

Deliverables 3.2 & 3.3

**BRAZIL**

## Analysis of strengths, opportunities, weaknesses and barriers for the adoption of a Circular Economy roadmap in Brazil

**Project:** Assessment of the current status of the Circular Economy for developing a Roadmap for Brazil, Chile, Mexico and Uruguay

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## Acronyms

ANP	National Agency of Petroleum, Natural Gas and Biofuels
CNI	National Confederation of Industry
CE	Circular Economy
C2C	Cradle to Cradle
CDR	Fuels derived from waste
Embrapa	Empresa Brasileira de Pesquisa Agropecuária
EMF	Ellen MacArthur Foundation
EPE	Energy Research Office
GHG	Greenhouse Gases
IBGE	Brazilian Institute of Geography and Statistics
LCA	Life Cycle Assessment
NDC	Nationally Determined Contribution
PNRS	National Solid Waste Policy
R&D+I	Research, Development and Innovation
SDG	Sustainable Development Goals
SME	Small and Medium Enterprises
SIRENE	Sistema Nacional de Registro de Emissões
SNIS	National Sanitation Information System
SINIR	National Solid Waste Management Information System
PMR	Partnership for Market Readiness
FINEP	Financiadora de Estudos e Projetos
NDC	Nationally Determined Contribution
MCTIC	Ministry of Science, Technology, Innovations and Communications
MDR	Ministry of Regional Development
MME	Ministry of Mines and Energy
PACTI	Science, Technology and Innovation Action Plan
PNDR	National Policy for Regional Development
PNA	National Adaptation Plan
UN	United Nations



## 1. Introduction

This report presents the results of **deliverables 3.2 and 3.3** of the technical assistance "Assessment of the current status of the Circular Economy for developing a Roadmap for Brazil, Chile, Mexico and Uruguay" RFP/UNIDO/7000003530.

This report presents an analysis of the strengths, opportunities, weaknesses and barriers in the country to support the development of a general roadmap for the implementation of a circular economy in Brazil. This methodology was conceived in line with the work plan, and with the approval of the national designated entity. The focus on a general approach at national level can lay down strategic areas for the development of CE Value Chains, to enable the engagement of different economic sectors to explore collaboration within and across sectors and account for the different regional characteristics in the country.

This assessment is based in the SWOT analysis methodology applied for the objectives of this technical assistance. A SWOT analysis is a tool originally developed to help find the best match between contextual trends (opportunities and threats) and internal capabilities (strengths and weaknesses) of an organization. In our case this analysis is used to provide insights and help decision makers to take advantage from perceived opportunities for the implementation of a CE in Brazil — by employing strengths and avoiding threats by understanding them or by correcting or compensating for the identified weaknesses. Relevant data about the national context were gathered from key actors participating in the survey and interviews for **deliverable 2.4** as well as the assessment of complementary data added in **deliverable 3.1**.

First, an analysis of the strengths and opportunities in Brazil for the adoption of a general circular economy process will be presented, according to the work plan, particularly to the following aspects:

- a. Industrial, innovative and technological infrastructure;
- b. Policies and initiatives related to recycling, climate change and circular economy;
- c. Governance and leadership related to CE;
- d. Level of incorporation of non-conventional renewable energies, (NCRE);
- e. Alignment of public and private agendas (commitment of government, companies, organizations, academia and society);
- f. Potential for job creation;
- g. Impact on NDCs and SDGs to Brazilian context; and
- h. Main economic activities in the country that might be most impacted by the circular economy.

Next, an analysis of the weaknesses and barriers in Brazil for the adoption of a general, circular economy process according to the work plan, particularly to the following aspects:

- a. Regulatory;



- b. Market;
- c. Cultural;
- d. Entrepreneurship support;
- e. Financing and capital;
- f. Industrial and technological; and
- g. Recovery of products or materials (logistics, collection, repair and manufacturing).

As a result, from this assessment, it was possible to draw some recommendations to the development of a general roadmap for the implementation of a circular economy in Brazil. It is important to note that different evaluation perspectives from these presented here may arise in different contexts and for different actors. The same fact that one considers an opportunity can be seen as a threat, or an apparent strength can be perceived as a weakness, or a weakness can also represent a strength. This kind of situation can bring new perspectives to evaluate implementation strategies of pilot projects and other actions and should be taken into account when working with key actors in future development processes of the circular economy roadmap in Brazil.



## 2. Strengths and opportunities for adopting a Circular Economy in Brazil

In the following table a framework is presented for analysis of strengths and opportunities for the adoption of **a general circular economy in Brazil**. This information not intends to give an analysis of all strengths and opportunities but to propose a framework that could help to improve the understanding of the general context for a CE implementation in the country.

