Using Environmental Justice to Adapt Circular Economy to the Context of Low- and Middle-Income Countries: The Case of Fortaleza, Brazil

（サーキュラーエコノミーを低中所得国の状況に適応させるための環境正義の利用：ブラジル・フォルタレザ市を事例として）

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Table of Contents

List of Tables

List of Figures

Abbreviations

BRICS = Brazil, Russia, India, China and South Africa

BRL = Brazilian Real

C2C = Cradle-to-Cradle

CE = Circular Economy

CESPS = Ceará State Plan on Solid Waste Management

CF = Federal Constitution of Brazil

CODES = (Ceará) Department of Sustainable Development [*Coordenadoria de Desenvolvimento Sustentável*]

Colimp = Special Department for Urban Cleaning [*Coordenadoria Especial de Limpeza Urbana*]

COSAN = (Ceará) Sanitation Department [*Coordenadoria de Saneamento*]

EnCA = Environmental Crimes Act

EJ = Environmental Justice

EOL = End-of-life

EOP = End-of-pipe

EPR = Extended Producer Responsibility

EU = European Union

GDP = Gross Domestic Product

HDI = Human Development Index

HICs = High Income Countries[1]

[1] In this study I have ignored the definition differences of similar terms and used the following interchangeably with HICs: Global North = developed

IDB = Inter-American Development Bank

IQM = Municipal Indicator of Environmental Quality [*Índice Municipal de Qualidade do Meio Ambiente*]

LC = Complementary Law [*Lei Complementar*]

LMCs = Low- and Middle- Income Countries[2]

MIS = Municipal Solid Waste Plan

MP = Public Prosecutor Department [*Ministério Público*]

MSWM = Municipal Solid Waste Management

MSWMS = Municipal Solid Waste Management System

NaPS = (Brazilian) National Policy on Solid Waste Management Act

OECD = Organization for Economic Co-operation and Development

PEV (Schools) = (Schools with) Voluntary Drop-off Points [*Pontos de Entrega Voluntária*]

PlaSMs = Plan for Solid Waste Management

RL = Reverse logistics

SD = Sustainable Development

SEMA = Ceará Environmental Bureau [*Secretaria do Meio Ambiente*]

SEUMA = (Fortaleza) Municipal Bureau of Urbanism and Environment [*Secretaria Municipal de Urbanismo e Meio Ambiente*]

SINIR = National System of Information on Solid Waste [*Sistema Nacional de Informações sobre Resíduos Sólidos*]

[2] In this study, I have ignored the differences of definitions of similar terms and used the following interchangeably with LMCs: Global South = developing = underdeveloped.

SMEs = Small and medium enterprises

SSE = Social and solidary economy

SW = Solid Waste

UN = United Nations

UNCED = United Nations Conference on Environment and Development

UNCRD = United Nations Centre for Regional Development

UNDP = United Nations Development Programme

UNEP = United Nations Environment Programme

WHO = World Health Organization

WM = Waste Management

WPs = Waste pickers

WPA = Waste Picker Association

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Abstract

Many circular economy (CE) studies acknowledged that the CE literature currently houses a considerable social gap. While some attempts in recent years tried to bridge this previously academically empty space, most of these proposals address the symptoms, not the causes. This thesis is a qualitative study proposing to bridge the existing social gap in CE literature and practices by adding an environmental justice (EJ) layer to the concept of CE. It uses both a theoretical perspective based on EJ and sustainable development (SD) to look at CE legislation, coupled with field research (interviews) to obtain the results presented here. A case study is presented to better exemplify the use of the proposed framework, with Fortaleza (Brazil) chosen for the role. First a legal study took place, using keywords associated with the three CE principles of the Ellen MacArthur Foundation (EMF) to identify relevant CE policies and laws on all three levels of government: federal, State and municipal. With a clearer picture of the legal background, interviews were conducted to verify the real scenario, and the Ecopoints program became the focus of the present study. Under a CE lens using the three principles, the city of Fortaleza appears to be transitioning well into a CE. Especially under the second principle (circulate materials as long as possible), many policies were favorable to the transition, including the Ecopoints program. However, from an EJ perspective, the previous results prove not quite accurate: the interviews showed that a relevant group of actors that is already marginalized, namely the waste pickers, were further excluded by the Ecopoints policy. This issue is significant for at least two reasons: first, if unchecked, it will translate into increased social inequalities, which would contradict SD, considered here the ultimate goal of CE. Second, it illustrates how an important municipal solid waste management (and CE) policy was decided without the participation or input of major these stakeholders. In conclusion, a CE without a social lens can still be detrimental to CE itself,

especially if SD is the final objective. EJ provides a valuable analytical tool that looks at root causes of social issues whilst considering the relationship between these issues and the environment. Therefore, the framework presented in this study may offer policy-makers a preventive tool in the transition to a just CE, avoiding unintentional but harmful consequences to society, namely to the marginalized groups.

1. Introduction

A circular economy (CE) is a socio-economic system that prioritizes the use of readily available resources over the use of new (raw/virgin) materials, reducing the need for consumption where possible and allowing the recovery of Earth's natural systems, thus striving to regenerate the stocks and overall equilibrium of planet. CE is not without its flaws, one of which is CE's lack of social concern. This gap is repeatedly cited in academic literature, and, compared to other topics such as waste management, material cycles and business models, the gap refers to how little CE literature touched upon issues such as consumer rights, wage equality, workers' welfare, income disparity, racism, gender inequalities and so on. Perhaps one of the first authors to point this fault was Moreau et al. (2017), and since then, very little has changed. Korhonnen et al. (2018) and Geissdoerfer et al. (2017) are authors repeatedly cited when mentioning this social gap, and both agree that CE would be more comprehensive and an even more sustainable concept once this gap is bridged.

According to the Ellen MacArthur Foundation (EMF), CE is a regenerative economy (EMF, 2013a: 7; 2020: 9). Since the past century, concern over the environment has increased, perhaps especially over impactful environmental changes such as global warming and the decrease in natural stocks. Such concerns gave rise to the concept of sustainable development (SD), which aims to balance not only economic needs everywhere, but also environmental conditions and social wellness (Beyerlin & Marauhn 2011: 76, 83). Traditionally, a sustainable development is one that allows both current and future generations to satisfactorily meet their respective needs (Brundtland, 1987). Within this new paradigm, many other concepts have emerged, such as eco-economy, green economy and ecological modernization, among others, but it is likely CE that currently stands out the most – whether that is because it appeals the most economically, or because it may call for real

social changes, though, remains to be seen.

There is a well-known adage that "the logic of capitalism is consumerism," although there is debate on the matter, such as Friedman's argument that the role of corporations is to generate profits ultimately for the benefit of its business society (Friedman, 1970), and Carroll's stance that consumerism and capitalism are actually opposites (Carroll, 2021). Currently, many capitalist societies are dominated by compulsive consumption, which Bauman (2007: 47) argues to be "the necessary condition for happiness," placed to satisfy the human emptiness, an idea with which Finkielstein (2022) concurs. It seems consuming does not bring about well-being or happiness except perhaps the temporary kind (Bauman, 2001: 89), although some may argue against such a stance. In CE terms, or more specifically for the Performance Economy (Stahel, 2016), however, consumption is swapped for usage, which deprioritizes property and prioritizes needs instead. In this sense, there would be a considerable reduction in the exploitation of natural resources, perhaps even allowing nature time to both heal and recover its natural stocks. However, there should always be concern for the negative social effects, such as the neglect of workers' rights, and rebound effects (Schröder, Anantharaman et al., 2019: 9), or, in other words, compensating a reduction on one side by increasing consumption of another, e.g., reducing ownership over cars, but increasing roads so that the use of shared cars – and consequently fuel consumption – off-balances the initial reduction.

1.1 Wastefulness: Breaking Planet Boundaries

In 2005, 44% of the materials in the economy were directed at energy production (Moreau et al., 2017:500; Haas et al., 2015: 770) – and much of this is non-renewables. The study by Schmidt et al. (2020: 770) for the Circle Economy group revealed that, "in 2017, 100 billion tons

of resources were consumed." McDonough and Braungart (2002: 27-28), when introducing their Cradle-to-Cradle (C2C) methodology, explain that, in the USA, up to 90% of the materials extracted to manufacture products "become waste almost immediately." Moreover, on average only 5% of the resources used to produce (and deliver) something are actually part of the product itself – most of these materials are used during the production process, with at least 15% emitted into the air and another 25% released in the environment (Fraser et al., 2023: 18-19), most likely without proper treatment. Perhaps worse is the fact that sometimes the product itself is discarded just as quickly (McDonough & Braungart, 2002: 27-28).

At the very least since 2009, researchers are aware of at least three planetary boundaries that have likely already been crossed, according to Röckstrom et al. (2009: 3): "climate change, rate of biodiversity loss, and changes to the global nitrogen cycle." In his groundbreaking benchmark study, Röckstrom et al. identified nine planetary boundaries and proposed quantitative marks for seven of them, including climate change. Röckstrom et al. also explain that it was the stable weather after a glacial period that allowed humanity to "invest" in the environmental instead of exploiting it (Röckstrom et al., 2009: 4). The data on the wastefulness of the as-of-yet preponderant cradle-to-grave system is likely not complete – there is still much to discover about the ongoing stress that industrialization and unchecked consumption have caused the earth. Although it is clear today that the exploitation certainly continued, it was since the first industrial revolution that humankind's 'investments' started pushing the boundaries of the planet (Röckstrom et al., 2009: 4-5).

Regarding consumption, McDonough and Braungart (2002: 16) present the following analysis:

> Consider this: all the ants on the planet, taken together, have a biomass greater than that of humans. Ants have been incredibly industrious for millions of years. Yet, their productiveness nourishes plants, animals and soil. Human industry has been in full swing for little over a century, yet it has brought about a decline in almost every ecosystem on the planet. Nature doesn't have a design problem. People do.

This passage is particularly relevant in understanding what is perhaps the main difference between a linear economy and a circular one, and the keyword is 'design' (EMF, 2015a). A CE and any production or service in a CE system is planned, from sourcing materials – preferably from non-virgin stocks – through following cycles and, finally, until it is discarded or, ideally, returned to the environment within safe standards (EMF, 2015a). In other words, in a CE, the end-of-life (EOL) of a product is postponed as much as possible, and the logistics of returning the product and/or packaging so that the materials may be used again with the same or higher quality should be factored into business plans (den Hollander et al., 2017: 519). Possible externalities, such as eventual emissions into air, water, or soil are likewise accounted for when designing a new product or service (EMF, 2020).

Regarding emissions, in a CE it is preferable to eliminate waste in any production process, avoiding techniques such as landfilling and illegal dumping. Surprisingly, incineration is also amongst the techniques that CE should avoid whenever possible, since it eliminates the possibility of recovering most of the materials that suffer this process (Braungart, 2020). A similar procedure, waste-to-energy is just as harmful, and some studies show that it might even be counterproductive to a CE (UNEP, 2019). McDonough and Braungart (2002: 55) even cite a German case of a vicious cycle in which some heavy metals are emitted into the environment from an incinerator, and the trees have to be incinerated due to their high toxicity from such hazardous materials. There would

barely be any need for such health and environmental risks if emissions and waste in general could be avoided or at least drastically reduced.

To make use of the materials already extracted and in circulation, information on such stocks is necessary. Specifically, how much, where and in what state are materials stocked (EMF, 2015b: 23). Collecting non-virgin resources that are wasting away in old infrastructures, storages or stockpiles, amongst other sources, to produce something new is urban mining (Rau, 2019). Just as the logistics for CE is essential to returning materials for a new cycle, the process of recovery of materials within cities, urban mining, is equally important, both environmentally by preventing the extraction of virgin resources, as well as financially, since these materials are currently wasted instead of producing value (Haas et al., 2015). The Global e-Waste Monitor showed in 2017 that 44.7 t^3 of e-waste alone corresponded to €55 billion worth or valuable resources (UNU, 2018). In this sense, some European organizations launched the Urban Mine Platform, the first database of "scrap vehicles, spent batteries, waste electronic and electrical equipment, and mining wastes" (UNU, 2018).

All in all, it is safe to say that human development up until now harmed and continues to harm the earth and its systems (Rockström et al., 2009; EMF, 2015a, 2020). Academia and practitioners searched for ways to make changes and sprouted ideas such as industrial symbiosis, green economy, blue economy, shared economy, ecological modernization, etc. According to Rossi et al. (2020), what sets CE apart from other concepts is its focus on eco-effectiveness as opposed to eco-efficiency, the latter stressed by the other concepts. In other words, CE emphasizes not on minimizing the negative impacts, but on optimizing the positive (Rossi et al., 2020: 1). This characteristic alone gives CE an advantage over other ideas, but it is not without its own defects, as shown in the following section.

1.2 The Main Problem for CE in LMCs and the Research Question[3]

There is a serious critique against CE regarding its unbalanced focus on economic and even environmental issues, but this is not a problem that is unique to CE. Other concepts such as Ecological Modernization (Spaargaren & Mol, 1992) and Industrial Ecology (Hobson, 2020: 106-107), for example, have faced this as well, and both of these are part of the foundation of CE. In a similar analysis regarding SD, Schröder, Anantharaman et al. (2019: 15) state that:

> Historically, in the context of sustainable development, failure to explicitly consider the needs and lived experiences of marginalised populations (women, indigenous people, etc) has resulted in poor development outcomes. Thus, in the CE, policymakers, practitioners and thought leaders might be well-advised to think about existing patterns of inequality and how these might be ameliorated or exacerbated in the CE.

