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## **ENVIRONMENTAL MANAGEMENT TOWARDS THE CIRCULAR ECONOMY: HOW BRAZIL PRESENTS ITSELF IN THIS DISCUSSION**

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### **ABSTRACT**

Environmental issues are widely discussed in all sectors of the economy and actions to reduce the impacts of environmental degradation are still insufficient but over time have been massively diffused, this approach being extended to social issues related to the impacts generated by the companies. Among the actions to change production and consumption patterns, the circular economy brings the proposal of opposition to the linear model “extract, transform, discard”, still heavily used today, and which depends on large quantities of materials. The circular model is characterized as an economy that is restorative and regenerative and aims to keep products, components and materials at its highest level of utility and value. Thus, the objective of this article was to present the main concepts of the circular economy and the proposed actions for Brazil, based on bibliographical and documentary research through the publications of the Ellen MacArthur Foundation, the report of the European Commission for Sustainable Development and documents of lectures held in Brazil. The result shows the circular economy as a process that allows the optimization of production through the elimination of waste, as these can be used as by-products or as a source of energy; and that Brazil presents advances in this sense, verified through the actions that are already being carried out.

**Keywords:** Environmental management; Circular Economy; Solid Waste; Sustainability.

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## 1. INTRODUCTION

Environmental issues are widely discussed in all sectors of the economy and actions to reduce the impacts of environmental degradation are still insufficient, but, over time, they have been massively diffused, this approach being extended to social issues related to the impacts generated by the companies.

Environmental management is directly related to social responsibility; and although they are treated differently, these concepts are inseparable, since environmental issues cannot be addressed without addressing social ones. The company needs to “look” at its environment, as it is responsible for possible impacts to the community (Barbieri, 2007). The company’s strategy must be aligned with both environmental aspects and those related to social conditions and relations with its consumers, employees, suppliers, partners and other interested parties.

Since the Industrial Revolution, economies have developed a ‘take-make’ - consumption and disposition, growth pattern characterized by a linear model based on the assumption that resources were abundant, available, easily accessible and cheap to eliminate (European Commission, 2014).

The minimization of environmental problems must be part of the management strategies of companies, in order to adopt administrative and technological practices that contribute to increase the support capacity of the planet (Barbieri, 2007). Within this perspective, adopting practices of circular economy becomes a fundamental factor in this process.

The notion of a circular economy is not new. Its origin is related to the publication of the article “The Economics of the Coming Spaceship Earth”, of the American evolutionary economist Kenneth Boulding, in 1966. Since then, the issue has attracted increasing attention in recent years: in China, circular economy is part of the Clean Production Promotion Act, enacted in 2002; in 2010, the Ellen MacArthur Foundation conceptually adopted the circular economy; the European Commission formally adopted the circular economy as a conceptual framework in 2014, and more recently India did it in 2016 (EMF, 2016).

“The subject became evident on a worldwide scale in 2012, when the Ellen MacArthur Foundation published the first of a series of reports entitled “Towards a Circular Economy” (Azevedo, 2015, p. 2). In Brazil, the actions within this focus are based on the National Policy on Solid Waste, established by Law 12,305/2010.

The economic model of linear production whose processes consist of “extract, transform, discard”, still heavily used today, depends on large quantities of materials of low cost and easy access, as well as energy. This “model was central to industrial development and generated an unprecedented level of growth” (EMF, 2015, p. 2). In the current production model, the industries manufacture products with aging incorporated. This means that the products last almost exactly until the moment you want to replace them (Westerlo, 2011).

The difference between linear and circular economics is that, in the former, natural resources are used in a disorderly way without considering that they are increasingly scarce. Linear production transforms the raw material into products that are packaged, sold, consumed and discarded, ignoring the need to pay attention to the disposal and reuse of packaging. “In the circular economy, what is considered waste is regarded as food for the next system, with a logistics of reuse, including packaging, so that it does not lose value” (Borges, 2015, online).

It is observed, in view of the above, that the circular economy involves an awareness of all involved: supplier, producer, consumer and government. It is a cyclical process. “Circular economics is a transformational change in public policies, business models, technologies and consumer choices” (BCSD Portugal 2013, p. 5).

In the circular model, product life cycles are optimized, from concept and design to the production process and waste management that were not possible to eliminate. Regarding product consumption, it involves the question of the disposal of this product. In this sense, awareness-raising actions are needed. “Some examples of information needed by the user would be: guidelines on how and where to return products” (Ribeiro; Kruglianskas, 2014, p. 12).