**Table 1. Strengths and Opportunities related to industrial, innovative and technological infrastructure aspects**  
Source: own elaboration.

Strengths	Opportunities
<p>The industry, government, research institutions and academia are engaged in a joint effort for promoting and developing Life Cycle Assessment methodologies (LCA) and Life Cycle Inventories (LCI)</p> <p>An industrial symbiosis program for collaboration in innovation is being developed in the country. There are some pioneer cases in industrial symbiosis already in operation.</p> <p>Results from a recent survey by CNI claims that the industrial sector in Brazil is carrying out many initiatives related to the CE.</p>	<p>LCA and LCI methods can be the basis for assessing CE solutions in products and processes.</p> <p>There is a great opportunity to improve professional development by learning from CE approaches to deliver more sustainable production processes and having a wider adoption of LCA and LCI methods.</p> <p>Creating complex cross-sector networks — where waste from one side is a resource for another — is one important feature of a CE.</p>
<p>Brazil has robust governmental agencies with long experience in supporting R&amp;D+i for agriculture and industry sectors that are to apply the CE approach</p> <p>The Science, Technology and Innovation Action Plans in Brazil were built based on the guidelines defined by the National Strategy for Science, Technology and Innovation 2016-2022 (ENCTI).</p> <p>Brazil's 'Country Program' for the Green Climate Fund (GCF) present opportunities for financing proposals that meet the fund's criteria in line with national priorities, with economic viability and potential for transformational impact.</p>	<p>CE Resources management can promote advances in data and information management for industry.</p> <p>CE systems for materials and products management can be implemented by adopting industry 4.0 technologies.</p> <p>The National Science, Technology and Innovation Strategy (ENCTI 2016-2022) proposes the establishment of a collaborative innovation paradigm in Brazil, with the participation of the scientific community, the productive sector and public bodies.</p>
<p>The national plan for low-carbon agriculture has programs and themes well aligned with biological cycle CE innovations.</p>	<p>CE approach can support advances in: recovery of degraded pastures; crop-livestock-forestry integration (iLPF) and agroforestry systems (SAFs); biological nitrogen fixation (BNF); planted forests; animal waste treatment; adaptation to climate change.</p>



<p>The country has recently released the Bio-economy National Action Plan, and the circular economy is one of the main directives of it.</p> <p>Advances in energy generation from renewable resources, mainly biogas and biofuels, are being developed with great success in Brazil.</p> <p>Studies to implement a National Carbon exchange Market are in progress.</p>	<p>Bioeconomy and Bioenergy are fields that have a huge potential in the agroindustrial sector in Brazil, by implementing CE biological cycle to enable cross-sector integration in circular systems for food, energy and nutrient cycling.</p> <p>CE biological cycles may promote innovations for technology in biomaterials and biotechnologies associated with biodiversity and ecosystem services protection.</p> <p>Clean renewable energy production is one of the cross-sector potentialities of the CE value chains.</p>
<p>Many companies in Brazil are players in global supply chains and willing to comply with waste management demands.</p> <p>The national waste management policy (PNRS) principle of shared responsibility for wasted products and materials and the sectoral agreements for implementing reverse logistics systems are powerful regulation instruments in place.</p>	<p>There is room for many improvements in PNRS sectoral agreements and support to frontrunners in materials management in Brazil (packaging, paper, plastics, glass, metals, electronics).</p> <p>Many Brazilian cities have competitive construction sectors which may gain with a more sustainable approach from CE business models.</p> <p>Cities have potential for Urban Mining activities as a strategy for not losing the value from products and materials that are currently being wasted.</p>



**Table 2. Strengths and Opportunities related to policies and activities in recycling, climate change and circular economy**

Source: own elaboration.

Strengths	Opportunities
<p>The National Solid Waste Policy (PNRS) recognizes the economic value of wasted materials to reduce, reuse and recycle, prioritizing the avoidance of the generation of waste in the first place.</p> <p>According to the PNRS, recycling is not considered a type of waste treatment, but rather a step, in solid waste management.</p>	<p>The circular economy approach can pull concrete actions connecting resources management (materials, co-products and products), decent jobs opportunities and climate change mitigation and adaptation strategies in convergence with the National Waste Management Policy.</p> <p>This creates an opportunity to the establishment a broad National Policy on circular economy, converging other governmental initiatives linked to it, like the Bioeconomy Action Plan and others.</p>
<p>National legislation for industrial waste requires a management plan with identification and classification of the types of industrial waste existing in the company including listing of recyclable waste.</p> <p>The recycling processes require the implementation of a selective collection program, which needs training and awareness of the workforce and valuation of materials to improve quality of the waste and facilitate its transportation and handling.</p>	<p>CE may promote cross-sector collaboration to comply with the PNRS.</p> <p>Having a common goal for the implementation of the technological advancement towards CE in the country is important to guide policy makers.</p> <p>Similar types of Industrial and urban waste can be managed by the same systems.</p>
<p>Most of the initiatives from the private sector in the country are looking for improvements in waste reduction and reverse logistics.</p>	<p>There is a short-term economic gain recognized by efficient use of resources and keeping the most value of materials for as long as possible.</p>



