A CIRCULAR ECONOMY IN BRAZIL: An initial exploration

A product of the collective expertise of members of the CE100 Brasil Network

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ABOUT THE ELLEN MACARTHUR FOUNDATION AND THE CE100

The Ellen MacArthur Foundation works with business, government and academia to build a framework for an economy that is restorative and regenerative by design. It was established in 2010 with the aim of accelerating the transition to the circular economy.

Since its creation, the Foundation has emerged as a global thought leader, establishing circular economy on the agenda of decision makers across business, government and academia. The charity’s work focuses on five interlinking areas: insight and analysis, business and government, education and training, systemic initiatives, and communication.

The Circular Economy 100 (CE100) is a pre-competitive innovation programme established to enable organisations to develop new opportunities and realise their circular economy ambitions faster. It brings together corporates, governments and cities, academic institutions, emerging innovators and affiliates in a unique multi-stakeholder platform. Specially developed CE100 programme elements help members learn, build capacity, network, and collaborate with key organisations around the circular economy.

ABOUT THE CE100 BRASIL

Launched in October 2015, the CE100 Brasil is tailored to organisations who have identified opportunities in the Brazilian market. The programme runs in parallel to and complementary with the CE100 global network. It offers a pre-competitive collaboration and innovation programme that brings together key stakeholders from businesses, governments, academia and affiliate organisations to work as a living lab for the transition to the circular economy in Brazil. The CE100 Brasil enables member organisations to develop understanding, overcome challenges, and capture opportunities arising from the country’s unique characteristics.
CIRCULAR ECONOMY REFLECTIONS FROM WITHIN BRAZIL

‘We need to reinvent the way we think business. Evolving from linear to systemic thinking is key to innovate towards regenerative production and consumption patterns. This is how we shift business’ role in society, generating positive social, environmental and economic impact.’
- Renata Puchala, Sustainability and Social Strategic Impact Senior Manager, Natura

‘Within the Tarkett Group we are convinced of the circular economy’s importance. This is a purpose that guides our decisions daily. We are proud to work with the Ellen MacArthur Foundation in Europe, the United States, and now also in Brazil. We believe that the CE100 is a powerful collaborative platform for exploring new business models in Brazil and developing creative solutions aiming for sustainable growth. As well as exchanging experiences with companies in other sectors, we seek to share our knowledge on the circular economy, contributing towards the development of a new industrial model.’
- Walter Gonçalves, Vice President for Latin America, Tarkett

‘Circular economy is a broad, multidisciplinary and aggregating concept. Society’s efforts towards accelerating the transition will necessarily involve adapting the concept to the realities of each country, region, or city. For that reason, this research was fundamental in establishing the first foundations of a “tropicalised” circular economy, a Brazilian style transition, which is being collectively built for a country with a natural talent for circularity.’
- Luiz Ricardo Berezowski, Nat.Genius Business Unit Sr. Manager, Embraco

‘The transition is not just about building a universal consciousness, but about creating a new industrial ecosystem led by leaders with vision and ability to influence the markets.’
- Carlos Ohde, Country Manager, Sinctronics
‘It is well known that organisms that support the life surrounding them are more resilient and sustainable in the long term. The circular economy practice is crucial for maintaining economic value generation without having to increase the extraction of our system’s natural resources. Sistema B integrally supports the Ellen MacArthur Foundation in this relevant study for the transition towards a new economic model, based on the principles of interdependence, collaboration and low carbon emissions.’

- **Tomás de Lara**, Co-Leader at Sistema B Brasil

‘Rethinking materials use, while respecting the planet’s physical limits, is fundamental for developing a regenerative and restorative economy. And businesses have a fundamental role in this circular economy, whether that is promoting changes in culture and internal processes, or influencing their supply chain. This allows for production optimisation, management of existing natural capital, and the construction of a new economic paradigm.’

- **Marina Grossi**, President of the Brazilian Business Council for Sustainable Development (CEBDS)

‘The shift from a linear mental framework towards a circular one influences various aspects of the way we produce and consume in our society. The circular economy concept points towards that shift, and can present opportunities for creating new enterprises and revising current business models. The search for economic sustainability emphasises the need for the creation of new production chains that can promote more effective resource use in our society, aiming at designing out waste and promoting quality of life. In this sense, it is necessary to revise regulations, credit lines and promote more restorative and regenerative businesses, so that the concept of a circular economy can become a reality.’

- **Shelley de Souza Carneiro**, Executive Manager for the Environment and Sustainability, Confederação Nacional da Indústria (CNI)
INTRODUCTION

OBJECTIVES, SCOPE AND METHODOLOGY

This paper is intended to be an introductory piece that provides an initial overview of existing circular economy activities in Brazil and identifies potential opportunities in bringing such activity to scale.