In view of this, this research aims to answer the following questions: How is the evolutionary process and what are the international experiences that underpin the circular economy, specifically in Europe? How does Brazil present itself in the process of transition towards circular economy? What are the barriers and challenges to be overcome?

Therefore, the main objective of the study is to analyze the evolutionary process of the circular economy, the way Brazil presents itself in terms of environmental management and the actions proposed in this sense. In order to achieve the general objective, the following specific objectives were outlined: addressing the circular economy in other countries, specifically in Europe; identifying actions for the transition from linear to circular economy in Brazil; and identifying the limitations and challenges to be overcome in this process.



## 2. THEORETICAL REFERENCE

In this section, the theoretical reference used to carry out the study is presented.

### 2.1 Circular economy: conceptual aspects

The discussions on circular economics are not recent and are related to the publication of the article "The Economics of the Coming Spaceship Earth" by the evolutionary economist Kenneth Boulding, presented at the Forum on the Future and Environmental Quality in Growing Economy in Washington, in 1966. With the metaphor of planet Earth as a spacecraft, the author explains the current economic model, the relationship with the environment, its impacts, and the modern environmental crisis (Spash, 2013).

The concept of circular economy is characterized as an economy that is restorative and regenerative and aims to keep products, components and materials at their highest level of utility and value all the time, distinguishing between technical and biological cycles (EMF, 2015). The concept of cradle-to-cradle design has the potential to expand, not reduce, the choices of available materials (Braungart; McDonough, 2012).

In the linear model, the economy is characterized by the use of natural resources without considering its limitation, in which the productive processes are constituted by the transformation of the raw material into products that are mostly discarded without proper use after their useful life, thus generating increased waste production and the consequent environmental and human health impacts. As opposed to the linear model, the circular economy is based on a cyclical process in which the waste is reinserted in the productive process, either as a source of energy or as by-products. Figure 1 shows the comparison between the two models.

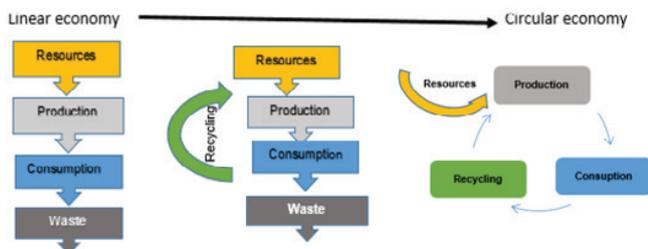


Figure 1. Model of transition from linear to circular economy

Source: Portal of the Economy Circular Portugal (2019)

The circular model aims to "eliminate inefficiencies, throughout the product life cycle, from the extraction of the raw materials to its use by the final consumer, through a more efficient management of natural resources, minimi-

zing or eradicating the creation of waste and maximizing the useful life and value of the product" (Lemos, 2018, p. 15). In this sense, materials are designed to circulate efficiently and be replaced in the production, thus playing the concept of non-waste or residue (Azevedo, 2015).

For Lemos (2018, p.15), circular economy is based on productive processes: "what nature has done millions of years ago, in line with the observation of the famous French chemist, Antoine Lavoisier, for whom, 'in nature, nothing is created, nothing is lost, everything is transformed'". In this sense, the circular economy is based on the following basic principles (EMF, 2015, p. 3):

- 1 - Preserving and enhancing natural capital, controlling finite inventories and balancing flows of renewable resources;
- 2 - Optimize the yield of resources by circulating products, components and materials in use at the highest level of utility all the time, both in the technical and biological cycles;
- 3 - Stimulate the effectiveness of the system, revealing and excluding negative externalities from the outset.

It is observed that the principles are based on the technical and biological cycles; therefore, the transition to a circular economy model has, among its proposals, the concept of innovation, assuming, "as the main driver, the systemic effectiveness to generate positive impacts, in which efficiency and effectiveness are sought to generate positive consequences for the parties involved in the system" (Confederação Nacional da Indústria, 2018, p. 22).

The innovation process must be geared to the development of cleaner processes and products. In this context are the principles of ecodesign regulated by the international standard ISO 14006, of 2011, also used in Brazil, which defines the criteria of production with use of raw material and production of products that generate less impact to the environment.

ISO 14006 - Environmental Management System (EMS) - is the standard for "ecodesign", which consists of "providing guidelines to help organizations establish a systemic and structured approach to incorporate and implement an ecodesign process within an environmental management" (2011, p. 9). The ecodesign proposal also focuses on controlling the generation and final destination of waste generated in production, culminating in their reuse, either in the production of energy or as by-products.