<p>The Brazilian "Bioeconomy Action Plan" is committed to reducing considerably greenhouse gas emissions. One focus of the NDC mitigation strategy on accounting the role of conservation units and indigenous lands as forest managed areas.</p> <p>The National Biofuels Policy aims to expand biofuels adoption in the energy matrix (specially biodiesel and biomethane) reducing GHG emissions in energy production and consumption.</p> <p>The Low-Carbon Agriculture national Plan aims to stimulate and monitor the adoption of climate change adaptation and mitigation technologies combining conservation with economic results.</p> <p>The PNMC guidelines fosters practices to effectively reduce GHG emissions and encourage the adoption of low carbon activities and technologies, and more sustainable production and consumption standards. The instruments for its implementation are, among others: the National Plan on Climate Change, the National Fund on Climate Change and the Communication of Brazil to the United Nations Framework Convention on Climate Change.</p>	<p>The National Policy on Climate Change (PNMC) establishes guidelines for sectoral plans and themes for mitigation and adaptation to climate change among them agriculture, industry and mining, electric power infrastructure, transport and urban mobility, health, vulnerable populations, water resources, biodiversity and ecosystems, cities and urban development, natural disasters, food and nutritional security and coastal zones.</p> <p>The PNMC recognizes the complementary role of south-south cooperation, on the basis of solidarity and common sustainable development priorities. Thus, Brazil aims to undertake efforts to enhance cooperation initiatives with other developing countries, particularly in the areas of forest monitoring systems, biofuels capacity-building and technology transfer, low carbon and resilient agriculture, restoration and reforestation activities, management of protected areas.</p>
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**Table 3. Strengths and Opportunities related to governance and CE leadership**

Source: own elaboration.

Strengths	Opportunities
<p>The National Confederation of Industry (CNI) carries out many publications and advocates on the competitive advantages of the EC to the Brazilian industry.</p> <p>The 'Circular Economy Strategic Map for Brazilian Industry' just released by the National Confederation of Industry (CNI) has pointed to the main priority areas in the country to accelerate CE implementation, which are: Policies, Education, R&amp;D+I, Financing and Market.</p> <p>The national Action Plan for a Bio economy shows a willingness to pull incentives to the use of renewable resources.</p>	<p>It is expected that the CE will develop a positive vision of the future in order to convene the players to turn CE projects into practice.</p> <p>Bioeconomy is a global newborn market which may give competitive advantage for national industry.</p> <p>CE projects can demonstrate the strategic value of the circular economy and confirm Industry expectations.</p>
<p>The National Policy for Regional Development establishes the National Integration Routes (including the Circular Economy Routes) to promote coordination of public and private actions to foster innovation, differentiation, competitiveness and sustainability of associated enterprises, thus contributing to the productive inclusion and regional development.</p> <p>The National Solid Waste Policy (PNRS) has some powerful instruments in practice like the sectoral agreements and shared responsibility to reverse logistics of products and packaging.</p>	<p>Most cities and metropolitan areas in Brazil could implement CE systems in large scale and major cities may have the capacity for investments to push forward CE solutions.</p> <p>CE approach may boost sectoral collaboration in PNRS to engage all value chain actors including industry, commerce, service providers, distributors and consumers in alignment with State and Municipal level, accounting for different regional contexts.</p>
<p>The National Bank of Life Cycle Inventories (SICV Brasil) is a national information system adapted to the context of Brazilian industrial production and agro-production.</p> <p>The National Sanitation Information System (SNIS) is an information system dedicated to urban solid waste management, water and sewage services, and rainwater drainage and management. The SINIS has data from 85% of the Brazilian population in urban areas (151Mi people).</p>	<p>CE may create space for collaboration in sectoral agreements and for Life cycle inventories to improve dialogue between government, companies and actors within the value chains.</p> <p>The CE projects may explore what are the best options in the CE for the industry across different sectors.</p> <p>CE projects are an opportunity for open innovation collaboration between large companies, SMEs and startups.</p>