Both History and business studies are littered with failed attempts of different kinds of developments. One needs to look no further than the French Revolution, which was urged by huge social disparities, or the many revolutions against slavery worldwide during the 19th and 20th centuries. On one hand, an example of failing SD projects is found in cases where gender disparities widened instead (e.g., Schröder, Anantharaman, 2019: 15), or when already oppressed groups such as waste pickers (WPs) are further marginalized (e.g., Schröder, Anantharaman, 2019: 15). On the other hand, successful cases also frequently point out social factors such as community

[3] Parts of this section, as well as Chapters 2 (particularly sections 2.3-2.4), Chapter 4, and most of Chapter 5 were based on an article the author of this thesis previously published: Amorim de Oliveira, Í. (2021). Environmental justice and circular economy: Analyzing justice for waste pickers in upcoming circular economy in Fortaleza, Brazil. *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-021-00045-w

involvement, education, and social equity (WB, 1997: 1). The World Bank also acknowledged the significant role that social capital and people (human capital) play in development, especially when the goal is sustainability, even qualifying such factors as “the most important” when determining the wealth of a nation (WB, 1999: 1).

It is clear from the arguments above that current CE risks exacerbating social disparities. CE’s relationship with SD is also a continued point of discussion. Geissdoerfer et al. (2017) and Kirchherr et al. (2017) defend that CE is either part of or aims for SD, while others differ, such as Sauvé et al. (2016), who argue that CE will only lead to a weak sustainability unless it can bring about a paradigm change, which requires a more holistic view (Lehman et al., 2014; Webster, 2013). On this topic, Korhonen et al. (2018: 547) proposed a more inclusive definition of CE:

> CE is a sustainable development initiative with the objective of reducing the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system. CE promotes high value material cycles alongside more traditional recycling and develops systems approaches to the cooperation of producers, consumers and other societal actors in sustainable development work.

In such a definition, the expression “develops systems approaches to the cooperation of producers, consumers and other societal actors in sustainable development work” clearly includes more elements than traditional CE, which is typically concerned more with business models, waste management and the decoupling of environment and economy (Kirchherr et al., 2017). In Korhonen’s definition, CE is ready to accept a social obligation in its design. There is much to be discussed on the matter. More importantly, however, is to clarify whether CE is a concept that concerns itself with the social conditions of its members and, inherently, with the SDGs, or does

it principally involve only two of the three SD pillars, namely environment and economy.

Recent CE literature presented some attempts at bridging the social gap currently holding back CE. Inigo and Blok (2019), for example, proposed using Responsible Research and Innovation (RRI). A study conducted by Schröder et al. (2020) proposed using the Human Development Index (HDI) to analyze social indicators of CE. Gutberlet et al. (2017) propose the Social and Solidarity Economy (SSE) which they argue would be fairer to groups such as waste pickers, who are particularly relevant players in a CE, especially in Low- and Middle-Income Countries (LMCs). Araújo (2020) even proposed the fusion of the theory of well-being – a concept used by Ecuador and Bolivia that Araújo alleges has improved the economies and social indicators of these two countries – to create a CE better adapted to the context of Latin America. As pointed out by Gibbons (2020: 2-3) regarding sustainability studies, most of the literature is "dominated by the descriptive-analytical mode of inquiry," and the same can be said for the above attempts at a more social CE.

Pitkänen et al. (2020: 164) additionally point out that the definition of "the social" or "social sustainability" also varies, and it reaches both a limited interpretation – such as "social networks and capital, community involvement, or charity" (Pitkänen et al. (2020: 164) – and a broader one, which tackles issues such as "social equity, empowerment, health and well-being" (Pitkänen et al. (2020: 164). Much of the published works focusing on social aspects of CE place emphasis on social metrics or social assessment, for example, without investigating the reasons behind the issues they find. Gibbons (2020: 3) finds that focusing on symptoms instead of causes may unintentionally foster greater unsustainability, and Middleton & O'Keefe agree (2001: 16).

This study suggests filling the gap presented above with Environmental Justice (EJ), which is both a theoretical concept, as well as a movement. This dual facet makes it dynamic, avoiding

similar downfalls as the ones described above. EJ may be generally understood as the fair access to environmental decision-making and "the just treatment […] of all people […]" (EPA, n.d.), with "the goal of promoting justice and accountability in environmental matters, focusing on the respect, protection and fulfilment of environmental rights, and the promotion of the environmental rule of law" (UNDP, 2022: 5). With this concern for social disparities, EJ can support CE in achieving the ultimate goal of the SDGs and the UN, "leave no one behind," an objective CE alone is not equipped to fulfill. This study does not propose indicators or any quantitative methodology, and it does not focus on the symptoms. It rather suggests a qualitative framework that investigatively explores social issues, examining the causal relations that hinder a just transition to CE. This provides CE policy planners the opportunity to use prevention and precautionary initiatives not to cause harm to the environment or to fractions of society.

A second advantage of using EJ for a more social CE is that EJ has the unique quality of looking at the relationship between social issues and the environment (Taylor, 2000: 542; Schlosberg, 2007: 73), more specifically at the distribution of burdens and benefits, be they social, economic or environmental. This is even truer if the expression "no one" the UN employs regarding its Agenda 2030 for SD includes not just the anthroposphere, but the biosphere as well. In this sense, if CE needs to be wary of causing unwanted or unplanned social harm or even social unsustainability, then EJ provides a proactive lens to help realize a more social CE, which is inevitably the only kind of CE in which LMCs are interested. Especially since, according to Schlosberg (2007: 79-81), EJ in the Global South is very different from where the movement originated from (the USA):

> […] environmental concerns [in the Global South] are often brought within the larger (or local) discourse of social justice – and the movements associated with such general calls

> for justice. Environmental justice is much more a component discourse in these social justice movements, or one of many organizing concerns, than it is a stand-alone movement of its own (Schlosberg, 2007: 81).

CE's origins are mostly from HICs, and, thus far, CE is mostly restricted to business actors and (occasionally) policymakers (Korhonen et al., 2018: 37). This limited set of agents restricts the reach and the real possibility of change that CE can achieve (Hobson, 2016; Hobson & Lynch, 2016; Schröder, Anantharaman et al., 2019, chapter 1), since it would require the participation of all segments of society to make the shift a reality. Likewise, as CE was mostly developed by HICs, perhaps the lack of involvement of LMCs can partly explain the lack of social considerations, an aspect which LMCs are possibly more conscientious of. Whatever the case, changing the whole system has thus far failed in most countries, with very few fully committing to such a transition, amongst which China – which "plays a significant role in the literature" (Prieto-Sandoval et al., 2018: 608), Sweden (Orange, 2017; Söderholm, 2011) and Finland (Ministry of Economic Affairs and Employment, 2021).

The need for a systematic change is intrinsic to the success of a CE, but such changes are neither easy nor fast. On the contrary, they require a complex understanding of the economy, of natural processes and of society. As Martinez-Allier (2021: 2) and Polanyi (2001) state, the economy only exists within a wider physical system, although the opposite is not true (Söderholm, 2011: 913). The economy also requires an abstract (social) system as well, although this aspect is perhaps not as quickly recalled as the environmental side.

Lastly, whether a CE definition tackles the social aspect or not, the current definitions of CE often do not tackle the issue of consumerism, which is likely the root cause of the rupture of earth's limits. The notable decrease of forested areas, of clean environments, of biodiversity and

of overall resource stocks are some of the reasons why humans are currently searching for new ways of production, since the (linear) system thus far used will not be indefinitely possible. Bauman (2001) pointed out in his works that the human being became a consumer, an entity that seeks satisfaction and happiness by acquiring progressively more property, even if the happiness fades immediately after the moment of acquisition (Bauman, 2007). Therefore, if a paradigm shift is necessary, and if CE is the adequate system for this, the role of consumerism and of the consumers – nay, of individuals – still need to be considered, though it is currently understudied (Kirchherr et al., 2023: 1242), as well as the effects a CE system might impose on the environment (Zink & Geyer, 2017), including humans.

This study follows Schlosberg's EJ tripartite theory, which identifies three components to analyze conflicts: recognition, participation (procedural) and distribution. Many studies (e.g., Dawson et al., 2017; Martin et al., 2015; Holifield, 2012; Middleton et al., 2015) make use of this theory to explain the roots of institutionalized injustices, and some also propose improvements upon drawing conclusions. Such conclusions would most definitely follow the EJ layout described by Walker (2012), who notes that most cases of EJ fit a normative-diagnosis-prognosis structure.

EJ, like CE and SD, does not have a standardized definition, so different authors in diverse fields present varied understandings. However, it is a concept that garners increasingly more attention, since it is linked to contemporary debates such as climate justice and racism. In this paper, the understanding of EJ comes from the definition proposed by Bryant (1995: 6)[4] and the

[4] "Environmental justice (EJ) is broader in scope than environmental equity. It refers to those cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities, where people can interact with confidence that their environment is safe, nurturing and productive. Environmental justice is served when people can realize their highest potential, without experiencing the 'isms'. Environmental justice is supported by decent paying and safe jobs; quality schools and recreation; decent housing and adequate health care; democratic decision-making and personal empowerment; and communities free of violence, drugs and poverty. These are communities where both cultural and biological diversity are respected and highly revered and where distributed

17 principles of Environmental Justice announced back in 1991 as a result of the First National People of Color Environmental Leadership Summit, easily available online (e.g., Environmental Justice Network, 1996; Environmental Working Group, 2007) and very well-known. Altogether, these principles point out many inequalities the current generations face, including the unbalanced decision-making (Principle 7), the unfortunate and forceful choice between unsafe livelihood and unemployment (from Principle 8: the right to a safe and healthy work environment), and exacerbated consumption, which will require a lifestyle shift (Principle 17).

The issues raised by the principles of EJ enumerate the importance of a social CE. While it is common practice to divide topics in order to study (and effectively implement) them (Nogueira et al., 2019: 567), there is always a risk of forgetting that each part (or topic) interacts with a broader system. Nogueira et al. (2019: 567-568) mention that the efforts to bridge the gaps created in between the reductionist subfields of scientific knowledge is what formed systems thinking, which studies the interconnectivity and relationships of the components of a complex system. Indeed, CE is certainly classifiable as a complex system, and, since 1990, according to Lehmann et al. (2014: 5), CE encompasses a more holistic view that incorporates systems thinking (Webster, 2013), and this should include social relationships. Khitous et al. (2020) warn, however, that current CE research still falls short in providing a holistic view, and, in this sense, it is ever more important to expand the CE literature so that it can boast a wider range of research. This does not mean that CE needs to be all-encompassing, as that would be neither pragmatic nor realistic, but CE research and likely CE policies also do require awareness of such boundaries (Schröder, Bengtsson et al., 2019).

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justice prevails" (Bryant, 1995: 6).

Given the above, this research proposes EJ as a powerful tool to further improve CE, bridging the social gap. This view was recently endorsed by prominent CE writers such as Schroeder and Barrie (2022). EJ is likewise an effective tool to identify otherwise undermined stakeholders and avoid injustices in the very basis of CE. Bringing a social element to CE is vital to ensuring its durability, since "the unsustainability of the current modes of production and consumption has been documented in detail" (Ziegler et al., 2023: 2), and bringing a qualitative social component to CE will most likely contribute to a stronger and resilient CE, especially regarding its adaptability to LMCs. Considering the previously explained background, this research aims to answer the following research question (RQ): How can the concept of environmental justice support LMCs toward a better transition to a CE? The assumption here is that EJ can provide a bridge to CE's social gap. To answer the main research question, the following sub-questions are answered first: Q1) From a traditional CE perspective, how are cities in LMCs transitioning to a CE? Additionally, Q2) From an EJ perspective, what challenges do cities in LMCs face in the transition to a CE?

Different chapters present the answers to the sub-questions. Chapter 3 describes the legislative background of the case study and pertinent legislation, contextualizing the empirical data of the case study, and thus paving the way to answer the sub-questions in the following chapters. Chapter 4 first presents the main actors and their activities relating to WM in Fortaleza based on the empirical data obtained via semi-structured interviews with different types of stakeholders, and then analyzes the presented data using the proposed framework described in Chapter 2, answering the first sub-question (Q1). Chapter 5 uses the CE-EJ framework to answer the second sub-question (Q2). The results of the sub-questions together answer the main question, as explained in the last chapter (Chapter 6), which delineates the final remarks. These answers are

derived from the proposed analytical framework, which is itself one of the contributions of this study, aimed at fulfilling the social gap that many authors have observed to be CE's weak point.

The framework provides CE with a tool to incorporate social considerations into its structure, something which has been missing until now. Aside from the main research question, the sub-questions also provide suggestions as to how EJ could be adopted in CE, given that, as happens to many concepts born in HICs, it is not sufficient to simply transpose them in LMCs without adapting them to local issues (Schröder, Anantharaman et al., 2019). In the case of LMCs, which are generally different from most HICs, there is a need to consider other social conditions that are often not present in HICs, and which most likely affect the workings of CE (Schröder, Anantharaman et al., 2019: 15).

1.3 Methodology

This research leans towards a qualitative nature. Qualitative studies focus on words over quantification and are well suited for understanding social phenomena, usually by interpreting them (Bryman, 2012: 380). In this study, the analysis takes on an over-all critical-realist view, searching for the underlying motives of issues raised.