The paper focuses on three areas significant to the Brazilian economy: agriculture and biodiversity assets, buildings and the construction sector, and electrical and electronic equipment, and includes in an appendix case examples of Brazilian companies operating circular economy business models. It does not attempt to quantify the size of the potential business opportunities at a sector level and does not include any macroeconomic analysis for the Brazilian economy as a whole. It draws on Ellen MacArthur Foundation insights and is based on the collated findings of in-depth interviews with more than 25 businesses, academics, and policymakers in Brazil that are working in this space, and incorporates feedback from the collective intelligence of the CE100 Brasil network. Eight case studies were provided in support of this paper and these are situated in the attached appendix.

As a landscaping exercise the paper is part of a longer-term collaborative effort being undertaken by the CE100 Brasil network to explore the potential benefits of applying circular economy principles to Brazil. It was presented at the October 2016 CE100 Brasil workshop and contains updates made in January 2017 to reflect linkages to the most recent Ellen MacArthur Foundation research.

Our intention is for this paper to act as a springboard for further research on circular economy opportunities in Brazil, and to provide a helpful starting point for businesses, academics, and policymakers. We invite you to join us in this exploration.
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DISCLAIMER

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EXECUTIVE SUMMARY

The circular economy is gaining traction globally as an attractive alternative to a linear take-make-dispose economy, offering an opportunity for society to prosper while reducing its dependence on finite materials and non-renewable sources of energy. In joint research by the Ellen MacArthur Foundation, McKinsey Centre for Business and the Environment, and SUN has shown that by adopting circular economy principles, Europe can harness the impending digital technology revolution in a circular economy scenario to create a net GDP benefit of €1.8 trillion by 2030.1 Similar analysis, also by the Ellen MacArthur Foundation, has shown that a circular economy path to development could bring India annual benefits of 40 lakh crore (US $624 billion) in 2050 compared with the current development path - a benefit equivalent to 30% of India’s current GDP.2

Early findings indicate that a transition to the circular economy could unlock opportunities for greater innovation and value creation in Brazil. With unique market and social characteristics, and unparalleled natural capital, Brazil is a compelling setting in which to further explore the opportunities that the circular economy could bring in building a country’s economic, social, and natural capital.

A circular economy is one that is restorative and regenerative by design. It aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between the cycles of technical and biological materials (see Figure 1). This approach seeks ultimately to decouple economic development from finite resource consumption and to remove negative externalities from the economy.

The principles behind a circular economy are not entirely new in Brazil, and have begun to appear in pockets of activity across the country. Businesses and other organisations see these principles as drivers of innovation with proven value creation potential, and as an opportunity to achieve differentiation in the market, even in times of economic turbulence and budgetary constraint.

FIGURE 1. CIRCULAR ECONOMY SYSTEM DIAGRAM

PRINCIPLE 1
Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
ReSOLVE levers: regenerate, virtualise, exchange

PRINCIPLE 2
Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles
ReSOLVE levers: regenerate, share, optimise, loop

PRINCIPLE 3
Foster system effectiveness by revealing and designing out negative externalities
All ReSOLVE levers

1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input

SOURCE: Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; Drawing from Braungart & McDonough, Cradle to Cradle (C2C).
OPPORTUNITIES FOR BRAZIL: FOCUSING ON THREE AREAS

This research has identified several potential opportunities in transitioning to a circular economy across three focus areas. These early indications should be seen as areas for further exploration by businesses, academia and policymakers.

Agriculture and Biodiversity Assets

1. **Amplify existing efforts in regenerative business models in agriculture and biodiversity assets.** Applying regenerative models in agriculture and across urban bioeconomies could restore Brazil’s rich reserve of natural capital, boost biological diversity, close nutrient loops, increase nutrient content in food, all whilst improving long-term yield and profitability.

2. **Stimulate development of the nascent bio-intelligence sector.** The combination of Brazil’s rich natural capital and social diversity has resulted in the aggregation of vast knowledge on Brazilian biodiversity assets. This should be leveraged to allow Brazil to apply such bio-intelligence more broadly within its territory as well as across global value chains.

3. **Harness digital technology to unlock circular economy potential in the bioeconomy.** Technology can be used in digitised supply chains, enabling resource efficiency as well as knowledge exchange and asset sharing solutions. This increases transparency in markets within the sector, and generates pooled economies of scale for smallholder farmers (without the need to scale themselves).

Buildings and Construction

4. **Use a circular economy lens when investing in new real estate to avoid linear lock-in.** This is a chance for Brazil to avoid getting locked into the linear development path in the built environment, and transition directly to a circular economy, thereby limiting the transition costs that would otherwise be involved.

5. **Potential to increase accessibility and affordability in the built environment by applying circular economy principles.** Integrating concepts such as flexibility and modularity, increased resource efficiency, reduced structural waste could contribute to increasing affordability across the economy of housing and other buildings.