**Table 4. Strengths and Opportunities related to level of incorporation of non-conventional renewable energies (NCRE)**

Source: own elaboration

Strengths	Opportunities
<p>The country has long experience, mature knowledge and built capacity in biomass to biofuels technologies through the National Biofuels Policy – Renovabio.</p> <p>The addition of biofuel (anhydrous ethanol) to gasoline (27%) and other fuels is mandatory in the country.</p> <p>There is a national program Biogas Brazil for bi-methane production from organic residues in landfills and sewage treatment plants to replace natural gas in electricity generation and vehicular use. Processes also result in bio-fertilizers for application in agriculture, forestry and reforestation.</p> <p>Currently in Brazil, there are 548 biogas production plants with bio-digestion technology to waste treatment for electric, thermal, mechanical and bio-methane energy generation. The country's potential of biogas production is up to 2,303,247,268 m<sup>3</sup>/year.</p>	<p>The Brazilian National Biofuels Policy aims the expansion of the biofuels in the country and also there is great expectations to establish a national carbon market to push renewables adoption, thus creating a positive environment for CE.</p> <p>The CE biological cycle related to renewable energy production may bring opportunities for economic growth associated with climate change mitigation and adaptation.</p>
<p>The Brazilian ABC Program (Low-Carbon Agricultural Program) is also supporting the development in the use of organic manure for local energy generation and fertilizers, integrating actions between agriculture and the energy sector (storage, purchase and distribution).</p>	<p>Renewable energy can deliver a large competitive advantage for industry and agriculture, especially in global supply chains. CE can be turned into a driver for investments to increase renewable energy participation in the Brazilian energy matrix.</p>



**Table 5. Strengths and Opportunities related to alignment of public and private agendas (commitment of government, companies, organizations, academia and society)**

Source: own elaboration

Strengths	Opportunities
<p>In general, the Brazilian industrial sector understands that CE is aligned with the National Solid Waste Policy (PNRS) sectoral agreements efforts for reverse logistics.</p> <p>Overall, Brazilian companies agree that the CE may be important to contribute to competitiveness.</p>	<p>The CE has space in the current national agenda for the industry to gain credibility and build trust among the actors across the productive sectors.</p> <p>The CE can become a reference for the different actors in society and facilitate the identification of a common vision for sustainable development.</p> <p>The CNI Circular Economy agenda for the Industry sector highlights the opportunities: 1- This new economic model brings opportunities to value good practices and take advantage of the comparative differentials of Brazilian industry; 2- It is strategic for the industrial sector to take advantage of business opportunities related to circular economy practices to develop new links in its production chain.</p>
<p>The PNRS has a focus on Urban waste management and brings a systems perspective considering the whole product life cycle and the whole supply chain integration.</p> <p>In general waste management is a main concern in cities and in Brazil more that 85% population lives in urban areas.</p>	<p>The CE approach could help the different actors better understand their roles for materials and products management regarding shared responsibility.</p> <p>CE can support improvements for sectoral agreements to reverse logistics in PNRS, finding ways of cooperation and coordination between actors.</p>



## 2.1. Strengths and Opportunities related to job creation

**Table 6. Strengths and Opportunities related to job creation**

*Source: own elaboration*

Strengths	Opportunities
<p>The PNRS recognizes that waste management is a social and economic development tool and encourages the collaboration between industries and the recycling cooperatives.</p> <p>The Law recommends that wasted materials recovery should be carried out primarily by recycling cooperatives. In Brazilian cities, 30% of recyclable material is recovered by cooperatives.</p> <p>Waste management in Brazilian cities employs 333,000 workers, plus 27,000 workers in recycling associations (2018).</p> <p>From the urban waste recovered 91% are recyclable materials from civil construction and household waste.</p> <p>High amounts of materials are recovered for recycling mainly paper, plastics, metals and glass.</p>	<p>Many activities related to materials and products management are labor intensive which absorbs low skills workers, potentially promoting job creation and formalization.</p> <p>The circular economy has the potential to create also high-quality jobs in new product-service business models, improved supply chains, industry 4.0 technologies.</p>
<p>In Brazil, there are many commercial activities in products reuse, share, resale, maintenance, refurbishment and redistribution.</p>	<p>The potential of Brazilian services sector and consumer market can be explored by CE new business models for product-service, in diverse contexts in cities.</p> <p>CE improvements in waste management can open opportunities to create more jobs in Brazil.</p> <p>In general, new CE business models increase job creation through labour intensive activities in product-services systems.</p>