As this research proposes a social addition to current CE, it requires an in-depth analysis. Therefore, this research also presents a case study, which is recognized as a research design that can better elucidate details in social science (Bryman, 2012: 66), especially "How" or "Why" research questions, which seek to explain social phenomena (Yin, 2018: 10). As de Oliveira et al. (2019: 564) defend, interviews are suitable for collecting data of such nature, and are thus employed in this study.

Beyond this first chapter, which is an introduction to the research questions and the

structure of this research, Chapter 2 presents a brief overview and state of the art, regarding both CE and EJ. As shown in Chapter 2, an analytical structure was formed using mainly Schlosberg's EJ teachings, and a CE layer was added to finalize the proposed framework. Chapter 3 presents the policy background of the case study, specifically the documental research focusing on the CE legislations pertinent to the case study (mainly regarding WM). Chapters 4 and 5 use the CE-EJ framework to analyze the CE policies raised by the documental research, especially regarding WM and WPs, as well as the findings/results of the 15 in-depth semi-structured interviews conducted in Fortaleza in 2019. Chapter 6 presents the conclusion and final remarks, including the research limitations.

The methodology uses literature review, document analysis, case study, and semi-structured interviews. In the preparatory stage, literature review on CE eventually elucidated the existence of CE's social gap, and the author began posing research questions that could lead to a bridge. Once EJ was selected as a possible tool, case study became a logical selection for a research design, since its very essence allows for deeper appreciation, a characteristic quite necessary to EJ studies. Accordingly, a combined use of documental research and interviews was employed for data collection. The search for legislation and official documents related to the case study helped shape the research questions and the interview questions as well. The first set of documents in the preparatory stage for the case study focused on environmental policies in general, which were then selectively discarded by using the keywords specified in Chapter 3, and the second round narrowed the search to CE-related policies and norms using those keywords.

In the second stage, the interviews were conducted (see section 1.4), the research questions were refined and additional documents on specific topics mentioned during the interviews were added to the collected data, especially regarding WM and WPs. The Ecopoints program, which

saw over 60 drop-off points for recyclables and a few other kinds of waste built throughout Fortaleza, became the main focus of the case study in this stage.

In the third stage of the research is the analysis using the proposed CE-EJ framework. This part is divided into two steps: first, a CE perspective using the three Ellen MacArthur Foundation (EMF) CE principles (labeled in this study as C1, C2 and C3), and, second, an EJ perspective using Schlosberg's EJ elements (labeled in this study as J1, J2 and J3). The CE-EJ analysis combines the six points to paint an overall picture of the studied object – in this case, the CE transition in Fortaleza, mainly the Ecopoints policies.

1.4 Case Study: Choosing Fortaleza and the Interviewees

Chapters 3, 4 and 5 present a case study of Fortaleza, a big city located in northeastern Brazil, to illustrate the empirical usefulness of the proposed CE-EJ framework. Fortaleza experienced rapid development over the last decades, currently occupying 8th place in the ranking of cities with highest purchasing power in Brazil (G1 CE, 2022a). Its size, population and GDP are not as outstanding as megacities such as São Paulo, Tokyo or Beijing, which sets Fortaleza closer to more typical municipalities in LMCs, suggesting a higher replicability. Likewise, the municipal government's continuous efforts to achieve sustainable city status also offers the city unprecedented environmental improvements, including an award from UNESCO in 2019 as a Creative City (Diário do Nordeste, 2019). This also shows the city's commitment in transitioning to a more sustainable economy, boding well for CE.

As May (2011: 223) explains, case studies are often employed when a researcher aims for generalization, although the method may be used when the researcher is looking for some particularity instead (May, 2011: 224). May also points out that case studies bring humanistic

values to light (May, 2011: 225) by focusing on stories, anecdotes, i.e., the human facet of complex social research. Following Yin's (2018: 5) opinion that case study is a method apt for examining in-depth complex contemporary sociological phenomena without losing a holistic view, especially when the researcher has no control over the events, this paper set the geographical limit to a "city" range to raise the manageability (Dunleavy, 2003: 23-25). The author chose Fortaleza due to its potential in eliciting "generalizable conclusions" (May, 2011: 223).

The researcher gathered local legal literature and documents and conducted four preliminary interviews to immerse in the environment. Later, the researcher conducted 15 semi-structured interviews with key stakeholders, initially with the municipal government agency in charge of Fortaleza's environment (including WM/material circulation) and the state agencies involved with WM/material circulation, since the latter topic is a strong part of CE and what much of the literature focuses on, as shown in chapter 2. From that point on, using the snowballing technique (Bryman, 2012: 202-203), the interviewee list expanded to waste picker associations (WPAs) and the WM company in charge of Fortaleza's waste collection (and additional services), as these actors play pivotal roles in the current CE status of the city.

The first interviewee was a representative of SEUMA (Fortaleza's environmental bureau), who revealed a conflict amongst the WPs and a certain distance that had since developed between the municipal government and the WPs. Out of the many WPAs in Fortaleza in 2019, about 10 had completed their registrations, plus the cooperative (COOPMARES). The author interviewed at least one member – usually the leader or president of the registered associations, or the respective former leader/president.

The questions used in the interviews, especially the structured parts, were based on the criteria and questions presented in Table 2-3 (see chapter 2) and in the concept of EJ in general. *In*

loco interviews were preferred for the data collection due to the possibility of personal interaction with the interviewees while also providing the comfort of an environment familiar to them. The researcher chose semi-structured interviews because, as explained by May (2011: 134-135), they allow for flexibility and adaptation during the interview process, while still maintaining standard questions that can later be compared. The standardized questions can be found in the Appendix (Table A-1). Below, Table 1-1 presents information on the interviewees.

Table 1-1. Interviews in 2019 with the Targeted Stakeholders in Fortaleza.

#	CATEGORY	ORGANIZATION	POSITION	CODE
1	Government	Municipal (SEUMA)	Staff member	SEUMA
2	Business	Start-up recycling (R3)	Executives (3)	R
3	WP	Association	Affiliate	S
4	Education	Government educational program	Government-WP Liaison, ex cooperative executive	C
5	Education	Government educational program	Government-WP Liaison, ex cooperative executive	T
6	Mix	Government educational program/Association	Liaison/WP association affiliate	A
7	WP	Association	Affiliates (3)	V
8	WP	Association	Affiliate	M
9	WP	Association	Affiliates (2)	U
10	Business	Waste management (ECOFOR)	Staff member	ECOFOR
11	Government	State (COSAN)	Staff members (2)	COSAN
12	WP	Association	Affiliate	J
13	WP	Alliance (REDE)	Affiliate	REDE
14	Government	State (CODES)	Staff members (2)	CODES
15	Scholar	University	Professor	University

Source: Field work conducted in 2019.

Most interviews lasted 40-60 mins and were recorded with two devices to avoid accidents or malfunctions. The researcher asked all interviewees for their consent before recording, and, on record, asked if they consented to their names, information and/or opinions being published. All interviewees accepted, although the researcher redacted their names in the final product. During the interviews, the researcher took quick notes in Notebook 1 of: name, affiliation and contact of interviewees; main points of the interviews; cited norms or policies; specific answers to the structured questions; suggested interviewees (snowballing), etc. The author completely scanned Notebook 1 for backup purposes.

The researcher heard the recording multiple times at different dates in order to organize

and interpret the data. The first time relistening to the recording started about a month after the interviews were over, and the researcher added information in the respective pages in Notebook 1. Colored sticky notes were also employed to facilitate looking up information. The second time the author relistened to the interviews was in 2020 for confirmation purposes, or to more accurately paraphrase the interviewee. The third time relistening occurred was to prepare the initial draft of this thesis, and the researcher took notes in Notebook 2 using colored pens for more efficient organization. Notebook 2 contains relevant information organized according to the structured questions and the CE-EJ framework. The data annotated in both Notebook 1 (mostly written in bullet points, using one color, and the topics are mixed) and Notebook 2 (written in sentences with multicolored pens and the topics are organized using the CE-EJ framework) were then reprocessed and summarized in Chapter 4, and used for the analysis in Chapters 4-5.

Lastly, a triangulation of all the answers through all the different sources of data is necessary, including the initial documental analysis, the interviews and general observations *in loco* during the visits made to the WPAs and other locations. Such a process was necessary for the internal validity according to Yin (2018) and also Demajorovic et al. (2016: 122). Chapters 4-5 shine further light on the details of the research by applying the proposed CE-EJ framework to a real case (Fortaleza).

1.5 Contributions

The study has multiple contributions. First, it strives to fill CE's social gap, suggesting EJ as a possible complementary concept. Recent literature pointed out the critical importance of EJ in CE (Schroeder & Barrie, 2023), yet there is no model or tool kit to actively merge, apply or otherwise utilize EJ within CE research. Though not exhaustive, the case study presented here

shines some light on a possible application. Nonetheless, the initial contribution here lies on a preliminary level: by patching one of the most notable gaps within the CE literature with the investigative concept that is EJ, CE emerges with the capacity to incorporate social considerations and ties with the environment from its very core. This contribution mainly benefits the field of CE studies.

Secondly, the present thesis contributes a new tool for developing CE policies and initiatives within the SD paradigm, especially in LMCs, by offering the CE-EJ framework. This means that CE may contribute to a wider range of SDGs than those it is most often associated with. According to Schröder et al. (2018), CE directly affects the mostly economic or environmental goals of SDG 6-8, 12 and 15. Expanding this range to more social goals such as SDGs 1, 5 and 10 is likely to ensure a faster acceptance and adoption by LMCs. The proposed CE-EJ framework may be used in both the developmental stages of policy designing, as well as analytically when used to locate the causal relations of social issues impacted by CE policies. Here, the mainly benefitted fields are those of environmental studies, environmental policies, public policies, policy designing, and sustainability studies.

Third, the research also contributes empirical studies from the case study of Fortaleza, contributing to more data on CE of LMC origin. The country (Brazil) has long pursued SD and more recently CE as well, with sustainable public procurement, climate change and WM amongst the topics already legislated by the federal government. Much of the production comes from the southern part of Brazil, e.g., da Silva (2018); Dutra et al. (2018); de Oliveira et al. (2019). While adding to the increasing amount of studies of CE in Brazil and in LMCs, this research also diverts from the usual geographical center of academic production in Brazil on the subject.

The state of Ceará is no stranger to environmental policies, and pursuing mixed clean

energy sources has long been on the state's agenda, currently boasting about 60% of its energy matrix from solar and wind power alone (ANEEL, 2023), with more on the way (Agência Brasil, 2022), including wave generation and a green hydrogen hub (Ceará, 2023). While the municipality of Fortaleza is not an internationally known case, it continues to strive for SD and, recently, CE. Its persistent struggle in creating WM policies and other initiatives in, for example, public transportation and public health-related initiatives, move Fortaleza to the roll of cities inching closer to CE and to sustainability, thus justifying the choice of the city as a case study. This last contribution also benefits the fields of environmental policies, public policies, and sustainability studies, as well as environmental law and CE case studies, especially those of LMC origins.

2. Concepts and Theories

Humans rip the Earth of its resources without replenishing (Lahane & Kant, 2022：1), while also expecting a depleted environment to clean itself up when used as a sink for human-made wastes (Söderholm, 2011: 913). Some of the consequences are already felt, such as climate change and a depletion of natural stocks (Haas et al., 2015; Fraser et al., 2023), but others may take some more time to be felt or even discovered. Some authors argue that we have already surpassed the planetary boundaries (McDonough & Braungart, 2002: 16), and without any correction or, indeed, reparation, it will likely not be long until the planet is no longer able to support the living systems it still houses. Due to this new relationship with Earth, since the last century there is no shortness of calls for a more sustainable economic model, and there is a growing body of literature that associates current environmental issues with the predominance of linear economy (Korhonen et al., 2018: 37), which is often summarized as a take-make-dispose model (Ghisellini et al., 2016: 11).

2.1 CE Concepts, Principles and the "Butterfly Diagram"

An attempt to find a final definition for CE, Nobre & Tavares (2021) acknowledged the influence of the EMF in the development of CE practices and concepts, specially in the EU, considering such influence to be widely recognised. Amongst a widespread of papers discussing different definitions for CE, Nobre and Tavares reach a very long and descriptive definition that is unfortunately not well suitable for encouraging its usage:

> Circular Economy is an economic system that targets zero waste and pollution throughout materials lifecycles, from environment extraction to industrial transformation, and to final consumers, applying to all involved ecosystems. Upon its lifetime end, materials return to

> either an industrial process or, in case of a treated organic residual, safely back to the environment as in a natural regenerating cycle. It operates creating value at the macro, meso and micro levels and exploits to the fullest the sustainability nested concept. Used energy sources are clean and renewable. Resources use and consumption are efficient. Government agencies and responsible consumers play an active role ensuring correct system long-term operation. (Nobre & Tavares, 2021: 10).