6. **Harness digital technology and innovative circular economy practices to create new value in the buildings & construction sector.** Circular economy approaches can help disrupt and encourage innovation offer the next horizon for further development of the sector.
Electrical and Electronic Equipment (EEE)

7. **Leverage EEE market dynamics specific to Brazil to create new circular economy business opportunities.** These market dynamics include: the proximity of growing consumer markets to manufacturing centres, established reverse cycle infrastructure, and existing knowledge, skills, and capacity.

8. **Integrate the informal economy into the EEE sector for a win-win collaboration.** Bring the best of the two worlds together: integrate the efficiency and operational capacity of the formal industry with the agility, scale and capillarity of the informal sector.

9. **Develop new business models to increase access to and affordability of EEE products.** With the appropriate system conditions in place, circular economy business models that promote sharing, pay-per-use, and refurbished products can provide more affordable, higher value and more updated products to users.

10. **Create mechanisms to inform design processes.** A bottom-up approach, where Brazilian companies provide feedback into the design process of global EEE players, could leverage the knowledge generated by the market to improve design processes in the sector.
AGRICULTURE AND BIODIVERSITY ASSETS

Over the last four decades Brazil has transformed itself from a food importer into one of the world’s largest food exporters. Brazil’s economy now relies heavily on the output of two of its renewable resource stocks: agricultural land and biodiversity more broadly.

Agriculture (including crops and livestock) represents 22% of GDP, and was the only sector in the Brazilian economy that grew in 2015. Global agricultural value chains rely greatly on Brazilian ecosystems – it is amongst the top producers of coffee, sugar, sugar cane, ethanol, orange juice, and soybeans. The sector is also significant from a social standpoint, with 16.5 million people relying on agriculture for their livelihoods. 89% of Brazilian territory is covered by some sort of vegetation with diverse uses, from large-scale agriculture to native forests.

The scope of this paper includes crop agriculture (excluding livestock, on which further research is certainly merited) and biodiversity assets (including soft or non-timber products that are part of the food, beverage, biochemical and cosmetic value chains). Urban farming practices and urban biocycles are beyond the focus of this paper. However, recent research has shown that the valorisation of urban biocycles and the opportunity to close nutrient loops within cities, and between cities and agricultural land can significantly support the shift to regenerative and restorative practices. The World Economic Forum estimates the potential global revenues from the biomass value chain - comprising agricultural inputs, biomass trading and biorefinery outputs - could reach $295 billion by 2020.

CURRENT CIRCULAR ECONOMY ACTIVITIES

Mainstream agriculture and forest land management industries in Brazil have to date been largely dominated by a linear model of production. However, innovative and promising examples of the transition to the circular economy are emerging and permeating through the market. Important trends include the following:

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4 CEPEA/USP and CNA.
5 In 2015, the agriculture sector grew 1.8%, while industry and services retracted leading to a 3.8% decline in Brazilian GDP in that year. IBGE. ‘Contas Nacionais Trimestrais’. January to March 2016.
Environmental certifications are being adopted as a first step in the transition to the circular economy. As prerequisites for access to the main international markets for agricultural commodities, these certifications have often acted as an initial driver for businesses to move towards more regenerative agricultural practices. For example, the Roundtable on Sustainable Palm Oil requires practices to maintain soil fertility (or where possible improve soil fertility) at a level that ensures optimal and sustained yield, and maintains the quality and availability of surface and groundwater. Imafloira (The Institute of Agricultural and Forest Management and Certification in Brazil) has increasingly seen these certifications as the beginning of the journey for producers to understand the importance of preserving and regenerating natural resources, as they begin to track and measure, for example, soil productivity and water usage.

Regenerative farming practices are starting to be proven at scale. Regenerative agricultural systems are designed to build soil health and regenerate soils by using practices including composting, crop rotation and cover cropping, and minimising tillage. In such a system the integrity of the natural system is preserved, non-biodegradable toxic materials are phased out, and nutrient leakage is minimised. For example, zero tillage is broadly used in Brazil – a practice in which crop residues are left in the soil, no mechanised tools are used to turn the soil, and weeds are controlled by non-polluting herbicides. Motivations to use this method include the resulting reduction in mechanised tool costs and reduction in soil erosion. According to the Brazilian National Zero Tillage Federation, in 2008 Brazil had 62 million acres of land managed with this practice, representing 50% of the land planted with crops that year. For an example of regenerative farming practices applied at scale, see Native’s case study in the appendix.

Restoration of degraded land is in progress. The Brazilian Federal Government is investing in the recovery of 15 million hectares of degraded pastures to develop them into new agricultural areas (out of a total of 200 million hectares of degraded pastures). Degraded land recovery can be seen as a ‘transition’ lever to the circular economy, and once the land has been recovered it should be maintained using regenerative farming practices.