**Table 7. Strengths and Opportunities related to impacts on NDCs and SDGs**

*Source: own elaboration*

Strengths	Opportunities
<p>The country has a consistent National Policy on Climate Change (PNMC) and a National Plan for Climate Change Adaptation (PNA).</p> <p>Most companies and technical bodies in government recognize the 2030 Agenda and the Paris agreement.</p> <p>Around 70% of recyclers in cooperatives in Brazil are women.</p>	<p>Formalizing informal jobs in waste management and actions for climate change mitigation are two important social aspects that the CE could help explore in Brazil.</p> <p>Understanding the work of recycling cooperatives from a CE perspective is essential to explore the PNRS full potential for CE.</p> <p>CE projects can demonstrate their potential to deliver beneficial social impacts in the Brazilian context.</p> <p>There is an aspiration that the CE for Brazil will embrace the participation of recyclers cooperatives and promote social inclusion of informal waste pickers.</p>
<p>Brazilian NDC has set up clear areas of action that are related to CE biomaterials cycling: biofuels, low carbon and resilient agriculture, forest monitoring, restoration and reforestation, and management of protected areas need to be developed.</p>	<p>Fostering the Bioeconomy action Plan implementation using the CE approach can reduce GHG emission and support responsible exploration of natural resources.</p> <p>The broad adoption of CE in economic sectors could boost bioenergy and deliver improvements to the NDC for Climate Change Mitigation.</p>

**Table 8. Strengths and Opportunities related to economic activities in the country that might be impacted by circular economy**

*Source: own elaboration*

Strengths	Opportunities
<p>Biogas production uses predominant sources of organic substrates mainly from industrial sources (sugar; food and/or beverage and dairy products) and agriculture (pig farming, dairy or beef cattle farming, poultry or pig slaughterhouse and laying or cutting poultry) and sanitary treatment plants (sewage, landfill, sewage sludge and co-digestion of waste).</p>	<p>The concept of consortia established in the PNRS can serve as a way to create local productive arrangements (APL) between industries, agriculture and services sectors and other actors.</p>



Strengths	Opportunities
<p>In the PNRS, manufacturers, importers, distributors and traders are obliged to establish reverse logistics programs of recyclable and reusable materials, primarily in partnership with recycling cooperatives.</p>	<p>In CE value chains, companies can partner to get advantages by increasing individual efficiency, simplify and streamline processes, and shared control of resources.</p> <p>In CE value chains partnerships between small companies and large industries must be established.</p>
<p>Many industrial sectors in the country are using 2<sup>nd</sup> raw materials from recycling as inputs for products, among them wood, paper and cellulose, glass, aluminum, steel and plastics.</p>	<p>The packaging industry using steel, aluminum, plastics and paper may gain a lot from CE innovations.</p> <p>Using CE criteria to guide products re-design is considered a key strategy to improve materials management.</p>
<p>Services sector in Brazil has many activities related to reuse, share, resale, maintenance and refurbishment of products.</p>	<p>Value chains in textiles and apparel, packaging, household appliances and electronic devices are some of the sectors that could take many advantages from the adoption of new product-service systems CE business models.</p> <p>Brazilian socio-cultural context may be open for setting up CE commercial product-services systems in cities.</p>



### 3. Weaknesses and barriers for adopting a Circular Economy in Brazil

The following table presents an analysis of **weaknesses and barriers for the adoption of a general circular economy in Brazil**. Not all barriers and weaknesses were listed here, the idea is to demonstrate how to improve the understanding of the general context for a CE implementation in the country.

**Table 9. Weaknesses and barriers related to regulatory aspects**

*Source: own elaboration*

Weaknesses	Barriers
<p>Materials management in Brazil needs to account the different social, cultural, economic regional characteristics, as well as the different industry sector profiles.</p>	<p>Very different contexts of the Brazilian regions may impose a challenge to the implementation of CE nation-wide value chains.</p>
<p>In general, standards for products and materials management needs enhancements to protection to human and environmental health.</p> <p>Industrial waste needs many types of processes or operations to be recovered as co-products or secondary raw materials, and not as rejected waste.</p> <p>In general, the usual linear economic model approach in most of the regulatory systems disregards the importance of maintaining the value of resources already produced.</p>	<p>The mobilization of industry, waste recycling cooperatives and the government, and many more actors are needed to push change in some regulations which may be restraints for the deployment of CE systems.</p> <p>New taxation models are needed to support the creation of a strong market on secondary materials management on materials and products. One challenge is double taxation to recycled materials.</p>



**Table 10. Weaknesses and barriers related to market aspects**

*Source: own elaboration*

Weaknesses	Barriers
<p>More "linear thinking" sectors are very important to the national economy, like the extractive sector (mining metals, wood, fishery), Agri-business (monoculture, cattle) and oil sectors.</p> <p>Climate change in Brazil is related mainly to resource extraction, deforestation, use of fossil fuels and waste of resources (production-consumption patterns).</p>	<p>Brazilian industry needs to build many improvements in materials management to show its commitment in the global sustainability causes, like for plastics, food, textiles and apparel products.</p> <p>There is a need for behavior change in society and better understanding on the importance of sustainable use of resources.</p>
<p>In general, for the marketing of products, there is a lack of understanding and skills in communicating the advantages of sustainable products to the general public.</p> <p>There are difficulties in collaboration between actors in value chains to push in market innovations for more sustainable products.</p> <p>In Brazil, cities up to 30.000 inhabitants recovers only around 25% of potentially recyclable waste.</p>	<p>Business managers and the general public acceptance must be taken into account to increase the chance of success of CE innovations in the market.</p>