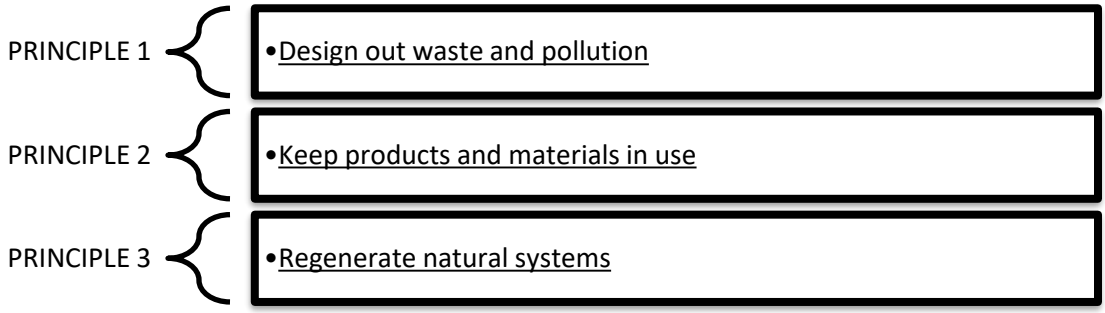
A thorough review article by Kirchherr et al. (2023: 30), after a long analylsis of 221 CE definitions, concluded "that a final definition may never materialize." The authors explain that any definition is neither possible nor desirable, given the evollution "of technology, environmental conditions, and economic and socio-political contexts" (Kirchherr et al., 2023: 30). They concede that all attempts at a definition share the initial motivation of finding a system to replace the tradional linear model by one that respects the limits of the earth, and this intent is serving to expand the scientific boundaries. In summary, the traditional linear economic model is unsustainable and needs to be replaced by another that takes into account the full use of the resources and the reduction of their waste, so that the earth could continue to provide the necessary basis for mankind to survive (Korhonen et al., 2018: 37-46).

The design of the CE is universally acknowledged via the "Butterfly Diagram" (EMF, n.d.-a), regardless of the struggle for a definition. It is the quintessential image of a CE, presented by the EMF. The diagram inherits much of the cradle-to-cradle systematics, especially regarding the division between renewables (mostly biological) and finite materials (otherwise known as "technical"), which should not mix. It also shows many cascaded cycles before recycling, the latter being another arguably common topic in CE studies. The inner circles aim to prolong the use of products or their materials for the longest possible (without quality loss), in a direct reference to

CE's second principle (EMF, 2015b: 50), before the materials eventually get discarded. At least in the technological circle (the blue side, i.e., the right wing), the smaller the circle, the more preferential the action, as it requires less energy/resources (EMF, 2015a: 8) and, thus it also likely requires less cost (Korhonen et al., 2018: 38).

While the Butterfly Diagram represents CE "in a nutshell," the three principles ascribed by the EMF are not explicit, but are just as inherent to CE. Represented in Figure 2-1 below, these principles represent CE as viewed by the EMF, focusing on materials and resources. The first is "design out waste and pollution," the second is "keep products and materials in use," and the third is "regenerate natural systems" (EMF, 2020: 11). These principles undergo changes in their wording (e.g., EMF, 2016: 34), but not in their essence. They do not include abstract values, nor social needs such as well-being of citizens or quality of the work environment.

Figure 2-1. The Principles of CE.



Based on EMF, n.d.-b

The EMF does not explicitly prescribe how to apply the principles, nor go into detailed limitations of their definitions, but some studies apply "CE principles" in their analyses. However, their definitional parameters differ. Some authors consider the 3Rs "reduce, reuse, recycle" as the CE principles (Rodríguez-Espíndola et al., 2022), while others expand the list of principles (Bugaian & Diaconu, 2020; Suárez-Eiroa et al., 2019). Mutezo and Mulopo (2021) directly apply

the three EMF principles, and even mention that "it is important to look at circular economy principles as enablers for achieving Sustainable Development Goals." The EMF (2021) itself also used its three principles to analyze climate change.

This research recognizes the strong influence of the EMF in the development of the CE practices, concepts and principles, especially in the EU, as many authors acknowledge (e.g., Nobre & Tavares, 2021). The strong CE presence in the developed world is also attributed to the role of the EMF, hence the usual critique that CE is a concept born and applied in High-Income Countries (HICs) and not well adapted to the Low- and Middle-Income Countries (LMCs). The EMF has put out three principles that are the basis for an ever larger amount of classifications of CE principles (Nobre & Tavares, 2021). From this seminal classification – namely, "design out waste and pollution" (EMF, 2018: 36), "keep products and materials in use" (EMF, 2018: 36), and "regenerate natural systems" (EMF, 2018: 36) – many subsequent authors proposed other typologies, often in the form of n-Rs.

A bevy of studies apply or study the CE principles, including the EMF's. Pesce et al. (2020), for example, relate what they discern as the six normally used CE principles, amongst them the ones from the EMF chosen in the present research. Pesce et al. analyze the application of principles into practice in a study of the CE in China. Another paper on the usage of CE principles by Gursel et al. (2022) defines CE principles, presenting a table with the collation of the 10 most used CE principles starting again with the EMF ones. Among those principles there are the so-called 3R typology that appears in so many scientific papers, but that repeatedly shows differences in their numbers. Beginning with the 3R's (reduce, reuse, recycle), they evolved to 4R's (reduce, reuse, recycle and recover), and than escalate to higher numbers such as 38R's (Reike et al., 2018), 45R's (Mhatre et al., 2021) and 60R's (Uvarova et al., 2023). Uvarova et al. recognized that these

typologies are useful depending on the kind of business, strategies and companies they are apllied to. The latter authors also see them as a kind of language exercise, while simultaneoulsy recognizing that the human mind has some difficulty to grasp these higher typologies.

The EMF typology not only has the advantage of its constancy, but its three principles likewise served as origins to many other frameworks that are in fact the same three EMF principles translating into different names and adaptations. In this sense, Reike et al.'s review explains that in many of their analyzed articles, authors used different words and ideas to denote the first EMF principle: "refuse, reduce and re-purpose represent different ideas in different contributions" (Reike et al., 2018: 258), but they are all encircled by the idea of design out waste. A similar phenomenon befalls the other two principles. In short, C1, C2 and C3 are at the heart of many CE studies, despite different wordings. Authors such as Wright et al. (2019) recommend the application of these principles in LMCs, in a similar way this research does, whilst alleging advantages to public health (Wright et al., 2019: 2). Others such as Martínez-Martínez et al. (2023) observe the importance of the CE principles in their study on producing cement from waste.

In summary, while still broad, there are many ways to apply the three principles in conceptual or analytical CE studies. Table 2-1 presents the definition of the three EMF CE principles (middle column), as well as how the author interpreted them (right column). This table clarifies the (definitional) limits of the principles in this study, based on literature produced by the EMF and others, especially the C2C (McDonough & Braungart, 2002).

Table 2-1. The Three EMF Circular Economy Principles: Definitions by EMF and Limitations within this Study.

	EMF DEFINITION	DEFINITIONAL LIMITS IN THIS STUDY
C1: ***Design out waste and pollution***	"A circular economy reveals and designs out the negative impacts of economic activity that cause damage to human health and natural systems. These costs include: the release of greenhouse gases and hazardous substances; the pollution of air, land, and water; and structural waste, such as underutilised buildings and cars." (2018: 23)	Encompasses any action that was created (designed) to reduce or eliminate waste, pollution or emissions. There should be an intent, a voluntary desire to achieve this result, preferably not as a remedial action towards post-consumption products, but since the pre-production stage.
C2: ***Keep products and materials in use***	"The circular economy favours activities that preserve value in the form of energy, labour, and materials. This means employing reuse, remanufacturing, and recycling to keep products, components, and materials circulating in the economy. Circular systems make effective use of renewable materials by encouraging many different economic uses before they are returned safely to natural systems." (2018: 23)	The act of planning for materials not to go to the environment, but back into the same production or usage cycle. Alternatively, the material may also go into a different cycle of equal or higher value than its previous one. Although end-of-pipe actions, especially those resulting in downcycling are considered C2 because they put the materials back into circulation, such actions have a lower priority than the systems that were planned since pre-production to recover the materials.
C3: ***Regenerate natural systems***	"Economic activity can, and needs to, actively rebuild biodiversity. For example, regenerative agricultural approaches such as agroecology, agroforestry, and managed grazing sequester carbon in the soil and improve its health, increase biodiversity in	Actions that involve a consumable product or service and their resulting ecologically positive effect on the environment. The cycle of a product or service has an intentionally regenerative effect. Purely environmental actions such as

	surrounding ecosystems, and enable agricultural lands to remain productive instead of degrading over time, thereby reducing pressure to expand them." (2021: 5-6) "The circular economy favours the use of renewable resources and aims to enhance natural systems by returning valuable nutrients to the soil." (2021: 23)	cleaning a river is not considered a C3, but mere preservationist/conservationist (EOP) acts that are somehow connected to C3, but do not represent it.

Source: EMF, 2013a: 22; 2013b: 26-28; 2016: 5-8; 2018: 23; 2021: 5-6, 21-23.

The three principles of CE reflect those of the C2C model's, as does the butterfly diagram, but there is a clear absence of social issues in these CE representatives. The diagram shows a clean system that takes back much of the materials, and the principles set the stage for the possibility of such a system, as well as its continuity by restoring natural environments. Although the social gap may be justified by some authors with CE's lack of relationship with, many writers disagree, clearly relating both concepts, albeit in different ways. The following section will shed further lights on this debate.

2.2 The Role of CE in Sustainable Development: A Work in Progress[5]

Humanity began worrying about the environment – or, more specifically, about the relationship between humans and the Earth – at the very least since the 1972 UN conference on the Human Environment in Sweden. After that conference, representatives from more than 170

[5] Part of this chapter, particularly section 2.2, was based on: Amorim de Oliveira, I. & Masuzawa, Y. (2022). Sākyurā ekonomī (Junkan keizai) ron no kadai: Jizoku kanōna kaihatsu to no taihi ni miru shakaiteki kōsei eno shiten (Questioning the circular economy and sustainable development: A social equity perspective). Journal of Human Environmental Studies, 20(1): 49-60. https://doi.org/10.4189/shes.20.49

countries and over 700 observers from NGOs attended the UN Conference on Environment and Development (UNCED) in Rio de Janeiro (Beyerlin & Marauhn, 2011:13–14). Important agreements such as the Rio Declaration, the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity relate to UNCED, but it is possible that the most significant result of this meeting was the clear attempt to overcome the intellectual conflicts between the Global North & South (Beyerlin & Marauhn, 2011: 14-19).

The opposing stances between LMCs and HICs was crystal clear during the UNCED (Beyerlin & Marauhn, 2011: 14). The developing countries desired equal standing with the developed countries, particularly regarding the economic inequality between both groups, and to manage their environmental resources without interference from HICs (Porter & Brown, 1996: 108-117). Developed countries, on the other hand, pushed for all countries to work together to solve global environmental problems, including the LMCs (Porter & Brown, 1996: 114). The debate regarding social-economic development and environmental awareness resulted in the Rio Declaration, which reflected the ideas of SD, a principal that has since then permeated many international agreements (Beyerlin & Marauhn, 2011: 14-19; Porter & Brown, 1996: 128).

The 1987 document “Our Common Future” by the Brundtland Commission spread the most well-known definition of the principle of SD. Jim MacNeill, the lead writer of the famous Brundtland Report, however, mentions that the research group originally defined SD from many points of view（Smith et al., 2010: xxxiii–xxxiv), such as the social or from an ecology angle. MacNeill laments that only one definition caught on, that which introduces the needs of future generations (Smith et al., 2010: xxxiv). Not all aspects of SD’s complex concept are equally considered by decision-makers, but, despite the many criticisms on the principal of SD, its three pillars are well established: economic development, social development and environmental

protection (Barral, 2018:106).

Circular Economy and Sustainable Development: Partners or Rivals

The ideal of SD is integrating into political debates perhaps almost as persistently as "democracy, justice and liberty" (O'Riordan, 1993: 65), regardless of the inconsistency of its definition, ambiguities and contradictions. The latter three exist for millennia, so only time will tell if SD will join the list, but it is certainly proving resistant thus far. Perhaps it is due to this permeation that other concepts such as CE earned attention too, although, according to Geissdoerfer et al. (2017: 757), the relationship between SD and CE is not so well established yet (Schöggl et al., 2020: 2), a statement that the study of Kirchherr et al. (2017: 227) confirmed. There is a general assumption that CE leads to SD, however, as of yet, this is merely a conjectural statement, as claimed, for example, by Panchal et al. (2021: 2). Although their study sets out to explore if CE helps realize the SDGs, the study was inconclusive (Panchal et al., 2021: 18).

The current concept of CE merely leads to a "weak sustainability" (Sauvé et al., 2016: 53). i.e.: "that economic benefits can replace human and natural capital" (Loiseau et al., 2016: 367). Weak sustainability likewise does not target "deep transformations of the current linear production and consumption system" (Prieto-Sandoval et al., 2018: 609). This is clear in the criticisms of Kirchherr et al. (2017: 227).

Another significant criticism by CE authors and more specifically Geissdoerfer et al. (2017: 765) is that CE thus far seems to lack a "holistic view," neglecting the balance of the three pillars of SD elucidated by Elkington in his famous triple-bottom-line concept of "economic prosperity, environmental quality, and social equity" (Elkington, 1997: 397).

Elkington's triple bottom-line is presently close to synonymous with SD, and can point out

differences between SD and CE. Each dimension should have equal importance for SD,[6] and, theoretically, CE. Yet this is one point where the differences between the two appear. Sauvé et al. (2016: 51) objectively point this out, stating that SD has a more "anthropocentric perspective." According to the authors, however, for some experts SD is linked to linear economy, and consider this a combination which has already failed (Sauvé et al., 2016: 54). Therefore, if CE were to also be half-heartedly implemented and, in fact, resemble a linear economy, the result would not be any more successful.

In terms of scope of action, it seems that for Sauvé et al. (2016: 54), SD presents a more holistic approach, with a broader scope, whilst CE is limited to a specific sphere, namely, producing, manufacturing and consumption. This view seems limited and most likely in misalignment with other authors, many of which agree that CE has a broader spectrum in theory, but has thus far failed to consider all aspects, especially the social one. Despite this, Sauvé et al. (2016: 54-55) do seem to advocate that CE can promote a more radical paradigm shift from linear economy by, for example, allocating the external costs of environmental and human health issues into the costs of production and, consequently, consumption.