Brazilian producers are extracting additional value by cascading agricultural products. The orange juice industry in Brazil is a good example of cascading its by-products to other uses. Citrosuco, the largest orange juice producer in the world, uses citrus pulp residue from its production processes as an animal feed that can be used as a substitute for corn. Essential oils, obtained

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8 The agricultural commodities referred to include soybean, cotton, sugar cane, ethanol, biodiesel, orange, palm oil, coffee, cocoa, timber, and beef.
9 FEBRAPDP. http://febrapdp.org.br/area-de-pd
from the pressing of orange peel after the extraction of juice, are used in the food, pharmaceutical and chemical industries. Alcohol obtained from the fermentation of the sugars in orange residue is also used as a fuel and in the composition of beverages and vinegar. 100% of the orange is utilised in some way\(^1\).

**Businesses and traditional communities are cooperating over the valorisation of biodiversity assets.** Traditional communities have a wealth of knowledge about how to valorise biodiversity assets whilst preserving natural capital - a skill that businesses can leverage and integrate into their practices (see case study appendix, Natura case). In 2016, Imaflora and the Socio-Environmental Institute (ISA) created Origins Brazil, a project that aims to create links between traditional communities and large companies. Grupo Pão de Açúcar supermarkets, Wickbold bread, and the consumer products of Mercur were the first companies to join the project, sourcing honey, nuts, rubber and artisanal copaiba oil-resin from traditional communities and indigenous people\(^2\). The commercial relationships are based on transparency, responsible use of resources, and respect for the diversity and lifestyle of traditional communities.

**Application of new technologies are emerging in the sector.** IT and automation are positively disrupting farming practices by enabling precision agriculture - a whole-farm management approach that leverages IT, big data, remote sensing, and satellite positioning data. These technologies are enabling resource-efficient agricultural practices, increasing the efficiency with which farms use water, fertilisers and pesticides. The role technology can play in other aspects of agriculture is also being driven forwards in pockets of the sector, for example organisations are promoting the use of information technology by smallholder farmers, facilitating access to market and technical information.

**FUTURE OPPORTUNITIES FOR BRAZIL**

To build on the progress that has already been made, this research has identified three key opportunities for further exploration.

1. **Amplify existing efforts in regenerative business models in agriculture and biodiversity assets.** Regenerative farming applied at scale could restore Brazil’s rich reserve of natural capital, boost biological diversity, close nutrient loops, increase nutrient content in food, and save water, all while improving long-term yield. These practices could lower costs of resources used and create an advantage over conventional agricultural methods. To achieve scale will require increased access to long-term

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finance, both for large operations and smallholders, through new financial vehicles, and better information about the long-term returns and risks of regenerative versus conventional agricultural systems. It will also require the dissemination of knowledge to farmers across the country about the benefits of regenerative approaches, along with detailed, local information about how to implement them. It will also require a strong link to urban centres as cities work to strengthen systems to recover urban organic waste and strategies to valorise it. This process of capturing the value of the urban bioeconomy can close nutrient loops by returning nutrients to the soil.\textsuperscript{13}

2. **Stimulate development of the nascent bio-intelligence sector.** The combination of Brazil’s rich natural capital and social diversity, with numerous traditional communities (such as indigenous caçarás, seringueiros, and quilombolas), has resulted in the aggregation of vast knowledge on Brazilian biodiversity assets. This knowledge shows how to generate profit from these assets in a regenerative manner (i.e. extracting value not only without depleting natural assets and ecosystems, but managing to regenerate these assets). The knowledge of these traditional communities, and other early pioneers that have developed regenerative models in agriculture and in the use of biodiversity assets, should be leveraged to allow Brazil to apply such bio-intelligence more broadly within its territory as well as across global value chains. Brazil could use its inherent expertise in this space, in conjunction with its prominence as a global player in this sector\textsuperscript{14}, to shift and influence global production systems. This would also shift perceptions of the country as an exporter of crops and raw biological materials to one at the forefront of innovation and experimentation in the area, sharing and exporting its knowledge around the world. In addition, practices to ensure fairer distribution of benefits across value chains are seen in the examples studied, valorising the knowledge of the traditional communities.

3. **Harness digital technology to unlock circular economy potential in the bioeconomy.** While leveraging knowledge developed from centuries of understanding of natural ecosystems, Brazil can also harness developments in technology to create a more effective agricultural and biodiversity assets sector. Technology can be used in digitised supply chains, enabling knowledge exchange and asset sharing solutions, increasing transparency in markets within the sector, generating pooled economies of scale for smallholder farmers (without the need to scale themselves), and generating efficiency gains. These factors will continue to enable system wide optimisation, and increase production yield.

\textsuperscript{13} World Economic Forum & Ellen MacArthur Foundation ‘Project Mainstream Urban Biocycles’, 2017

\textsuperscript{14} The country is the world’s biggest exporter of five internationally traded crops, and number two in soybeans and maize. The Economist, ‘The World’s Farm’, August 2010. http://www.economist.com/node/
BARRIERS

There is progress being made across many parts of the arable agricultural sector in Brazil to adopt regenerative practices, but there remain barriers to rolling out such practices across the sector as a whole, and to encouraging early adopters to move to the next level of sophistication in regenerative agricultural systems. Through interviews with those working in this space, barriers identified included the transfer of new knowledge and skills across the sector, access to credit for new, regenerative models – as regenerative farming in particular has a much longer return on investment – and the need for platforms to facilitate pooled investments, sharing of assets, distribution of by-products etc. for smallholder farmers (representing 84% of total rural productive units)\(^\text{15}\).