## 2.2 The circular economy in the context of environmental management

The circular economy has its theoretical basis grounded on different approaches, previously existing, on the subject of sustainability, including: industrial symbiosis, cradle to cradle, and the concept of design developed in the 1990s by Prof. Dr. Michael Braungart, a chemist, professor at the University of Munich and William McDonough, architect, and the scientists at the EPEA *Internationale Umweltforschung*, in Hamburg, who titled the book published by them in 2002. The concept describes the safe and potentially infinite use of materials in cycles, allowing resources to be reused indefinitely and circulate in safe and healthy flows to humans and nature.

Industrial symbiosis consists of the business strategy through which companies from different sectors perform a collaborative work, sharing services and the efficient use of resources. This includes sharing infrastructures, common equipment, but also the use of resources. In the case of waste, industrial symbiosis consists of the integration of different companies, in order to make cyclical the flow in which wastes are integrated into the production chain as by-products or raw materials (BCSD, 2013).

Biologically- or bioeconomics-based economy “focuses on the exploitation of renewable biological resources, and biotechnology as axes to promote sustainable development, and can be divided into three fronts: industrial biotechnology, primary production and human health” (CGEE, 2016, p. 10).

The proposal for a production system that is beneficial to companies, people and especially the environment is presented through the analysis of the biological and technical cycles, Cradle to Cradle® model, which aims to create cyclical flows of materials, as nutrients, according to Figure 2. The model served as the basis for the formulation of the circular economy diagram that describes the same cycles.

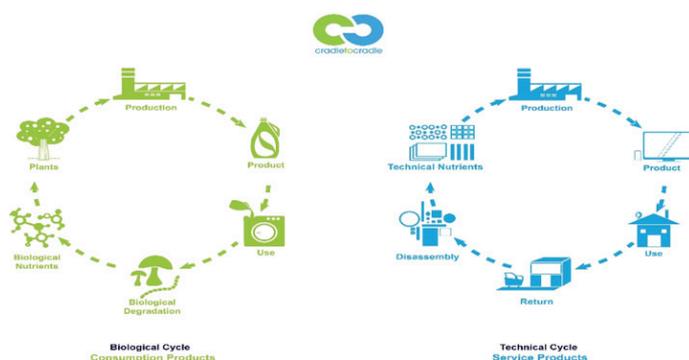


Figure 2. Cyclic flow of materials as nutrients - Cradle to Cradle® model

Source: EPEA Brazil, 2013

The technical cycle involves the management of finite material stocks. Usage replaces consumption. The technical materials are recovered and, for the most part, restored in the technical cycle, that is, they are used to circulate in closed industrial cycles, especially those that are not continuously produced by the biosphere. For products to be incorporated by the technical cycle, they must be composed of 100% recyclable materials - “technical nutrients” - and designed to ensure that the parts can be easily dismantled and the quality of the materials to be recovered or improved to be used for manufacturing new products (EPEA Brasil, 2013).

The biological cycle covers flows of renewable materials. Consumption occurs only in the biological cycle. Renewable (biological) nutrients are for the most part regenerated in the biological cycle (EMF, 2015). “Designing for the biological cycle means using healthy and safe raw materials to people and the environment, without toxic chemicals or polluting manufacturing processes, ensuring safety in the return of materials “to the environment (EPEA Brasil, 2013, online).

## 2.3 The circular economy in Europe

In terms of environmental management and actions aimed at the circular economy, the first initiatives were developed in Germany with the introduction of the principle of extended producer responsibility in 1991 and later with the adoption of a law on waste management, in 1994, with the idea of closed-loop substances. Subsequently, China had several pilot projects in 1999; in 2002 created a law and, in 2008, formalized the circular economy.

Japan followed along this line, creating its base law in 2000. Scotland is considered a benchmark in the circular economy sector; in 2010 it presented the strategic plan “Scotland Zero Waste Plan”. The United Kingdom approved the Resource Security Action Plan in 2012 and then the Netherlands in 2016, with the introduction of the “Cradle to Cradle” methodology in its economy and the promotion of industrial symbiosis (Lemos, 2018). The concept of circular economy has become popular in both the public and private sectors.

In the European context, the circular economy has been expanding since 2014, when the European Commission formally adopted it as a conceptual framework, together with a Waste Directive. In 2015, it was implemented with the adoption of the “Action Plan for the Circulars Economy”, which included, in addition to new legislative proposals on waste, indications on future measures in other areas and their timetable for elaboration and adoption (Santos, 2018).