Kirchherr et al. (2017: 227) cite the same authors (Sauvé et al., 2016: 54), along with Geissdoerfer et al. (2017: 765) and Lieder and Rashid (2016: 46), arguing that CE focuses mainly on 'environmental quality', highlighting that Lieder and Rashid (2016: 46) even state that this is done to the point that the economic dimension might be considered less important. However, Kirchherr et al. (2017: 227) are quick to refute such claims, presenting the result of their extensive

[6] Some authors use alliterations such as the 3 Ps (people, profit, planet) like Geissdoerfer et al. above, others such as Braungart & McDonough prefer the 3 Es (environment, equality, economy), but neither of these are universal, although the principle itself consisting of three interacting "fields" is universal.

literature review, under which "[t]he most prominent aim of CE is economic prosperity (46% of definitions), followed by environmental quality (37%–38% of definitions)."

CE and the LMCs: Still Searching for SD

Whatever the facet that CE focuses on, the CE literature is unanimous in pointing out that the current (linear) economic model is no longer an option, catalyzing the appearance of a new system (CE) to replace the existing one. For Luthra et al. (2022: 331), minimizing CE practices as well as waste, pollution and the sharing of resources all aim to achieve SD goals, making CE not an objective, but a means to achieve SD. Luthra et al. (2022: 321) further point out that CE's ability to conduct the shift in economic models has gained favor amongst decision-makers. Corona et al. (2019: 1) have similar opinions, but Kirchherr et al. (2017: 221) slightly disagree, stating that CE is mostly focused on businesses, and that because SD is increasingly considered too vague, it is subsequently difficult to implement, and thus the principle may be losing momentum (Kirchherr et al., 2017: 221). Vinante et al. (2021: 2), believe that the process was slow, but, ultimately, researchers and practitioners now mostly agree that "CE should ultimately seek to pursue sustainable development (Cautisanu et al., 2018; Kirchherr et al., 2017; Murray et al., 2017; Schroeder et al., 2019)."

Martinez-allier (2021: 2) warns that it might take conflicts caused by the uneven ecological distribution of materials and waste to steer the current economy towards a "less unsustainable direction." If it is true that CE is indeed pursuing SD, perhaps the worries of the aforementioned author could be overlooked. Examples of such conflicts are many (EJAtlas, n.d.), and they are related to the main concern of any ecological movement, the decoupling of economic growth from environmental exploitation. The Organization for Economic Cooperation and Development

(OECD) for example, mentions some of the main problems that are of concern today:

> Freshwater resources are of major environmental, economic and social importance. They are unevenly distributed among and within countries. If a significant share of a country's water comes from transboundary rivers, tensions between countries can arise. In arid regions, freshwater resources may, at times, be limited to the extent that demand for water can be met only by going beyond sustainable use. (OECD, 2020: 34)

> Main concerns relate to the pressures exerted on natural assets, the negative environmental impacts from the extraction, processing and use of materials and from inappropriate waste management on human health and the environment (e.g., air, soil and water pollution, climate change, degradation of natural habitats and ecosystems). (OECD, 2020: 42)

Conflicts arising from the mistreatment or misuse of the environment is a direct consequence of the failure of the linear economy, which not only ignored and then neglected the boundaries of the Earth, but also renegaded the human factor as well. The destruction of the environment or conflicts over resources in which poorer communities live can cause armed conflicts or even civilian unrest (Gedicks, 2005: 168-169). Gutberlet et al. (2017: 1-2), who see CE as a necessity to achieve SD (but do not see CE and SD as equals), urge that, especially for LMCs, the social aspect of SD not be neglected, although the CE literature does so (Jabbour et al., 2019: 794). CE should avoid the conflicts that linear economy fell into, and, thus, considering the additional necessities of LMCs, inclusivity is essential to both a global SD and a global CE, especially since many resources are extracted from LMCs (e.g., Ulrich, 2012: 31). Hobson and Lynch (2018: 457) might have said it best when stating that SD is "arguably the most fundamental guiding principal for contemporary life cycle initiatives," since many are the materials whose cycles currently start or end at an LMC.

LMCs have less economic resources and lower social indicators than HICs (UNDP, 2022) almost by definition, which makes the former especially vulnerable to natural disasters, such as climate change, floods and pandemics (IPCC, 2023: 17). A recent example, the COVID-19 pandemic affected almost all countries, but the recovery road likely varies. Some authors already pointed out that the pandemic further highlighted many of the downsides of a linear economy, such as the excessive amount of waste caused by unnecessary consumption, some of which could not be collected for a period and thus proceeded to accumulate in the streets, causing many disruptions to the public. At the same time, this event also elucidated the importance of waste-workers/material-collectors, formal and informal, as stated by Weghmann (2020). Perhaps this was most felt in LMCs, where the population of informal collectors is likley higher, and where waste collection tends to be more manual and less automated, thus more affected by a virus that is so easily spread. Weghmann (2020) is not so positive that CE will lead to SD, considering that important elements in the cycle such as waste collectors are not even mentioned in the EU Action Plan, yet companies whose products are based on planned obsolescence – a strategy that *stimulates* consumption and arguably waste – are able to obtain a certification that they are circular. Regardless, the EMF and others are advocating to "build better" (EMF, 2020), referring to reestablishing or even restructuring the global supply chains and the material cycles in more sustainable (circular) models. The World Bank, for example, stated that the CE can help achieve the SDGs, as well as mitigate some effects cause by both the COVID-19 pandemic and the linear economy (EMF, 2020).

Considering all the views cited above, it is straining to draw a conclusion on what is the relationship between SD and CE. For some, CE has no relations to SD (Muzaiek & Merico, 2019), but to most of the literature, SD and CE are linked, yet the nature of such a connection is highly

debated. This study considers that SD is a goal which CE aims to achieve, whether due to practical issues such as the already existing SDGs framework pursued by most countries, or be it for the fact that SD encompasses more aspects of human and non-human life on the Earth. However, the cautionary tale here is that CE will not be successful in realizing SD without its three pillars, further elements that much of the CE literature ignores.

Another aspect of CE not much mentioned in the literature is regenerating natural systems, even though it is one of the three principles of the CE, according to the EMF (see Table 2-1). All-in-all, it is clear from these discussions that CE has not managed to fill the social gap the literature is appointing. The following section delves a bit deeper into this debate.

The Social Gap of CE: What is CE Missing?

Moreau et al. (2017: 502), relying on Polanyi (2001) and Georgescu-Roegen (1986), ascertain that the economy is not independent, but fully inserted within the Earth's boundaries. The economy is furthermore "'embedded' in the social realm," and both "the economy and society are open systems embedded in the environment" (Moreau et al., 2017: 502). Despite this, CE deals with systems of production and consumption, involving mainly the life cycle of materials. Murray et al. (2017) can also be cited here, since they find that CE "places emphasis on the redesign of processes and cycling of materials," (2017: 369) yet they perceive an absence of social dimension considerations. CE is viewed in the literature as having many shortcomings and criticisms that are discussed in this section, mainly a lack of social concern (Murray et al., 2017). It is this flaw that is also known as the social gap of CE, i.e., CE does not consider the social dimension, such as income inequalities, access to affordable medical care, gender and race issues, etc.

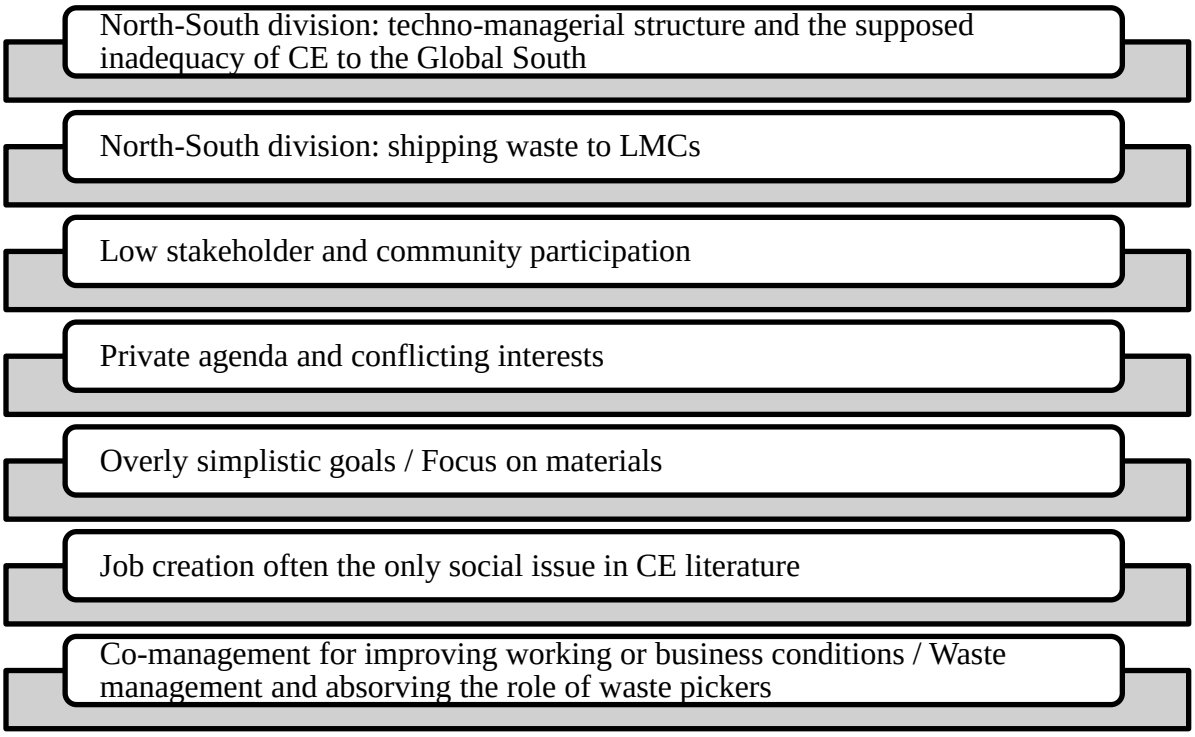
Kirchherr et al. (2017: 227) confirmed in their systematic review of CE definitions that

only 13% of the 114 definitions they examined dealt with all three dimensions of SD, pointing out that CE is presently only concerned with one or two of the three dimensions of SD. The same understanding has the support of authors such as Geissdoerfer et al. (2017: 765), Sauvé et al. (2016: 54), and Lieder and Rashid (2016: 46), the latter paper finding that CE focuses mainly on environmental aspects, thus leaving social considerations and even economic aspects missing. However, Lieder and Rashid's conclusions do not seem to reflect that of Kirchherr et al. (2017: 227), whereby "the most prominent aim of CE is economic prosperity [...], followed by environmental quality," contrary to Lieder and Rashid (2016). Furthermore, Kirchherr et al. (2017: 227) state that "[e]conomic prosperity is most frequently mentioned by practitioners (53% of definitions) who are oftentimes said to view CE as a pathway to boost growth (Lacy et al., 2015; Ghisellini et al., 2016)." CE debates need to include issues of social nature, including consumption and the role of citizens (Hobson & Lynch, 2016: 22). Although not all authors who reaffirm CE's social gap mention consumption, it is an increasingly included topic that CE is well related to "current economic constraints of competitiveness and unequal distribution of wealth" (Moreau et al., 2017: 498).

Given the above, CE is either silent on the social aspect, or it gives little importance to this dimension. There is no doubt that CE literature avoids dealing with the issue, taking for granted the ideas of Murray et al. (2017: 369) that CE, while contributing to more sustainable business models, also brings tensions to its absence of the social dimension, limiting its ethical dimension. The EU CE Action Plan, for example, focuses much on technocratic matters, but barely mentions issues of more social nature such as the protections of workers. Simultaneously, the literature brings a diverse set of criticisms ultimately related to the social gap of CE. The following paragraphs narrow down such criticisms to the topics listed in Figure 2-2 and further elucidated

below, but are in no way exhaustive. As Schöggl et al. (2020) point out, it is no novelty that CE is lacking a holistic view, as Anderson (2007) and others alerted. However, few decision-makers have adhered or even mended this issue, so a "vigorous inclusion of social and policy innovations in order to increase public acceptance and participation in CE activities" (Schöggl et al., 2020: 163) is still a rare event, if existent at all.

Figure 2-2. Main Topics of Criticisms Against CE from a Social Point of View.



The first and perhaps the central issue at hand is the criticism that CE is a techno-managerial structure (Chaturvedi et al., 2019: 26) that implies, for example, high quality recycling implementation in the North, but relieving to the Global South unwanted materials for recovery or landfill (Chen, 2021: 2). There is also a growing body of literature on CE and digitalization of services and products, but whether this will bring benefits to the lesser favored social groups or not is yet to be determined. On one hand, Pitkänen et al. (2020: 163), for example, point out that "CE relies much on digital technology solutions," yet a World Bank report shows that "[w]orldwide, some 4 billion people do not have any internet access, nearly 2 billion do not use a mobile phone, and almost half a billion live outside areas with a mobile signal" (2016: 4). The report also shows gender inequality in internet accessibility in the countries of Africa (WB, 2016: 7), meaning that CE's inherent digitalization may exacerbate social exclusions without proper measures to balance such inequalities. On the other hand, some positive experiences can be found

in the case study in this thesis[7] and, for example, the case of ScrapQ, an Uber-like app connecting waste pickers and emitters in Hyderabad, India (Webster, 2021: 259).