\(^{15}\) IBGE. Agricultura Familiar. 2006.
BUILDINGS AND THE CONSTRUCTION SECTOR

After rapid growth in new construction developments in the first decade of the millennium, from 2012 onwards the sector nationally has experienced reduced levels of activity and investment. In Brazil the construction sector represents 7% of GDP and 9% of the national job market. Common to construction sectors elsewhere, the sector is currently largely based on a linear model with significant embedded waste. Demolition and construction produces 50–70% of the waste going to landfill in Brazilians cities, at an increasingly high cost to both urban municipalities and the construction companies themselves.

Since 85% of the country’s population currently lives in urban areas, a figure expected to reach 91% by 2050, it is important that cities play a central role in economic development paths. It is estimated that 20% of Brazilians currently live in favelas, or informal, low-income housing settlements. In addition, many industrial and office buildings in metropolitan areas lie empty, abandoned and vandalised, with a number of urban areas requiring revitalisation and repurposing. According to UN Habitat, in 2008 the Brazilian housing deficit was 10% of the housing stock, and the number of vacant units amounted to almost the same percentage.

This research focuses on buildings, their construction, fit out and use. Infrastructure (roads, bridges, tunnels, water supply etc.) are excluded from this initial exploration of circular activities and opportunities in the built environment, although insights in this paper could inspire innovation across the whole sector.

Circular economy principles as applied to the building and construction sector incorporate all aspects of the development of a building. This includes design for modularity and flexibility, the sourcing of effective materials, material efficient construction processes, the sharing of space, effective operation of the building, including where building services and surrounding infrastructure can be designed to support the recovery of organic and non-organic waste, and finally the renewal, repurposing and disassembly of buildings. For more information and a comprehensive framework for the circular economy in buildings and construction, refer to the report “The Circular Economy in the Built Environment” (2016), developed by the Ellen MacArthur Foundation’s Knowledge Partner, Arup.

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19 UN Habitat. ‘Scaling Up Affordable Housing Supply in Brazil’. 2013.
CURRENT CIRCULAR ECONOMY ACTIVITIES

While the mainstream building and construction sector in Brazil follows traditional linear models of development, there is another tier of Brazilian businesses that is beginning to innovate along circular economy themes.

Circular design considerations are starting to emerge in the buildings and construction sector. Nossa Casa Planejada, a start-up from Tocantins state, has developed a technology to recover materials from construction and mining waste, in order to develop modular building blocks that work like Lego pieces to build completely modular houses at a low cost. Their sourcing strategy eliminates the need for cement, and due to their modular structure, the buildings can be remodelled and rebuilt on demand. Design for modularity and flexibility is not common practice, but some examples are emerging, as seen in a few of the venues (like the Future Arena and the Olympics Aquatics Stadium) for the Olympic Games in Rio de Janeiro in 2016, which included structures that could be removed, rebuilt, and repurposed.20

Circular construction practices can lead to sector innovations. In the construction phase, the application of lean methodology and innovative industrial approaches towards buildings is disrupting the sector. Precon Engenharia, a Brazilian precast concrete company, has developed a pre-fabrication factory that produces parts for the assembly of buildings. The company has reduced construction time by half and cut 90% of waste produced in their processes compared with traditional construction methods (see Precon Engenharia case study in Appendix). In interiors, Tarkett, the global leading company for flooring solutions and sports surfaces, is putting circular design at the core of its global strategy, focusing on closed-loop principles and Cradle to Cradle design (see Tarkett case study in the Appendix).

Important innovation in the use-phase is increasing the utilisation of buildings and unlocking benefits in urban spaces. The emergence of co-working spaces and collaborative houses across cities in Brazil is creating new ways to utilise space in cities. To take two examples, in the old port area of Rio de Janeiro, Goma, an ecosystem of companies and entrepreneurs, occupies buildings that were once abandoned and degraded. Goma has not only revitalised these buildings based on circular principles in the use of resources and integration into the natural environment of the city, but has also created a vibrant atmosphere that has re-energised the area. Meanwhile, in São Paulo city, driven by the idea of the “social function of urban property”, 21 an online collaborative map developed by City Hall crowdsources information from the


21 The project is based on the fact outlined in regulations that a property only meets social function if their use and occupation as defined by the owner, are oriented for the community interests (economic, social, environmental, urbanistic). More information on: http://mapacolaborativo.gestaourbana.prefeitura.sp.gov.br/funcao-social/
population about unused buildings so the city can start using them for socially beneficial purposes.