**Table 11. Weaknesses and barriers related to cultural aspects**

Source: own elaboration

Weaknesses	Barriers
<p>In general, the scientific and managerial knowledge on CE are not disseminated in the country.</p> <p>In general, more usual "linear thinking" is still in most of the value chains in many economic sectors.</p> <p>In Brazil most of the industry is still driven by a short-term vision and current policies are based on a linear economic approach.</p>	<p>The implementation of the CE depends on change in the mindset of policy makers, business managers and consumers.</p> <p>Implementing a CE demands capacitation in new professional knowledge and management practices to enable the adoption of technologies and systems innovations.</p>
<p>Sectoral agreements are complex and there are many conflicts to establish the reverse logistics within the PNRS.</p>	<p>The implementation of the CE in Brazil needs to be articulated and coordinated In the long term, with many actors from different sectors.</p> <p>CE value chains will need more cross-sector collaboration.</p>
<p>Change towards more sustainable products use and consuming patterns is still not strong in Brazil.</p> <p>There is not yet much engagement from the general public for materials and products recovery.</p>	<p>Engagement on shared responsibility schema for products and materials also depends on consumers behavior change.</p> <p>Social and cultural mobilization are necessary to influence changes in consumption, materials management, policies and cooperation mindset towards CE.</p>
<p>Besides the technological, human and financial resources, proper solid waste management depends on a change in "business as usual" attitude adopted and disseminated by managers.</p>	<p>Developing and adopting clear criteria and indicators are key to measure and monitor what is (and what is not) a CE system.</p>
<p>Regarding sustainability in business, there are still challenges for improvements in many of the industrial sectors in Brazil: compliance with regulations, resource efficiency, systemic and long-term vision, collaboration along the supply chain, innovation culture, are one of those.</p>	<p>To engage actors in the CE projects the goals for implementation need to be bold and inspiring.</p> <p>CE implementation needs changes from competitive to a more collaborative and "take care" mindset for business management and policy makers.</p>
<p>Currently there is no correlation being explored between Gender Equality and CE.</p>	<p>Most decision-making positions are occupied by men.</p>



**Table 12. Weaknesses and barriers related to entrepreneurship aspects**

*Source: own elaboration*

Weaknesses	Barriers
In general, companies need better environments capable of supporting collaboration.	Understanding interests and needs from different companies and establishing effective partnerships to articulate and engage them is key for CE.
There are still few means to enable and accelerate the technological and systems innovation for SMEs and startups.	CE projects need to be capable of scaling initiatives up to the regional level of the Brazilian territory.  Innovative CE solutions need a supportive environment for startups and SMEs before going to compete in the market.



**Table 13. Weaknesses and barriers related to financing and capital aspects**

Source: own elaboration

Weaknesses	Barriers
<p>In general, there are economic challenges especially for financing technological upgrading and innovation in the industry in Brazil.</p> <p>The CNI Circular Economy agenda for the Industry sector highlights the challenges: 1- The transition to a circular economy requires improvements in national infrastructure and public policies; 2- It is necessary to adapt the Brazilian tax system to encourage the best use of natural resources;</p> <p>There are high costs associated with reverse logistics implementation.</p>	<p>Changes in tax mechanisms can support the recycled materials market in Brazil and encourage technological innovation.</p>
<p>Currently, government spending on waste management in cities in 2018 was estimated at USD 5.2Bi, even though most of the materials value is lost in the process.</p>	<p>To gain efficiency in CE, keeping most of the value from materials and products is key to have a steady flow in financing R&amp;D+i in CE technologies and systems for industry and agriculture.</p>

**Table 14. Weaknesses and barriers related to industrial and technological aspects**

Source: own elaboration

Weaknesses	Barriers
<p>Many Brazilian companies have a limited culture of innovation.</p> <p>Companies are worried about being able to implement Circular Economy together with Ind. 4.0 technologies.</p>	<p>To have companies' broad engagement in innovations the CE projects need to show tangible results.</p> <p>It is possible to learn from European solutions and cases for CE, but most of the time they are not fitted or need to be adapted for the Brazilian context.</p> <p>In the same time that the Ind. 4.0 technologies may solve many technological issues on materials and products management, it may create unpredictable social consequences.</p>
<p>Mining and commodities are very important economic sectors in Brazil.</p>	<p>Extracting activities are considered one of the sectors that needs more changes in the way it operates in a circular economy.</p>