Related to the first issue is the second problem: the shipment of waste that cannot be recycled is also sent to the Global South (Campbell-Johnston et al., 2020; Gregson et al., 2015), making possible gains difficult or even unlikely. This inequality has a strong environmental impact in underdeveloped countries, annihilating any benefits from CE (Chen, 2021: 2). Regarding this issue, Kirchherr and Santen (2019: 2) point out that CE studies are mostly from a developed world perspective, rendering them "irrelevant" to the developing countries. The two authors further note that a CE in LMCs would most likely "look very differently," suggesting an unveiled kind of optimism. Additionally, Bocken et al. (2017: 479) defend that there is "significant potential for closing material loops […] in both high- and low-income countries," provoking the assumption that it is possible to construct a CE without the unjust shipment of hazardous wastes to LMCs.

The third criticism is the weak participation of many stakeholders in CE. Geng et al. (2009: 1001) already prescribed more public awareness and participation to successfully achieve a CE. As Chen (2021: 3-4) puts it, the effects of a CE system are dependent on the level of stakeholder participation in society, which used to be weaker in the Global South. Engagement determines the effectiveness of CE, but it is unlikely to happen in underdeveloped countries. Winans et al. (2017: 830) alert about the risks of implementing a CE without due considerations such as providing information to the general public.

Fourth, Nogueira et al. (2019: 566) raised an interesting question in their work on the different sorts of capitals when they questioned who decides the mobilization of resources, often

[7] See the E-catador program in Chapter 3.

determined by a selected few. It is not surprising that doubts arise regarding the vested agendas and interests of such decisions and whether they can be considered just. How can one be sure of the right intentions of these few parties and the appropriate allocation of their claims? When injustice in the distribution of resources occurs, CE does not accomplish its social agenda, even more so if there are conflicting interests at play. Thus, one of the social issues to be tackled in CE is how it will benefit the public – or, at least, a wider community than that of a single business.

Fifth, although CE has the potential to bring real change and promote a paradigm shift in the way humans produce, consume and dispose things, CE is plagued by "overly simplistic goals," mainly because of the repeated focus on "material flows and extension of life cycles" (Murray et al., 2017: 567). As Nogueira et al. (2019: 571) point out, in the 20th century, focusing on economic development and neglecting the environment and people culminated in both different sorts of pollution, as well as social inequalities. This century needs to revert such a trend to compensate this unbalance; "[i]f organizations [or governments] want to realize a CE, they will have to go beyond the focus of materials flows. They will have to recognize that multiple types of capital are needed to sustain a CE" (Nogueira et al., 2019: 567).

Sixth, job creation is often the only social issue represented in the examined CE literature. Job creation is almost a cornerstone of studies measuring sustainability in CE (Walker et al., 2021: 831; Padilla-Rivera et al., 2020; Geissdoerfer et al., 2017: 765), placing job creation as the almost sole element in the rare CE social dimension studies. While this indicator is important, job creation alone will not bring the necessary social improvements, especially considering that it has not been able to do so under a linear economy. So, the claim made by Schröder et al. (2020) for inclusion of social dimension in the CE is of little avail. Even so, the same authors seem to agree that there is a discussion of private agenda and conflicting interests. Walker et al. (2021: 840) explain that,

when “companies do not think that […] assessing social aspects is beneficial for them,” assessing social aspects “would not necessarily add credibility to their corporate activities” (Walker et al., 2021: 840). As Walker et al. (2021: 834) put it, “empirical data on how companies view the integration and assessment of the social dimension in CE is still rare and the question of why firms perceive social assessment of CE practices to be relevant (or not) remains to be addressed.” Nevertheless, it is a common understanding in business management that job creation is not the role of the private sector (Zimmerli, Holzinger & Richter, 2007: 173-178), whose existence is for profit (Friedman, 1970). Therefore, it is possible that job creation is the most significant social aspect of CE, derived from its business origins. Yet, from a holistic perspective – be it private or public – there are certainly other elements to consider, such as participation in decision-making, well-being, sense of social cohesion and fair wages.

Besides the techno-managerial structure that initiates the list of these criticisms, there is also the topic of co-management, a less discussed aspect of a more social CE, which ensures “a large set of social benefits, including income generation, reduction of gender inequality, cultural maintenance, and increasing of social organizations and self-esteem of local communities” (Paes et al., 2021: 29). One example is that of WP’s when properly organized, especially if there are governmental regulations supporting such activities as entrepreneurship. The cases presented by Gutberlet and Carenzo (2020), and the model Ferri et al. (2015) propose are two examples of this. Co-management has also brought an important element in the studies of CE, since WPs work in truly harsh conditions. Due to their urgent socioeconomic needs, WPs have long looked to resource recovering activities to manage their lack of material resources (Gutberlet et al., 2017: 2).

More popular than co-management and techno-managerial structure, waste management initiatives often translate into hope of income in LMCs, be it as sorting imported waste (WEF,

2019), or waste-picking activities (Wilson et al., 2019). Given that one of the three principles of CE is to eliminate [reduce] waste, managing discarded materials is an essential part of this system. Simultaneously, in a reductionist view, many CE studies focused on recycling, to the point that some confuse CE with this particular "R." Since CE requires Extended Producer Responsibility (EPR)/RL schemes to keep the materials circling (Bhullar et al., 2019: 90), as prescribed by another CE principle (C2), many studies even proposed the integration of WPAs in LMCs (Gutberlet et al., 2017; Ferri et al., 2015; Paes et al., 2019). There is a large population of WPs in the Global South, and while they practice waste-picking for survival, their contribution to the CE is already clear. Despite such benefits, it is also a fact that WPs are often exploited, since they usually work long hours, walk many kilometers in a day to collect as much materials as they can, only to be offered well-below-market prices, almost inevitably forcing WPs to remain in a cycle of poverty.

All-in-all, CE relates more to the northern environmental model of production, paying little or no attention to the social conditions of the Global South. However, it is important not to allow this gap to fall into the "definition slippage" as appointed by Hobson and Lynch (2018: 459), whereby concepts such as sustainability and "the social" are accused of non-precision. Hobson and Lynch (2018: 459) further point out that some debates, such as that on ecological limits, are more preoccupied with "the preservation of a particular social order [namely] a neo-liberal market-driven global economy, which enshrines a 'right to develop' (Hajer, 1995) through particular framings of global progress (e.g., market penetration and GDP growth)." To avoid such confusion, it is imperative to point out that CE should not extend the same systems that cause the current collapse of planetary boundaries.

Lastly, it would be remiss not to comment on one of the best CE examples already in practice: Fairphone, a Netherlands-based company of modular mobile phones that structured

almost 100% of their supply chains paying close attention to social conditions as well (Fairphone, n.d.). Fairphone is a good example of how a circular business can also influence its supply chain and observe the SDGs: the company sources most of its materials from areas that are conflict-free, pushing for fair wages whenever they can. Their modular designs also allow for refurbishing and repair as much as possible (Fairphone, n.d.).

2.3 Environmental Justice: Explanations and Applications

Injustice and justice are concepts that might not have existed since man first started walking, but the notion of justice likely already existed before the great Greek philosophers did. According to Agyeman and Evans (2004: 156), environmental injustices perhaps surfaced around the time of Christopher Columbus, although the movement of Environmental Justice started 5 centuries later around the 1970s (Vanderwarker, 2012: 53). Today, it is a parent term to climate justice and environmental racism, but EJ derived from grassroots movements often fighting against the unfair placement of environmental hazards such as landfills and incineration plants in areas where the less fortunate live (Walker, 2010: 312; Vanderwarker, 2012: 53). EJ is also a framework for social analyses, so it might be ideal to fulfill such a role in a CE.

The Role of EJ in Research

The distribution of natural resources or of their value is undoubtedly unequal (Pullen, 2013) causing social inequalities. EJ excels in such cases, offering a lens to analyze social disparities. In this sense, Middleton et al. state that EJ "is strongest in evaluating fairness in decision-making, and explaining why (in)justices may have occurred," (Middleton et al., 2015: 645) and that "the crux of environmental justice often focuses on the environmental burden and lack of access to

decision-making of economically, socially and politically marginalized communities" (Middleton et al., 2015: 637). Thus, EJ is a valid candidate to investigate the feasibility of CE in developing regions, including a social determinant.

EJ is increasingly linked to the SD principle, despite SD being another concept that lacks a universal definition (Agyeman et al., 2002; Okereke, 2008). Regarding this association, Haughton observes that "the interdependency of social justice, economic well-being, and environmental stewardship. The social dimension is critical since the unjust society is unlikely to be sustainable in environmental or economic terms" (Haughton, 1999: 234). A society that does not concern itself with its social issues is doomed to conflicts and ruin, and therein lies the importance of social research and the spreading of ideas such as SD and EJ.

Regarding the use of EJ as a problem-framing tool, Walker pointed out that EJ typically consists of three steps: the normative ideas that guide what should be; the diagnosis of what are the problems and who bears responsibility for these problems; and "prognosis of solutions and processes of change" (Walker, 2012: 17-18). Walker also explains the duality of "is-ought" (how things are, and how they should be), as well as the relationship between evidence of reality and the reasoning why it is so (Walker, 2012: 40). In this study, SD and the principle of equal opportunities feed the normative background, along with local legislation, while the interviews and other online and literature sources feed the diagnosis. A tentative prognosis is offered in the conclusory sections of Chapters 4 and 5, and in the final chapter as well (Chapter 6). Both Walker's problem-framing structure and Schlosberg's EJ theory (Schlosberg, 2004) set up the backbone of this paper; Schlosberg identifies three key issues to be considered – recognition, distribution, participation - briefly explained below.

Recognition (J1): this is the least explored element (Schlosberg, 2004: 519), but it is the

ontological root of the other two. Recognition focuses on why the groups who have the most advantages are in power and how they got there (Schlosberg, 2007: 15). Schlosberg builds on the ideas of Young (1990) regarding social groups and explains that J1 refers to an identity, or identifying oneself as part of a sub-group (1990: 9). The subgroup should be accepted by the society which it is a part of, and all its members should have the same rights as any other member of that society. She warns that lack of recognition may cause distributive injustice (Young, 1990: 9).

Distribution (J2): likely the most referred aspect of Justice in general, including EJ, possibly due to the link with Rawls' classic concept of distributive justice, whereby an individual's life prospects are heavily determined by his initial social position, or, as Rawls writes, "original position" (Rawls, 1999). What distributive justice is mostly concerned with is the allocation (distribution) of material goods and rights/duties, including benefits and burdens amongst members of a society (Schlosberg, 2007: 12-13).

Participation (J3): in recent decades, social research on participation has grown, with scholars increasingly recommending a wider participatory approach (Agyeman et al., 2002; Vente et al., 2016; Sojamo, 2015). For EJ, this element means decision-making, referring directly to the groups that have the power to do so and that commonly impede weaker yet often larger groups to have access to the same sort of power.

Schlosberg's three EJ elements are the main ingredients to answer the main criticisms against CE as appointed by the current literature. In fact, it brings elements to offer solutions to the previously mentioned criticisms of Kirchherr et al. (2017), Murray et al. (2017) and Geissdoerfer et al. (2016), regarding CE lacking a social dimension. By bringing EJ into CE policies, weaker groups such as WPs would engage in the social and economic policies to be

applied (participation), and all subgroups of a society should be included in any development attempt (recognition). Finally, distribution - or distributive justice - implies a fair allocation of material and immaterial goods and benefits amongst the members of the society, and also the damages that may occur in the development process.

EJ is in line with Moreau et al.'s (2017) requirements for a more social CE, referring to Polanyi (2001) who defends in his historical arguments an economy more embedded in society. It likewise follows Velis' (2017: 329) findings that CE in LMCs is "not mandated by ideology, but by social and market necessities." The prevailing conditions in developing countries require clear policies that promote inclusion and not exclusion in society. This can be seen in Martinez-Alier's argument of a rising international movement for global EJ and statistical studies as shown in the Global Atlas of Environmental Justice (Temper et al., 2018). The Atlas reflects the worldwide conflicts of unequal distribution and social struggles based on unequal access to services and goods, problems that are common in LMCs. Although Gutberlet et al. (2017) also mention these social difficulties, their principal objective was to clarify the need for CE to take social aspects into account. While their principle-based Advanced Circular Economy (ACE) concept seems to focus specifically on WPs, it lacks a theoretical perspective to assist policymakers in turning CE from its main economic concerns to include social concerns in CE policies. The present study proposes EJ to guide such a transition.

Implementing Social CE with EJ

Thus far few are the CE experiences that included issues that were less about the environment or the economy, and more about social aspects, especially welfare. As argued above, it will take all three pillars to build a long-lasting CE. Some of the related issues identified in

studies of CE implementation policies include topics such as techno-managerial structure, participation, North-South inadequacies, private agenda and conflicting interests. All of them are somehow related to EJ theory, and most, if not all of them, could benefit from an EJ policy.

On topics such as co-management and techno-managerial structure, Moreau (2017) advocated for a CE that follows the principles of a Social and Solidarity Economy (SSE) – or at least views SSE as a constructive example (Moreau, 2017: 504). In that author's view, the SSE molds the institutional environment, so that businesses compete on equal conditions.

> The social and solidarity economy (SSE) is an interesting counterpoint, as an economic practice that departs from the constraint of relative profitability and private ownership, and includes notions of equity in relation to the cost of labor. Whereas other economic models could be equally helpful, we have chosen the SSE as one example of how institutional conditions can contribute to the development of a CE by taking into account social institutions, societal norms, and political considerations […] (Moreau, 2017: 502).

