an important driver/enabler to enable a favourable environment for this transition.

6. Conclusions

6.1. Final remarks

The primary purpose of this paper was to propose a methodology to analyse and prioritize the current policies, strategies and initiatives related to the circular economy transition, involving all the stakeholders and using a multicriteria perspective and under the lens of NIT. The novelty of this paper is related to the discussion of circular economy transition in the macro-level level of cities, regions and countries, providing timely and vital information for stakeholders to decide and define strategies and policies at the macro-level. The proposed methodology was applied to a case study to compare Brazil and Italy's realities, highlighting the differences between developed and developing countries.

While we observed in Italy the influence of the mechanism of coercive isomorphism, in Brazil we verified the influence of mimetic isomorphism. As a member of the EU, Italy is forced to have a similar behaviour and initiatives aiming to standardise practices related to the circular economy. Incorporating some strategies or concepts related to the circular economy in Brazil occurs by observing best practices, in this case, from developed countries, mainly when we consider that Brazil is a supplier of several goods for developed countries. It means that a coercive mechanism can enable the transition in Brazil in long term, considering the demands from European countries related to the circular economy policies involving products exported for these countries.

We also categorised the strategies as reactive and proactive ones, and we found that the stakeholders from Italy have prioritised more proactive strategies. In contrast, Brazil is more focused on reactive ones. It is important to emphasise that proactive strategies require long-term planning and involves robust, disruptive and innovative changes. Contrarily, in Brazil, the reactive strategies, which are more tactical and operational, requiring medium and short-term planning and execution,

aim to solve the current problems and depend on legislation or institutional guidelines to be adopted.

6.2. Theoretical contribution

In emerging countries, CE and its potential benefits have gotten little attention. Apart from the setting of China, which dominates the present micro-level CE literature, few attempts have been made to identify the hurdles and motivations in implementing CE in emerging economies.

Comparative studies that explore the transition to a circular economy at the macro-level in emerging countries are rare. There is a need for more research that focuses on the context of developing and emerging economies and shows their nuances concerning existing literature at the macro level.

This study intends to fill this gap, analysing the prioritisation of macro-level strategies aiming at transitioning towards a circular economy at the macro-level, considering Italy and Brazil. Finally, this study contributed to the literature regarding prioritising strategies for transitioning to CE from the emerging economy perspective. We also analysed the prioritisation of the strategies under the lens of NIT, which fills the research gap related to the lack of theoretical consistency of studies on circular economy.

6.3. Contribution to practice

The proposed analysis can aid to understand different countries' behaviours in prioritising strategies when contemplating the macro-level transition to a circular economy. The findings can help decision-makers (stakeholders) in public and private spheres to design strategies to enable this process. This paper can help researchers and practitioners interested in the transition towards a circular economy by comparing strategies prioritised by stakeholders from several segments and sectors, given all dimensions of sustainability. Comparing countries in distinct geographical locations can bring light to some particularities and different strategies to be considered for local governments and other sectors involved in the transition. Another contribution is related to the gathering of primary strategies and criteria to evaluate the condition for the transition. Policymakers and other stakeholders can use it to analyse which public policies can contribute to boosting the transition.

6.4. Implications

Discussing strategies to be prioritised for enabling the transition towards a circular economy, given the existing differences between countries, can boost initiatives from stakeholders and policymakers involved in the transition. At a macro-level, this transition requires policy changes at the national (federal), regional, and municipal levels. Therefore, the shift towards a circular, more sustainable and resilient model can create business opportunities to reach new markets and categories of consumers that value sustainable and innovative products and services, thus, affecting the economic growth in several sectors positively.

Despite this, all the sustainable strategies adopted to enable the transition would also have economic, environmental, and social impacts, contributing to the reduction of costs to mitigate the effects of greenhouse gas emissions, reduction of the raw material extraction, better quality of life of population, stimulating innovation, and increasing competitiveness. According to the European Council (2022), these strategies in Europe, until 2030, can provide an additional 0.5% of gross domestic product, creating around 700,000 jobs.

Considering these positive impacts, it is essential to stimulate studies and discussions on circular economy at a macro-level, which can serve as a basis for reformulating public policies, mainly in developing countries, which are generally more focused on regulatory instruments.

For researchers and practitioners interested in this topic, this study presented the leading strategies and criteria considered to enable the transition at a macro-level, as well as showing the state-of-art CE strategies used in different countries, which can be helpful in further studies. The strategies at the macro-level usually impel strategies in the meso and micro levels as a consequence, which can create the ideal environment for an integrative and holistic transition.

6.5. Limitations and further research

Despite its contributions, this study suffers from some limitations. The study is limited to analysing the preferences of Italian and Brazilian stakeholders; nevertheless, factors such as knowledge and social and cultural factors can influence the results. Further studies can investigate these aspects to enrich the findings of this study. The study used a non-probabilistic sampling based on the snowball technique considering the criteria of representativeness and accessibility; thus, the findings cannot be generalised. Future studies can use probabilistic sampling or use cluster analysis to have more comprehensive results. Concerning the respondents' sample, we have a concentration from Academia, other segments, such as industry, had negligible participation in our study, despite the wide dissemination of the questionnaire to the public. It is suggested that future studies focus on this segment with the support of representative associations. Maybe the low participation can be explained by the low involvement of this sector, as mentioned by Cramer (2022).

We used the method of Electre IV, which has a non-compensatory aggregation procedure to prioritize the strategies. Methods that use compensatory aggregation procedures can result in different findings. So, further studies should use techniques such as the Analytic Hierarchy Process (AHP), multi-Attribute Utility Theory (MAUT), interactive and multicriteria decision-making (TODIM), and measuring attractiveness through a categorical-based evaluation technique (MACBETH) to compare the results. This study investigated the macro-level transition towards a circular economy in only two countries. We recommend further studies to compare and integrate the stakeholders' perspectives at the micro and Meso levels. We also suggest a macro-level analysis of other developing countries using the same approach in this paper.

Considering the limitation of the questionnaire size, which may demotivate some respondents to participate, we suggest that future studies analyse the best-ranked strategies, or still develop two different scales, one intended to cover the more proactive strategies and the other the reactive ones. This study used the lens of NIT to analyse the institutionalisation of the transition of circular economy considering the isomorphism mechanisms in the macro-level (countries). We suggest that future studies use the stakeholders' theory to analyse the transition to a circular economy at micro and meso levels to explain organisations' behaviour and the level of influence of the stakeholders in some decisions or policies.

CRediT authorship contribution statement

Patricia Guarnieri: Writing – original draft, Validation, Investigation, Formal analysis. **Augusto Bianchini:** Formal analysis, Investigation, Supervision, Writing – review & editing. **Jessica Rossi:** Formal analysis, Investigation, Writing – review & editing. **Lúcio Câmara e Silva:** Formal analysis, Writing – review & editing. **Flavio Trojan:** Formal analysis, Writing – review & editing. **Bárbara de Oliveira Vieira:** Writing – review & editing. **Mauro Lizot:** Formal analysis, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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