Weaknesses	Barriers
<p>In Brazil, industry needs to push forward efficiency in the use of materials in production processes.</p> <p>There are few available databases, at the national level, regarding the generation, treatment and final disposal of industrial waste.</p>	<p>A CE industrial symbiosis need to go beyond just using waste, by creating platforms for materials and products circulation in complex cross-sectoral relationships within industrial clusters.</p> <p>CE industrial systems need to be developed to keep the most of products and materials valued for as long as possible in the market and, after this, recover biological and technical materials as resources back to industry.</p>
<p>There is a need for much improvements in scale sustainable food production.</p> <p>Most of the cities in Brazil lack of good sewage systems infrastructure.</p> <p>Especially in rural areas and urban poorest communities there is much need for improvements in sanitation systems.</p>	<p>CE industrial systems need to be developed to use materials and produce products in a way that ecosystems services are regenerated, and people's and environmental health is improved.</p>
<p>The country lacks infrastructure and logistics systems to enable CE resources management in most of the Brazilian territory.</p>	<p>There is a need for many innovations and improvements in transportation and logistics infrastructures for CE implementation.</p>



### 3.1. Weaknesses and Barriers related to recovery of products or materials

**Table 15. Weaknesses and barriers related to recovery of products or materials (logistics, collection, repair and manufacturing)**

Source: own elaboration

Weaknesses	Barriers
<p>In Brazil, only 37% of the population in cities are served by a specific waste collection system for recycling.</p> <p>It is estimated that 30% of waste collected in urban areas is potentially recyclable (20% is not recoverable by any means), but only a fifth of this was recycled in 2018.</p> <p>In 2018, 55.2 Mi tons/year of waste went to "linear systems" like landfilling, incineration and dumping ground.</p> <p>From the total amount of urban waste, 50% is potentially recoverable organic waste, but in 2018 only 9% of this was sent to composting and/or branches and pruning facilities.</p> <p>Almost 40% of Biogas production facilities in the country are currently under construction.</p>	<p>Usual initiatives in waste management are mostly looking for improvements in waste reduction as a "end-of-pipe solutions".</p> <p>In general, there are no specific waste management systems to collect the abundant organic waste in Brazilian cities.</p>
<p>Most initiatives in waste management, including cooperatives, are addressing recycling but are not exploring the full potential of CE.</p> <p>Great part of the workforce in waste management is in informal jobs.</p> <p>There are many women enrolled in recycling activities in cooperatives, but there is not much debate on gender issues in this sector.</p>	<p>In Brazil there are not many examples of innovation projects developed with waste pickers and cooperatives.</p> <p>Recycling cooperatives need to gain capacitation and technology for professionalization of services.</p>
<p>There is no data regarding collection services dedicated for organic waste.</p> <p>It was not found consolidated information of industrial waste generated in the country.</p>	<p>Both Technical materials Cycle and Biological materials Cycle needs monitoring and evaluation systems for planning and assessing CE implementation.</p>



## 4. Recommendations for the country for implementing a circular economy

This report provides information about the strengths, opportunities, weaknesses and barriers to help take advantage of context opportunities in the country. Many insights can be explored to support decisions to the design of a general roadmap for implementation of CE in Brazil, by employing strengths, avoiding threats by understanding them or by correcting or compensating for weaknesses. With the results assessment, it is possible to draw some recommendations.

Developing a positive vision of the future and demonstrating the strategic value of the circular economy in projects are key to mobilize and coordinate actors. In Brazil, the industrial sector is already promoting the competitive advantages of the CE and urging for improvements in policies, education, R&D+I, financing and market to enable more CE business opportunities in the country. Implementing CE common goals is important to guide policy makers to update regulations for cross-sector collaboration in materials and products management as valuable assets, and also to engage as many actors as possible, especially business managers and consumers, with training and awareness programs.

In Brazil, CE is in line with the current national agenda for the industrial sector and is well aligned with the National Waste Management Policy (PNRS) sectoral agreements, thus implementing CE could address competitiveness as well as become a reference for mobilizing different actors in society. Current regulations for industrial waste reduction, materials management and reverse logistics could also apply the CE approach to look forward improvements to incorporate strategies for long-term economic gains, resilience and competitiveness.