**Policymakers and businesses are recognising the need to integrate urban systems.** For example, Vitacon, a Brazilian real estate developer, is launching residential buildings with a new value proposition: small sized apartments that are designed to integrate residential space with urban mobility. Vitacon offers shared car, motorcycle and bicycle hire schemes to its residents at a number of its São Paulo apartment buildings. Some buildings have also developed sharing services for residents such as co-working areas, laundry, cleaning services, tools, and storage space. In São Gonçalo do Amarante municipality in Ceará state, Planet Idea, an Italian start-up, is developing the first ‘social smart city’ in Brazil. It is creating an integrated space with industries, homes and high quality services available at low cost, where digital technology enables the sharing of mobility assets and other services. These models have unlocked economic value through sharing models, while providing a better quality of life for communities in an area that once lacked attention to basic needs.

**FUTURE OPPORTUNITIES FOR BRAZIL**

To build on some of the progress that has already been made, and overcome the barriers that stand in the way of the adoption of circular economy principles in the building and construction sector, this research has identified three key opportunities for further exploration.

1. **Use a circular economy lens when investing in the built environment to avoid linear lock-in.** As Brazil continues to urbanise, and given the expected investment levels in real estate and infrastructure in the next 10-15 years, Brazil has a chance to avoid getting locked into the linear development path in the built environment, and transition directly to a circular economy, limiting the transition costs that would otherwise be involved. It will be increasingly important to take a systemic view when approaching further urban development, exploring how the built environment and infrastructure grows alongside and integrates with other urban systems such as the urban bioeconomy, food and mobility.

2. **Potential to increase accessibility and affordability in the built environment by applying circular economy principles.** The core principles of the circular economy could result in a built environment that better serves the needs of its users. Integrating concepts such as flexibility and modularity into housing could make them both more affordable for users and more responsive and adaptable to their needs. Increased resource efficiency (especially as companies and researchers develop new technologies that reduce the costs, time and materials involved in construction), and reduced structural waste across the economy (through the increased utilisation of assets) could also contribute to increasing
affordability across the economy of housing and other buildings. These opportunities may be especially important for lower-income populations in Brazil, but it applies to all citizens.

3. **Harness digital technology and innovative circular economy practices to create new value in the buildings & construction sector.** Circular economy approaches can help disrupt and encourage innovation for further development of the sector. This includes digitally enabled sharing and integration with urban systems, innovation in materials, design for modularity, re-use and flexibility, and the use of technologies like 3D printing. Small and medium enterprises are experimenting with the benefits of applying such principles and are seeing the business advantage.

**BARRIERS**

Through interviews with those working on these initiatives, the initial sample of barriers identified in capturing and scaling these opportunities were largely applicable to the building and construction sector globally. They included factors such as economic instability that limits innovation in long-term business cycles, and inertia in these sectors to adopt new technologies. Barriers specific to the Brazilian economic setting requires further research.
ELECTRICAL AND ELECTRONIC EQUIPMENT (EEE)

The EEE industry in Brazil comprises production, consumption, and post-use markets, unlike in Europe and the US which are mostly end-customer markets of imported goods. EEE is a high value industry and one of the most innovative sectors in the Brazilian economy, encompassing distinct segments that include white goods (refrigerators and most kitchen appliances), green goods (telecommunication devices and computers), brown goods (audio and video equipment), and blue goods (portable electronic devices and electric tools). While a number of goods are entirely manufactured in the country, for example white goods, others like IT equipment are assembled from imported parts and components while control of the design is held by brands in other countries22.

The boom in the consumption of EEE in Brazil, largely driven by fiscal and credit incentives in recent decades23, has led to increased linearity in the sector, exemplified by significant growth in electronic waste. According to research by the United Nations University24, 2 million tonnes of EEE were added to the Brazilian market in 2012, generating 1.4 million tonnes of EEE waste – 7 kilograms per person – making Brazil the second largest generator of such waste in the world behind the US. Only about 2% of this waste generated each year is re-processed and valorised in some way25. Even when these materials enter formal value chains, high value materials such as precious and semi-precious metals in electronic boards escape26 from the Brazilian market are mostly being shipped abroad for industrial recycling, while recycling chains in the country only capture lower value materials like plastics.

The informal sector has historically developed a number of initiatives that apply circular principles through repair, refurbishing, recycling chains and sale to secondary markets. While informality accounts for the recovery of a large volume of equipment, parts and components, the sector suffers significant material losses as it employs low quality processes producing materials that do not meet industry standards for further usage.

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22 Through electronics contract manufacturing (contracts between brands and suppliers) schemes
23 The Lei do Bem, issued in 2005, provides tax incentives for products that have technological innovation and which are produced in Brazil. It is a tax incentive for industry and reduces the price of EEE for the consumer. Furthermore, tax exemption for EEE imports as of 2013 summed to credits incentives for consumers has significantly increased consumption of EEE in Brazil.
25 UNEP
26 Material leakages resume the material value that is lost in the system. Linear models are embedded with structural waste and represent economic losses and potentially environmental negative externalities.
A critical factor is product design. Currently, designers frequently optimise for the product’s use phase. Far less considered is the ability to disassemble the product after use to recover value. Embedding circular thinking at the design phase of electrical and electronic equipment can significantly support the value recovery and keep technical nutrients circulating at their highest possible value. The recently launched Circular Design Guide\(^\text{27}\) offers tools to support creative solutions for the circular economy.