SSE places "people above profit," so it can help build an economy that is more inclusive, while also "reducing social inequalities" (Moreau, 2017: 502). Although Moreau is one of the early authors to point out the social gap of CE, in his perspective, CE is capable of being a transformative economy, one that can promote equity if the right setting is in place (Moreau, 2017: 503). Other authors such as Gutberlet et al. (2017) and Jabbour et al. (2019) seem to agree, the latter stating that "[t]he circular economy can contribute towards organizational sustainability by re-shaping the role of businesses in society" (Jabbour et al., 2019: 794). The SSE agrees with Polanyi's idea of a business inserted in society, but disagrees with Friedman's notion that businesses should be aimed at profits to satisfy the shareholders (Friedman, 1970).

If CE also agrees that trading profit for people, or at least balancing its bottom-line profits

with the well-being of the society it is embedded in, then perhaps CE could promote equity more than the current model of economy does. Such a characteristic would be an asset for CE in the LMCs. However, Camacho-Otero (2018: 9) found in their analysis that "[o]nly two papers questioned the socio-political consequences of the circular economy and inquired about equity in this context," showing that there is still much room for development regarding this issue, which is critical to both to the Global South, as well as for EJ studies. EJ can contribute to this discussion under all three of its elements, but especially recognition; by placing people first, issues such as welfare, labor environment and gender inequalities would be factored into policies, and might therefore have, at the very least, equal importance to the (fair) distribution of wealth and resources.

WM is a topic that is related to all the issues mentioned: EJ, people, CE and its social gap, SD, and consumerism. While WM is unquestionably an essential element of CE, the current implementations and future ones require a deeper look, especially since, according to Marshall and Farahbakhsh (2013: 996), WM systems also require social components, otherwise they are not sustainable. Gutberlet and Carenzo (2010: 10) state that CE "can lead to a reduction of environmental impacts and raw material consumption," and while Dinkel agrees, he also alerts that the CE cannot be reduced to recycling if the aim is SD (Dinkel, 2021). Nevertheless, as Gutberlet and Carenzo (2020: 10) write, "[…] recycling, the one pillar the industry and politics is concentrating on, is not addressing some of the fundamental questions of production and consumption levels, like economic and social effects or rebound effects." While Solid Waste Management Systems (SWMS) are necessary for any human environment, they are particularly lacking in LMCs, presenting an opportunity to implement a CE that can meet the objective expectations of good WM, as well as establish parameters that improve social conditions.

Finally, when, pointing out some of the limits and challenges of the CE, authors such as

Korhonen et al. include limits of social and cultural nature (Korhonen et al., 2018: 41), since the existing business models are generally for profit and very limited in cultural aspects. Such restrictions could hardly be a cornerstone of CE policies. However, if partnered with EJ, tackling these limitations and presenting improvement would be part of the CE system, as seen from the non-exhaustive examples of social issues cited above. Therefore, private or public, a project may find in EJ the elements it needs to overcome the criticisms they face.

2.4 EJ as the Theoretical Framework of This Study

Lederman and Lederman (2015) explain that a theoretical framework consists of concepts derived from the literature review that explain an academic investigation. A theoretical framework sets up the parameters of questioning and analysis and is therefore imperative for academic works. In other words, as May (2011: 12) states, they are used to explain the observed social phenomena and the mechanisms that rule the actions of the observed.

SD is the background foundation of this study – or what Walker denominates as the normative layer. Despite not having a precise universal definition, SD has a widespread and renown one – that of the Brundtland Report, whereby "[s]ustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). SD, however, does not limit itself to a mere concept, and it is applied in many international agreements and development incentives.

The proposed framework is composed by the EMF principles of CE, and Schlosberg's EJ tripartite theory, both of these parts subjected to the auspices of the concept of sustainable development. Like SD and CE, the concept of EJ does not have a universally accepted definition, and many authors such as Martinez, Temper, Schlosberg and Bullard have offered definitions and

analyses. Perhaps its most common use today is in the discussions on climate justice, but EJ emerged from conflicts involving institutionalized racism and waste disposal (Walker, 2010: 312; Vanderwarker, 2012: 53). It is especially suited to analyze problems of injustice (Middleton et al., 2015: 645), inequalities and social issues. The specific framework used in this study is explicated in the following paragraphs, and summarized in Table 2-3.

Schlosberg's tripartite proposition of EJ is the backbone of the EJ lens used in this study. He suggests that EJ requires three elements in its structure: distribution, participation, and what he considers the underlying motivation of many social conflicts, recognition (or lack thereof) based on the ideas of Iris Young (1990). Recognition relates to the identity of a person, a group or community (Schlosberg, 2007: 15). Distribution is mainly concerned with the fair division of rights, benefits, obligations, and burdens (Schlosberg, 2007: 12-13). Participation is principally focused on access to the decision-making discussions or power to decide (Schlosberg, 2007: 27). Table 2-2 presents the keywords and a brief explanation of each of Schlosberg's three EJ elements according to how the author employs them in this study.

Table 2-2. Schlosberg's Three EJ Elements.

EJ Element	Keywords	Key idea
RECOGNITION (J1)	• Identity • Group/Community • Root of other issues	*Social inclusion or sense of belonging; whether a group is included in or ignored by a society*
DISTRIBUTION (J2)	• Rights/Benefits • Obligations/Burdens	*Access to material (ex.: reasonable income) and immaterial (ex.: justice) means and whether or not different social groups have more or less of these means*
PARTICIPATION (J3)	• Access to discussions • Decision-making power	*Access to decision-making processes or information; whether or not a group can influence decisions that concern themselves and their environment*

Source: Based on Schlosberg's works.

In this research, SD is considered the ideal scenario, i.e., the goal of CE, hence SD is placed

as what Walker (2012: 17-18) denominates the normative aspect of EJ, and the EJ diagnosis is lead by Schlosberg's triple-elements. However, to assess a CE policy or business plan, elements of CE also need to be considered, and since the three principles proposed by the EMF (see Table 2-1) are widely accepted, these three principles were included in the proposed framework as well. While Tables 2-1 (EMF CE Principles) and 2-2 (Schlosberg EJ elements) separately explained the criteria employed in the proposed framework, Table 2-3 presents the complete framework, including the key ideas that each criterion investigates in the form of questions, as well as the coding for each of these criteria.

Table 2-3. The Proposed CE-EJ Framework Using SD as the Normative Base.

	Criteria and their Codes	Key questions
EMF' s Circular Economy Principles	*DESIGN OUT AND POLLUTION (C1)*	*What actions intend to rethink or reduce externalities*
	KEEP PRODUCTS AND MATERIALS IN USE (C2)	*What actions keep materials from returning to the environment?*
	REGENERATE NATURAL SYSTEMS (C3)	*What actions not only preserve the natural environment, but restore the already affected natural systems?*
Schlosberg' s Environmental Justice Elements	*RECOGNITION (J1)*	*Which social group(s) is(are) have a prominent position in society and which social groups(s) is(are) marginalized?* *What are the roles of both of these types of actors (prominent and marginalized)?* *Why do some actors have more benefits?*
	DISTRIBUTION (J2)	*What is the division of benefits/responsibilities/externalities based on?* *Is it balanced/fair? If not, can the division achieve a better equilibrium?* *Upon which group (marginalized or prominent) do the (negative) externalities fall?*
	PARTICIPATION (J3)	*Who or what group(s) has(have) the power of decision?* *Are any relevant actors left deprived of decision-making?* *What is the source of decision-making power?*

Source: Based on Schlosberg's works and the EMF's CE principles.

The framework combines Schlosberg's EJ theory and the 3 CE principles proposed by the EMF. Since the author understands SD as the objective of CE, or, in other words, that CE is one of the tools to reach SD, then SD is placed as the basic normative umbrella. When applying the framework it is also advisable to consider the legislation and culture of the location as part of the normative step.

What Walker labeled as diagnosis is the most critical part of the framework, perhaps more so than the explanations and recommendations (prognosis) derived from the phenomena observed in the diagnosis stage (analysis & interpretation). Schlosberg's theory is particularly suited as it is not only frequently cited in other works (e.g., Velicu, 2019; Walker, 2012; Middleton et al., 2015; Martinez-Allier et al., 2016), it is also considered one of the center works of recent EJ, as asserted

by Agyeman et al. (2016: 335) after an extensive review of EJ:

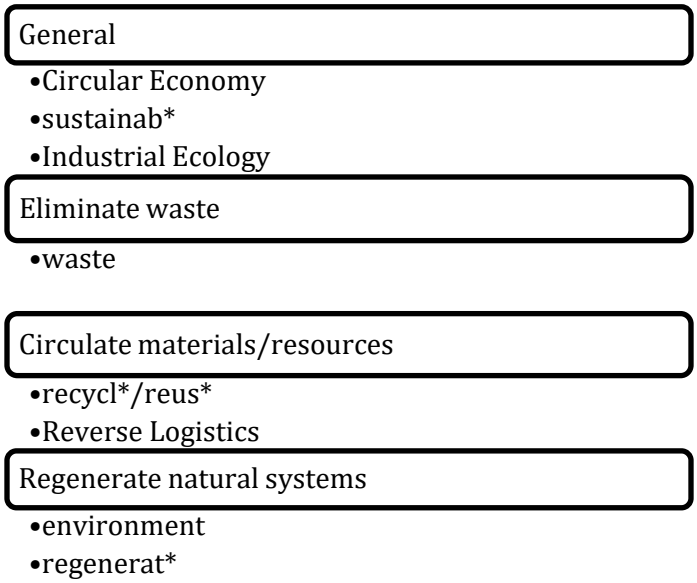
> Theoretically, the conceptions of justice at work in these newer elements and foci of EJ organizing continue to build on the pluralist foundations discussed by Schlosberg (27, 37), Walker (86), and others. For example, recent work by Bulkeley (67, 68) on urban climate justice applies and builds on work emphasizing that recognition, distribution, and participation are all key in actualizing a just, adaptable, and sustainable city. (Agyeman et al., 2016: 335)

Schlosberg's EJ seeks to identify the relevant aspects of recognition (J1), distribution (J2) and participation (J3). Each of these criteria is identified mostly by a key question word. The interviews and data collection verify how the actors were reacting to these points so that the study could appoint who, how and what was done to attend the three principles of CE: design out waste and pollution (C1), keep products and materials in use for as long as possible (C2), and regenerate natural systems (C3). It is crucial to know who is responsible, for instance, for zero waste, which is often the role of manufacturing companies or service businesses, as they have the most power to design waste out of the entire cycle. Other actors may play a role too, and if so, these actors (who) and their roles (what/how) should also be recognized. The same should be applied for each CE principle. It is this recognition, distribution and participation that is missing in CE literature and, more importantly, in dealing with CE projects in LMCs.

3. Legal Background for CE in Fortaleza[8]

This chapter is a preliminary study that provides legal background for the main analysis presented in chapters 4 and 5. The relevant policies that interviewees referred to were included as well. The basic keywords for the initial search were inspired by the three EMF principles and the work of Merli et al. (2018: 711-712), who found out that the main six keywords in CE literature are: circular economy, waste, industrial ecology, sustainability, recycling/reuse, and environment. Due to the second and third EMF principles, this study added "reverse logistics" (RL)[9] and "regenerat*" as keywords. Thus, the final list of keywords when searching for relevant CE policies is represented in Figure 3-1, already sorted according to the guiding principles:

Figure 3-1. List of Keywords Employed in Initial Research of Policy Documents.



[8] The federal laws presented in this chapter were obtained from the Presidential website (https://legislacao.presidencia.gov.br). The Ceará State laws were obtained from the website of the Ceará State Legislative Assembly (www.al.ce.gov.br/paginas/leis-e-normativos-internos). The municipal laws of Fortaleza were obtained from the website of the City Council of Fortaleza (https://sapl.fortaleza.ce.leg.br/norma/pesquisar).

[9] Under NaPS (art. 3, XII), the definition of RL is: "[an] instrument of economic and social development characterized by a group of actions, procedures and means to make it viable to collect and return solid waste to the business sector, for reuse, in its production cycle or others, or another environmentally adequate final disposal" (translated from Portuguese by the author).

The South American country enacted an extensive list of environmental legislation, and has likewise established many institutions to act as enforcers or supporters of environmental policies and enforcement. Aside from the Ministry of the Environment and Climate Change, other important institutions contributing to environmental vigilance include the Brazilian Institute of the Environment and Natural Resources (IBAMA), the National Council on the Environment (CONAMA) and the *Ministério Público*. As listing all Brazilian environmental protection acts would be a herculean task for a PhD thesis, only those that directly relate to the CE and the case study are portrayed in this chapter.

Brazil's National Policy on Solid Waste (*Política Nacional de Resíduos Sólidos*, hereinafter NaPS) is the country's norm with the strongest proximity to CE out of all the Brazilian environmental or otherwise CE-related policies, currently enacted or in force, according to Karl and Karl (2022) and the Brazilian National Confederation of Industry (CNI), but it is not the only CE-related policy the country has produced (CNI, 2020: 11). According to the CNI (2020), policies such as the National Policy on Climate Change and the Energy Policy are also connected to CE, but were excluded from this preliminary normative study, which ultimately limits its scope to materials/resources/waste in line with the case study. For the most part, only legislation enacted until 2019 was included since the fieldwork happened in that year. As explained in chapter 1, however, because Fortaleza (and Ceará) enacted many CE-related legislations during and after the pandemic, the researcher exceptionally added post-2019 legislation, considering the relevance of the topic to the ultimate object of the case study, the transition to a CE in Fortaleza.