The implementation of CE can take advantage of the principles of the national waste management policy, PNRS — like recognize value of waste management for social development, prioritize the recovery of the economic value of wasted materials and the avoidance of the generation of waste in the first place, and regulate recycling as a step in the management of materials back to industry — and thus, the CE approach for resources management, materials, co-products or products, can be in line with the creation of decent jobs opportunities and climate change mitigation and adaptation. The Brazilian PNRS already recognizes that waste management is a social and economic development tool and that should be carried out primarily by recycling cooperatives. Going forward on this, CE materials and products management and especially new business models in product-services systems — activities for products reuse, share, resale, maintenance, refurbishment and redistribution — are labour intensive activities.

Bioeconomy is also one very strategic area for Brazil that must receive attention, for development of technologies in biomaterials and biotechnologies associated to biodiversity and ecosystem services protection, where the CE is embedded and is also a driver to enable competitive advantage in the use of renewable resources, by implementing CE biological cycle, in cross-sector integration of food, energy and nutrient cycling sectors. The National Biofuels Policy and Low-carbon Agriculture are two main areas to promote economic growth associated with climate change mitigation and adaptation in Brazil. In this context, CE projects can turn into drivers for capturing international funds for



investments in industry and agriculture innovation, especially for global CE supply chains innovations. Brazilian experience and mature knowledge in biomass for biofuels, for bio-methane production from organic residues as well as the use of organic manure for local energy generation and fertilizers in rural areas are some examples.

It is important to increase the support in R&D+i for Industry and Agriculture sectors, including SMEs and startups to explore what the best options are in the CE for open innovation collaboration, especially in designing new products and processes and for the creation of more complex cross-sector networks, taking advantage from industrial symbiosis and low-carbon agriculture pioneer projects in the country. In general, Brazilian economic sectors can take advantage from innovations in biomaterials and biotechnologies associating sustainable development with biodiversity and ecosystem services, creating cross-sector integration in circular systems for food, renewable energy production and nutrient cycling. The Bioeconomy National Action Plan, the Bioenergy biogas and biofuels and National Carbon Exchange Market are some foundations to guide these efforts. Accelerating professional capacitation programs in CE technologies and systems, especially for industry 4.0 technologies adoption and integration, is also an important aspect. The national waste management policy (PNRS) principles, especially for shared responsibility and regulatory instruments like the sectoral agreements for implementing reverse logistics systems could be updated with CE to push urban waste management to another level — and even for urban mining in near future — for paper, plastics, glass, metals, electronics with potential impact in packaging and the construction sector in cities.

In Brazil many sectors can benefit from CE implementation. Biogas production uses predominant sources of organic substrates mainly from industrial, agriculture, sanitary treatment facilities. Local productive arrangements (APL) between industries and agriculture sectors could be created for regional development and productive inclusion. There are already many industrial sectors in the country using 2nd raw materials from recycling as inputs to products manufacturing, like from packaging industry using steel, aluminum, plastics and paper. Companies can partner to get advantages from products re-design in CE value chains. PNRS shared responsibility principle already obliges manufacturers, importers, distributors and traders to establish reverse logistics programs in partnership with recycling cooperatives. Moreover, socio-cultural context may be open for setting up CE commercial product-services in cities. Globally, textiles and apparel, packaging, household appliances and electronics manufacturers are adopting CE product-service systems related to reuse, share, resale, maintenance and refurbishment of products.

Understanding Brazilian regional specific socio-cultural, economic and environmental characteristics is another issue of much importance for the implementation of CE in Brazil. To this aim, the National Integration Routes from the National Policy for Regional Development — which already includes a 'Circular Economy Routes' approach for sustainable development in cities and metropolitan areas is a key element. The Circular Economy routes combined with the PNRS are powerful instruments and could leverage the CE projects capacity in engaging industry, commerce, service providers, distributors and consumers in alignment with State and Municipal level and accounting the different regional contexts in Brazil.



Brazilian companies and technical bodies in government agencies recognize the 2030 Agenda and the Paris agreement. Brazil has a consistent National Plan on Climate Change and a National Fund on Climate Change. CE implementation in Brazil can also demonstrate its potential to deliver beneficial social impacts by supporting recycling cooperatives in adopting the CE approach in their work and embrace the participation of recyclers cooperatives in CE projects. CE approach can help communicate better the benefits of PNRS systems perspective considering the whole product life cycle and the whole supply chain integration for actors and promote better understanding of their roles for materials and products management, finding ways of cooperation and coordination from sectoral agreements to reverse logistics. CE implementation in Brazil can take advantage from The National Bank of Life Cycle Inventories and National Sanitation Information System. Life Cycle Assessment methodologies (LCA) and Life Cycle Inventories (LCI) designed for CE products and processes provide tools for measuring and monitoring CE development. Current data and information management systems, like SINIS, can include management of biological materials, technical materials and products in a CE approach.



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