Applying circular economy principles to the EEE sector involves using the technical cycles, illustrated in the butterfly diagram in Figure 1, that aim to keep materials, components and products cycling at their highest value and utility at all times. A further growing area of research and innovation involves recognising, valuing and recovering the energy embodied in manufactured goods.\(^\text{28}\)

**CURRENT CIRCULAR ECONOMY ACTIVITIES**

In recent years, industry incumbents and some emerging players have been innovating around circular business models to capture lost value in the EEE sector. An important driver of this shift has been the National Waste Management Policy which sets the direction towards applying some circular economy principles in the sector.

**International certifications promote considered design and set rules for the industry in Brazil.** Electronic Product Environmental Assessment Tool (EPEAT) and Restriction of Hazardous Substances (RoHS) certifications are a market standard for every global EEE company. EPEAT addresses environmental criteria across the full product lifecycle including design, production, energy use and recycling; and RoHS specifies maximum levels for restricted hazardous substances. Large companies in Brazil require these certifications when buying electrical and electronic equipment. While these certifications do take into account aspects of disassembly and material choice, they are still limited in their scope and do not cover all aspects of design for the circular economy.

**Businesses moving from outer to inner loops are capturing more value.** As evident in research from the Ellen MacArthur Foundation, recycling initiatives, which are more focused on the outer loops of value creation (see Figure 1) are the least effective in retaining the utility, value and profitability of materials, components and products. Early innovators of circularity in EEE in Brazil have been moving towards the inner loops that make use of business models in remanufacturing, refurbishment and reuse. Recicladora Urbana, a small enterprise with an industrial plant in the state of São Paulo, is a clear example of this: the material value generated in the refurbishing segment

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27 Circular Design Guide: a collaboration between Ellen MacArthur Foundation and IDEO  
www.circulardesignguide.com  
28 REMADE Institute www.rit.edu/remade/
of the business is roughly ten times that created in the recycling segment of the company (see case study in Appendix). Another innovative example, eStoks, a start-up established in 2015, is developing a business model to capture value from pre-consumption waste (equipment that never entered the market or is collected from the consumption market with almost no use). The company optimises the logistics of collection and recovery by leveraging the concentration of EEE manufacturing plants in southern and central Brazil. It then applies an algorithm to analyse the equipment’s condition and then redirects it to secondary markets at 50–70% of the price of a new product.

Regulation has been an enabler for a lot of these activities. For example, Sinctronics (a business unit of Flex, the global electronics manufacturer) was created in response to Brazil’s National Solid Waste Law, which requires that companies properly dispose of electronic equipment at the end of its useful life. Sinctronics offers an attractive solution for these companies (see case study in Appendix).

**Some capacity and infrastructure for reverse cycles already exists.** This is due to two main types of players: the dominant informal players that operate most reverse logistics chains and operations to recycle electronic materials; and industry players that have emerged in recent years partly driven by (or enabled by) regulation. The latter group includes Sinctronics, a new company created through a collaboration between HP and manufacturer Flex to innovate in the post-use EEE market (see case study in Appendix) and Nat. Genius, a new business unit of a Brazilian manufacturer of compressors, Embraco, with a focus on the remanufacturing of EEE (see case study in Appendix).

Informal players have been able to collect significant volumes of materials and compete in the market with lower prices. For formal businesses, however, reverse logistics, which includes the costs of transportation and taxes paid on the collection of goods, represents the largest part of their recycling costs. World Bank analysis\(^\text{29}\) has shown that the keys for success in managing reverse logistics in this sector are achieving scale, maximising volume and minimising costs, particularly transport costs.

Successful models in Brazil are emerging from new forms of collaboration between large industry players, which operate with high quality standards, and the (once) informal organisations, which are responsible for large volumes of materials flows as well as providing capacity and infrastructure. Involvement from other stakeholders, such as academia and NGOs, can help put in place the enabling conditions of processing capacity and increased formalisation. In April 2016 an industry management organisation was created for reverse logistics (Green Eletron) by Abinee (the Brazilian Electrical and Electronics Industry Association) and 48 EEE companies. It aims to help identify and

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manage the organisations responsible for reverse logistics in the sector.