The actions proposed in the plan were directed to: production; consumption; waste management; secondary raw



materials, plastic and food; essential raw materials; construction and demolition; biomass and bio-based materials; innovation and investment; and monitoring: development of a monitoring framework for the circular economy (European Commission, 2014).

After the full completion of the plan and its 54 actions, called “circular economy package”, it was presented during the 2019 edition of the Conference of Stakeholders of the Circular Economy in March organized by the European Commission and by the European Economic and Social Committee (European Commission, 2019). In the European Union’s action plan, the circular economy was conceived with a view to linking “a sustainable, low-carbon, resource-efficient economy” and “EU’s top priorities”, namely competitiveness, growth, employment and social cohesion (CNADS, 2016).

In 2019, the European Commission adopted a comprehensive report on the implementation of the Circular Economy Action Plan, outlining the main achievements of the Action Plan and outlining future challenges to shape the economy and pave the way for a circular economy that is neutral to climate, in which the pressure on natural and freshwater resources, as well as on ecosystems, is minimized. (European Commission, 2019).

In the process of transition to the economy in Europe, benefits related to the use of resources, the environment, the economy and social aspects were identified, the latter related to job creation. The transition process necessarily requires profound changes, thus generating transition costs (European Environment Agency, 2016).

## 2.4 Circular Economy for Brazil

The circular economy marks a process of structural, social, economic and environmental changes. The initiatives that characterize it “mark the beginning of a new phase on environmental legislation in several countries, where resources must be used more efficiently” (Araújo; Vieira, 2017, p. 54). For the aforementioned authors, although Brazil adopts some initiatives, these still present themselves in an inconsistent and constant way.

In Brazil, the circular economy has taken its first steps with the National Solid Waste Policy (PNRS, acronym in Portuguese), instituted by Law 12,305/2010, which constitutes a set of principles, objectives, instruments, guidelines, goals, and actions for the development of management and waste management in an integrated way. This integration aims at cooperation between federal, state and municipal governments, the private sector, and civil society. Among the principles that underpin the PNRS are: the systemic view on solid waste management that considers the social, cultural,

economic, technological and public health variables; sustainable development, eco-efficiency and recognition of waste as reusable or recyclable, and shared responsibility (Brasil, 2010).

Eco-efficiency is presented in the PNRS and is based on the compatibility between the competitive supply of qualified goods and services that meet human needs and bring quality of life and reduce the environmental impact and consumption of natural resources at a level, at least equivalent to the planet’s estimated carrying capacity. The social dimension of politics can be understood as the recognition of solid waste reusable and recyclable as an economic good and of social value, generator of work and income and promoter of citizenship (Brasil, 2010).

Eco-efficiency is an environmental management model introduced in 1992 by the World Business Council for Sustainable Development (WBCSD). It implies the efficient management of resources, adding value without this reflecting the increase in the prices of products or services. According to Barbieri (2007), the WBCSD has identified seven factors to successfully achieve eco efficiency: (1) reducing the intensity of use of materials; (2) reducing the intense energy demand; (3) reducing the dispersion of toxic substances; (4) encouraging the recycling of materials; (5) maximizing the sustainable use of renewable resources; (6) extending the shelf life of products; and (7) increasing the intensity of services.

Among the objectives of the PNRS described in its Article 7 are the non-generation, reduction, reuse, recycling and treatment of solid wastes, as well as environmentally adequate final disposition of the wastes, following this order of priorities, reinforced in Article 9; and stimulating the adoption of sustainable patterns of production and consumption of goods and services (Brasil, 2010). It should be noted that the principles and objectives of the PNRS comprehensively seek to integrate efforts in the development of actions aimed at meeting the needs of the population, based on sustainable development, through the rational use of resources and respect for local and regional diversities through a systemic view.

The importance of reverse logistics addressed in Article 33 of the PNRS, which regulates the return of product packaging after use by consumers, is highlighted, independently of the public service of urban cleaning and solid waste management. Those responsible for the return of such waste and packaging, as well as other products whose packaging constitutes hazardous waste after use, complying with the rules for the management of hazardous waste, are the manufacturers, importers, distributors and dealers of agrochemicals (Brasil, 2010). The packages with compulsory reverse cycle are shown in Figure 3.