Product-service systems are growing in B2B markets and emerging in B2C markets. Printing, IT, lighting, and air conditioning services are already being provided by corporations in Brazil through performance models such as leasing or rental contracts. These pay-per-use models create longer lasting commercial interactions, reduce the level of upfront investment by users and improve the cash flows of service providers. For example, HP Brazil’s managed services offering includes IT services. This performance model optimises the technology lifecycle, reduces the risk of over-provisioning, reduces procurement costs, and offers a more flexible investment period (see case study in Appendix). Performance models or use models are still emergent in B2C markets, although initiatives in mobile and home appliances are already in place. An example of a B2C performance model being successfully applied in Brazil is Whirlpool, a manufacturer of home appliances that offers water filters as a service, providing maintenance and a lifetime warranty while retaining ownership of the filters themselves.

FUTURE OPPORTUNITIES FOR BRAZIL

To build on the progress that has already been made, and overcome the barriers that stand in the way of broadening the adoption of circular economy principles in the EEE sector, this research has identified three key opportunities for further exploration.

1. **Leverage EEE market dynamics specific to Brazil to create new circular economy business opportunities.** In Brazil the proximity of growing consumer markets to manufacturing centres can support remanufacturing and refurbishment business models. Brazil should also leverage and build on the industrial installed capacity, which works as assembly lines, could create a market for re-assembly, with reused parts and components feeding an industry of remanufacturing and refurbishment. This would be enabled by reverse cycles and new forms of collaboration in value chains.

2. **Integrate the informal economy into the EEE sector for a win-win collaboration.** Existing reverse cycle capacity and infrastructure could be improved to recover additional value from products, components and materials. The careful formalisation of these stakeholders currently working in the informal sector, could potentially unlock higher volumes of materials at higher quality standards that are currently leaking from the system, while at the same time promoting social inclusion. Multi-sectorial collaboration can enable such organisations to follow stewardship rules and quality standards, and build the appropriate capacity and therefore restore material flows in the sector. This is the opportunity to bring the best of two worlds together: integrating the efficiency and operational capacity of the formal industry with the agility, scale and capillarity of the informal sector.
3. Develop new business models to increase access to and affordability of EEE products. With the appropriate system conditions in place, circular economy business models that promote sharing, pay-per-use, and refurbished products can provide more affordable, higher value and more updated products to users, and at the same time create new market opportunities for service providers. The circular economy also promotes EEE products that are built-to-last, are reusable, and overcome premature obsolescence. All of these attributes will reduce total cost of ownership and deliver greater convenience to customers since they would avoid the hassle associated with organising repairs and returns. This opportunity is especially important for lower-income populations in Brazil, but it applies to all customers.

4. Create mechanisms to inform design processes. Brazilian companies that are well informed about the disassembly and collection processes for the EEE sector, such as Sinctronics and Nat.Genius, could provide the technology, information and insights required to improve the design of products to make them easier to disassemble, refurbish and remanufacture. A bottom-up approach, where Brazilian companies provide feedback into the design process of global EEE players, could leverage the knowledge generated by the market to improve design processes in the sector.

BARRIERS

Progress is being made across many parts of the EEE sector in Brazil towards adopting circular economy practices, but there remain barriers for early adopters to achieve scale. Interviews with organisations working in this space provided an initial sample of barriers to capturing and scaling these opportunities. They include tax policies that incentivise linear economic models, the lack of mechanisms to increase formalisation and collaboration between industries and organisations operating informally in the reverse cycles, and questions around intellectual property for new circular business models.
CALL FOR FURTHER RESEARCH

Brazil is at a pivotal moment in its economic history, with the opportunity to develop a new economic model that offers prosperity for its citizens and works in the long term.

While this research provides initial insights into the circular economy opportunities in three important areas of the Brazilian economy, it does not attempt to quantify any benefits at a sector level, or to analyse potential gains economy wide. However, as noted, previous macroeconomic research of other economies has shown that there are GDP and employment benefits available from applying circular economy principles across the economy. In addition to the purely economic value creation opportunities, a further aspect is its contribution to improving socio-economic resilience.

Certain opportunities and challenges are common to all economies, for example the importance of harnessing digital technology to capture circular economy opportunities. However, in countries such as Brazil, such digital enablement and solutions have a particular role to play since their low marginal costs can have a transformative impact on a country’s development path. Recent Ellen MacArthur Foundation research focused on India has, in addition, shown that countries with significant informal sectors have significant potential in this area. The social opportunities that arise from developing such informal sectors also need to be further explored. Another feature to emerge for Brazil, as it did for India, was a range of circular economy practices focused on the end of the value chain. Scaling-up such activities, and extending them up the value chain will support circular economy becoming mainstream. The Foundation and its partners continue to develop a range of tools to support such mainstreaming, including frameworks like the ReSOLVE framework for identifying business opportunities, the Circular Design Guide and a Toolkit for Policymakers.

The initial opportunities presented in this paper point to business opportunities that provide economic societal and environmental benefits. They make the case to undertake a fuller analysis of the size and scope of opportunities in the three focus areas explored here and for the Brazilian economy as a whole. The authors hope this paper becomes a first step in the further exploration of the economic, environmental and social benefits that a transition to the circular economy could bring to Brazil and would welcome further research to this end.