**Mandatory Reverse Cycle in Brazil - Law 12.305 / 2010 - PNRS-Article 33**

Manufacturers, importers, distributors and traders of agrochemicals, their residues and packaging, as well as other products whose packaging, after use, constitutes hazardous waste; Batteries; tires, lubricating oil packaging, sodium vapor, mercury and mixed light fluorescent lamps, as well as electrical and electronic products and components.

**Figure 3.** Required reverse logistics

Source: Prepared from Art. 33 of the PNRS (Brasil, 2010)

In addition to the reduction in waste generation, the PNRS also proposes the practice of sustainable consumption habits and a set of instruments to increase the recycling and reuse of solid wastes (Brasil, 2010).

Advances towards the circular economy in Brazil were presented at the FIRJAN Environmental Action Seminar, held in 2016. With the "Possible Paths" panel, the Brazilian Micro and Small Business Support Service (Sebrae, acronym in Portuguese) presented actions that are already being developed to implement the circular economy in industries of Rio de Janeiro, with investment in several productive chains, such as: tourism, fashion, creative economy, food, technology base, construction, petroleum, and naval and offshore sectors (clean energies) (Las Heras, 2016). Other initiatives such as Companhia Energética de Minas Gerais S.A (CEMIG) and the Corporate Commitment for Recycling (CEMPRE, acronym in Portuguese) were presented at the international seminar "Circular Economy and sustainability in the management of solid urban waste", which was also held in Rio de Janeiro in 2016 (Santos, 2018).

The research entitled "Closing the cycle: the benefits of the circular economy for developing countries and emerging economies" by the Ellen MacArthur Foundation addresses the circular economy in Brazil. The analyzes carried out in this work sought evidence of the economic, social and environmental advantages of the circular economy over the linear one in the Brazilian context and also sought to identify the role of the government in this process, in the sense of investing in the promotion of circular productive models (Fernandes, 2016; Santos, 2018).

It is noted that this process involves a number of necessary changes, including: "product design revolution, encouraging aspects such as longevity, durability, repair potential, upgradeability, reuse, remanufacturing and recycling" (Ribeiro; Kruglianskas, 2014, p. 19).

The publication "Circular Economy in Brazil: An Initial Exploratory Approach", launched in 2017 by the Ellen MacArthur Foundation, presents a series of actions proposed for Brazil, highlighting the existing circular economy activi-

ties and seeking to identify possible opportunities to scale these activities. "With unique market and social characteristics and incomparable natural capital, Brazil is an attractive scenario for the exploration of opportunities that could be brought to the construction of economic, social and natural capital by the circular economy" (EMF, 2017, p. 10).

The study "is based on the collection of conclusions drawn from in-depth interviews with more than 25 business representatives, academics and policymakers in Brazil who are working in this space and incorporates feedback from the collective intelligence of the CE100 Brazil network" (EMF, 2017, p. 6).

The actions proposed in the study are distributed in three sectors important to the Brazilian economy: agriculture and biodiversity assets, buildings and construction, and electrical and electronic equipment. In this context, the circular economy must be implemented comprehensively, except agriculture, which excludes agriculture and livestock for the proposal (EMF, 2017; Santos, 2018).

For the specific sectors, the idea is that existing efforts will be expanded in the case of agriculture, developing regenerative business models in agriculture and biodiversity assets, stimulating the bio-intelligence sector, leveraged by technology towards a green economy. In the building and construction sector, the proposal of the circular economy is that through the use of technology the circular economy can integrate sustainable construction projects (EMF, 2017; Santos, 2018).

Another highlight is the electronics sector, in which the industries showed a turnover of R\$ 129.4 billion in Brazil in 2016, despite the slowdown in the market compared to sales in 2015. The sector was one of the most representatives for the country's economy in the period (ABINEE, 2017). The proposal of the circular economy for the sector is to create business opportunities, integrating the formal and informal sectors, developing processes that aim to reduce costs and better utilization through the sharing of services, stimulating reverse logistics (EMF, 2017).

### **3. CHALLENGES FOR THE IMPLEMENTATION OF THE CIRCULAR ECONOMY IN BRAZIL**

The implementation of the circular economy, according to Ritzén and Sandström (2017), presents some barriers in the transition process, among which the authors cite: financial, operational, structural, attitudinal and technological. In the analysis presented, the authors identified that the barriers are related to the lack of or little knowledge of the circular economy and to the aversion to risks by companies. At the structural level, issues related to responsibilities and task as-



signments were identified. The technological question was seen as responsible for major transformations, which consequently implies a reorganization of the management and production processes. However, these are barriers that are considered as challenges because they are not a matter of choice between switching or not, in order to adopt efficient and environmentally sustainable production processes. It is a matter of necessity imposed by the current conditions of environmental problems.

For Brazil, not so different from what has been happening in other countries, the shift to a circular economy is not a simple process; some barriers and limitations are identified. Andrade, Cosenza and Santos (2018, pp. 15-16), identified in a study that analyzes the case of Brazil that the barriers that need to be overcome and which constitute as challenges are related to the following aspects: "1 - insufficiency in the separation of waste at source; 2 - low acceptance of products recycled by consumers and businesses; lack of investments and political incentives and geographical dispersion for companies of the same cycle".

However, overcoming these challenges involves a set of actions that develop an awareness of the need for changes to a green economy systemically. This implies strengthening environmental policies, more specifically the PNRS. The incentive to overcome the challenges, such as the lack of separation of waste and the low acceptance of recycled products, should be guided by actions of environmental education at all levels.

Environmental education must be aligned with information that can develop awareness of environmental protection. In this sense, it is necessary to develop social, economic and environmental responsibilities through changes in attitudes and understanding of the relationship that must be provided to environmental issues. These transformations involve not only formal educational processes, but of the most varied forms that can develop awareness for environmental citizenship (Santos; Horn, 2017).

With regard to lack of investment, there is a long way to go. In the municipal sphere, difficulties in waste management and handling are related to financial and technical capacity, which compromises the effectiveness of the PNRS (Monterosso, 2016). The difficulty is evidenced by the delay in the elaboration of the Municipal Plans of Integrated Management of Solid Waste (PMRIRS): of the total of municipalities, only 38.2% presented plans finalized in 2017 (Confederação Nacional dos Municípios, 2017).

The issue of geographical dispersion is emblematic because Brazil is marked by great economic and social differences in its regions. This aspect may hinder the integration of

processes between companies so that they can share their production.

Another aspect considered as a transition challenge for the circular economy is related to the rules of the indirect taxation system in Brazil, which allow for the collection of taxes more than once on the same added value. Every time a product is sold, part of the tax is collected repeatedly, making the products more expensive (Confederação Nacional da Indústria, 2018).

#### 4. METHODOLOGICAL PROCEDURES

The research was developed through an exploratory bibliographic review aiming to base the field of study. The bibliographic survey was carried out from the analysis of secondary sources in books, documents and articles published in national and international periodicals. "Exploratory research has as main purpose to develop, clarify and modify concepts and ideas, with a view to the formulation of more precise or hypothetical problems that can be searched for later studies" (Gil, 2008, p. 27).

For Marconi and Lakatos (2009), this type of research is characterized by the survey of the bibliography under its various forms on the subject. This approach includes documentary research, which aims to characterize the study in its context (Cooper; Schindler, 2011).

The documentary research was based on the publications of the Ellen MacArthur Foundation 2012, 2015 and 2016, the report of the European Commission for Sustainable Development, the PNRS, and the ISO 14006 of 2011, which deals with Environmental Management Systems and the Guidelines for the incorporation of the Ecodesign. It is, therefore, a research of an essentially qualitative nature.

#### 5. FINAL CONSIDERATIONS

The purpose of this research was to identify the actions of circular economy in Brazil. Thus, through the survey of sources, it was found that, although incipient, the country shows signs that this reality is possible, but challenging. Challenges can be understood by the need to change production processes, this implies broadening the use of technology, which will require investments in research aimed at finding sustainable alternatives to the circular economy. Another challenge is awareness for conscious consumption, which requires companies to invest in ways to draw people to that reality. In a highly consumerist environment, this can be a crucial challenge.



However, when considering the circular economy based on the principles that govern sustainable development, it is a fact that the current reality of social and environmental issues leads to an understanding of the need for actions aimed at implementing and strengthening a green economy centered on productive processes that aim to integrate the biological and technical cycles. With the proposals of the set of actions of circular economy for the three important sectors of the Brazilian economy, agriculture and biodiversity assets, buildings and construction and electrical and electronic equipment, Brazil takes its first steps in this direction, having an important normative and regulatory instrument, the PNRS; nevertheless, it is important to undertake efforts to strengthen the policy and its effectiveness.

For the above, the research has a relevant contribution, reinforcing the discussions about the circular economy, its advances in several countries, presenting the Brazilian reality, new interpretations and applications of the theme in order to consolidate the theoretical basis in which this discussion is inserted.

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