The norms are presented from larger to smaller scope (national, State and municipal jurisdictions) according to the three EMF CE principles, so that their relationship to CE is clear.

3.1 Brazilian (Federal) Norms

Up to December 2023, Brazil did not yet have a CE-specific law. There is, however, a bill on the topic currently being discussed in Brazil's national congress (Senado Federal, 2022). This bill will alter previous laws such as the one on public procurement (Federal Law No. 14,133/2021) the Pre-Salt Act (Federal Law No. 12,351/2010), and the law on financing different kinds of researches including agribusiness, health, genetics, aeronautics, etc (Federal Law No. 12,332/2002). None of the regulations presented here can be considered a purposely CE legislation, but they relate to CE and even to the CE principles in different ways.

1988 Federal Constitution of the Federative Republic of Brazil (CF)

Brazil's 1988 Federal Constitution was the first democratic constitution after the end of the military dictatorship of 1964. The 1988 constitutional assembly included not only the basic rules such as public administration, but also other types of norms, such as family rights. It also included the so-called "3rd generation" rights, such as those of consumers and the right of every person to a healthy environment. The latter is assured in the *caput* of the Constitution's 225th article:

> Everyone has a right to an ecologically balanced environment, which is a good of common use to the people and essential to a healthy quality of life, and it is up to the Government and to the collectivity to defend it and preserve it for present and future generations[10] (Constitution of the Federative Republic of Brazil [CF], 1988).

This article includes further provisions in its paragraphs. Some of the most relevant items

[10] Translation by the author. All Brazilian legal norms presented in this thesis were translated by the author.

include Paragraph 1, item VI on environmental education, which should be provided in all levels of education, as well as working for public awareness towards environmental preservation (CF, 1988).[11] Paragraph 3 warns that authors of any conduct or activity damaging the environment, be they a natural person or legal, will be liable penally and administratively, notwithstanding the obligation to repair the damages (CF, 1988). Paragraph 4 (CF, 1988) designates areas such as the Brazilian Amazon Forest and the Atlantic Forest as natural heritages. The Atlantic Forest is located along the coast, but with only about 15% remaining according to IBGE, Brazil's national institute of statistics analysis. Such areas allow exploitation or even usage only under the condition that environmental preservation is assured, such as the cosmetic company Natura's concept of a standing forest (Natura, n.d.). Although this doesn't have an implication on the case study here (Chapters 4 & 5), it does impact the solid waste plans in the Amazonian area, for example, and likely CE policies as well.

There are other CF (1988) provisions that are also relevant to this research, including some clauses on public administration, such as art. 30, which states the general responsibilities of the municipalities. Item V attributes to the Municipal Government the organization and execution of public services of local interest, either directly, or under concession or permission (CF, 1988). This includes the collection, transportation, treatment and disposal of waste, especially MSW (CF, 1988). Lastly, the *caput* of article 182 attributes to the municipalities the organization of its urban development policy – including social functionalities and the well-being of the population. Paragraph 1 specifies the Municipal Master Plan, which is mandatory for municipalities of more

[11] National Law No. 9,795/1990, the Environmental Education Law, was elaborated specifically to regulate this subject.

than 20,000 inhabitants, and also one of the legislations with which the Municipal Integrated Solid Waste Management Plan must harmonize (CF, 1988).

Federal Law No. 9,605/1998: the Environmental Crimes Act (EnCA)

Out of its many environmental laws, one of the most important is the Environmental Crimes Act (EnCA).[12] EnCA is one of the core Brazilian Environmental Laws, especially since forms of crimes against the environment are delineated in this norm, whether they be against fauna, flora, of administrative nature, etc. For this study, there are two clauses that are of particular interest labeled under the third section: "Pollution and Other Environmental Crimes."

Article 54 refers to actions that result in pollution "of any nature in levels that" [sic] may affect or affected human health, death of animals or mortality of fauna, which is punishable by imprisonment from 1 to 4 years, in addition to a fine (EnCA, 1998). Paragraph 2, item V, further elaborates that the penalty will be between 1 to 5 years of imprisonment, instead, if the pollution occurs by dumping waste (solid, liquid or gaseous), debris, oils or oily substances in violation of laws or regulation (EnCA, 1998).

Article 56 refers to toxic or hazardous substances, to human health or to the environment. It establishes a penalty of between 1 to 5 years, in addition to a fine, for those who "produce, process, wrap, import, export, commercialize [here understood as selling], provide, transport, store, keep, have in deposit or use" such substances in violation of laws or regulations (EnCA, 1998). Item I attributes the same penalty if one abandons such products, or uses them in violation of environmental and safety norms, and item II does the same for those who "manipulate, packs, store,

[12] Lei dos Crimes Ambientais [Environmental Crimes Act].

collect, transport, reuse, recycle or dispose in violation of the law or regulations (EnCA, 1998). These penalties are lower if there is only culpability (but no intention), and higher if it is intentional, especially, in the latter case, if there is great injury, death or irreversible damage to the environment or the flora (EnCA, 1998). Although EnCA and these crimes were established more than a decade before the law for waste management, it already portrays penalties for illegal dumpers. However, they apply only to big emitters (art. 54), or toxic and hazardous substances (art. 56) (EnCA, 1998).

Federal Law No. 12,305/2010: the National Policy on Solid Waste (NaPS)

The previous law on public sanitation (Federal Law No. 11, 445/2007) somewhat covered the topic of SWM, but NaPS is the Federation of Brazil's first national law focusing exclusively on SWM (Santiago et al., 2023). NaPS demonstrates much of the spirit of CE, including direct influences of C2C such as systems thinking and respecting diversity.

Article 6 cites the principles under which NaPS was elaborated, but without defining them. It is therefore up to the *academia* and legal customs to interpret them. They are listed here in full as they represent the essence of the norm: I, Prevention; II, Precautionary; III, Polluter pays; IV, Protector receives (environmental protection and stewardship should be rewarded); V, Systemic View (in this case, any waste-related decision should observe the variables of: environment, social, cultural, economic, technological and/or public health); VI, Sustainable development; VII, Eco efficiency; VIII, Cooperation (of government, businesses and society); IX, Shared responsibility over the life cycle of a product; X, Solid waste as an economic good; XI, Respect for local and regional diversities; XII, Right to information and control by society; and XIII, Reasonability and proportionality.

As seen above, NaPS predicates 13 principles, a rather long list. The norm's objectives

constitute an even longer list, covering a wide range of topics. They are listed under NaPS's Article 7, and the most relevant to the case under examination are those related to public health and environment (I); waste hierarchy and fomenting of recycling industries (II, VI, first part of XI, XIII); sustainable production and consumption (III); integrated SWM (VII) and integration of WPs (second part of XI); intragovernmental cooperation and also between business and government (VIII). and, lastly, environmental labeling (XIV). As shown above, Federal Law No. 12,305/2010 aims to guarantee a variety of rights and benefits, as well as duties. Article 9 reinforces item II of article 7, redetermining the hierarchical order that must be followed in WM in Brazil: "no generation, reduction, reuse, recycle, treatment and environmentally adequate final disposal" (NaPS, 2010). This hierarchy undoubtedly follows the one originally established by the EU's 2008 Waste Directive.

Not only does NaPS establish a hierarchy for WM, its article 13 also categorizes waste by origin (item I) and hazardousness (item II). There are only 2 categories for the latter (dangerous or not dangerous), but there are 11 categories according to place of origin. The most relevant for this study are urban solid waste, which includes domestic and urban cleaning residues (a, b, c), commercial waste (d), industrial (f), health services (g) and civil construction (h). These categories are further examined in the municipal laws.

NaPS mentions many sorts of SW Plans, most of them directed at different government levels (arts. 14-19), with detailed requisites for each governmental sphere, and others are for the business sector (20-24), namely the Plans of Solid Waste Management (PlaSMs). On the one hand, the requisites for national and state plans are nearly identical; only article 17, item XI, differs, establishing that the State Solid Waste Plans should include zoning, such as "ecological-economic zoning" (NaPS, 2010). On the other hand, the municipal government plans require much more

information (18-19), including items such as rules for SWM transportation (VII), and identification of environmental liabilities that are SW-related (XVIII) (NaPS, 2010).

The initial deadline for submission of the Waste Management Plans was August 2012 (article 55), but at the time only 10% of the Brazilian municipalities were able to elaborate it (Câmara dos Deputados, 2014). One of the measures to instigate the lower spheres to elaborate these plans as soon as possible is to condition their access to federal resources for waste management projects (NaPs, art. 18, *caput*). Fortaleza was slightly late, as it submitted its plan in December of 2012. Even in 2018, only a little over half of all the municipalities in Brazil had presented their Plans on Integrated Waste Management (PIWS), according to Brazil's then Ministry of the Environment (2018).

Articles 30-37 are debatably some of the most significant clauses in NaPS. These articles refer to a "shared responsibility" of products in general throughout the commercial chain. In other words, "manufacturers, importers, distributers, sellers, consumers and the legal persons responsible for public cleaning services and waste management" (NaPS, art. 30, *caput*) are all encumbered of providing adequate services for the safe disposal or recirculation of products they sell throughout the life cycles. It should be noted that packaging and containers are also included amongst such products.

Article 33 on "reverse logistics" establishes the categories for which RL is mandatory, namely pesticides, batteries, tires, oils and lubricants, certain types of lamps, electric and electronic devices and their components (NaPs, 2010). In terms of Brazilian SWM, Antunes (2005: 769) evaluates that setting mandatory RL schemes is one of the greatest innovations of NaPS,.

Finally, articles 47-49, state express prohibitions (including illegal dumping, for example) and penalty clauses, altering the EnCA, by, for example, specifying illegal dumping as a crime (1-

4 years of imprisonment) instead of a mere misdemeanor (NaPs, 2010). Finally, NaPS set 4 years (2014) for the municipalities to end all illegal dumping sites.

Presidential Decree No. 7,404/2010: Further Regulating NaPS[13]

NaPS (Federal Law No. 12,305/2010), establishing the National Policy of Solid Waste was further regulated by the Presidential Decree 7,404/2010. It is extensive, with 86 articles, but the following clauses delineated here were highlighted, starting with article 9, which sets the rules for segregated collection. According to its *caput* and paragraph 3, generators shall separate the waste according to its constitution and composition, in the terms set by whoever executes the "public service of urban cleaning and solid waste management."[14] Since sorted collection thereinafter becomes mandatory, paragraph 2 provides the minimal division possible, which would be dividing the waste into "wet" and "dry" parts. The latter category should be progressively further divided (Presidential Decree 7,404/2010, art. 9, para 2).

One of the innovations of NaPS was the attention – or, more specifically – the inclusion of WPs in SWMSs. Article 11, for example, prioritizes the participation of waste picker cooperatives or, any associations of natural people of low income for the purpose of reusing or recycling materials for the implementation of sorted collection.

Regarding RL, article 18 of the Decree determines its implementation by the manufacturers, importers, distributors and retailers of the products listed in NaPS's art. 33, items II, III, V and VI,

[13] This decree was revoked in its entirety in 2022 by a newer version. However, the replacing Presidential Decree (No. 10,936/2022) has very similar content, and some parts are even identical to Presidential Decree No. 7,404/2010. The author decided to include only the original decree as it was the one valid during the time of the field research in 2019.
[14] This concept is defined in art. 7 of Federal Law No. 11,445/2007. To summarize, this term encompasses the actions involving collection, treatment, disposal and so forth of both domestic waste and urban cleaning, including sorting and recycling.

and of packaging and containers of the products listed in items I and IV of the same article 33, and, finally, of those listed in paragraph 1 (of NaPS, article 33, which refers to packaging and containers in general, but especially those made of plastic, metal and glass). Paragraph 1 (article 18 of the Decree) states that, as part of this system, collection points may be installed, but the participation of scavengers and associations/cooperatives takes priority. Paragraph 2 sets the responsibility of manufacturers, importers, distributors and retailers regarding RL schemes to the limits of their participation in the internal market, but also observing progressive, intermediate and final goals.

Article 77 sets environmental education as part of NaPS, the former's objectives being: "the enhancement of knowledge, of values, of behaviors and lifestyles related to the environmentally sound management of solid waste." Environmental education is a topic that has its own federal law, EEL (Federal Law No. 9,795/1999), which was enacted almost a decade before NaPS, and therefore has no mention of CE, WPs or waste in general.

In the NaPS Decree No. 7,404/2010, the 2nd paragraph of article 77 describes some of the activities to be undertaken by the government to promote environmental education towards solid waste management. These provisions are more objective than those listed in the specific law mentioned above (EEL), but they should also observe the latter's commandments (art. 77, para 1). These activities include: encouraging educative and pedagogical activities, in collaboration with members of the business sector and of the society (Presidential Decree No. 7,404/1990, art. 77, para 2, item I), including those aimed at manufacturers, importers, retailers and distributors, focusing on the (direct and indirect) agents of the segregated collection and reverse logistics (para 2, item III); promoting awareness of the consumers regarding sustainable consumption (para 2, item IV); and capacitating public managers to act as multipliers of integrated management of solid waste (para 2, item VII).

Articles 78-79 stipulate the access to resources for SWM or urban cleaning (which is, as previously studied, conditioned to the elaboration and Federal approval of the SWM Plan), conditioning said access to proof of fiscal regularity (art. 78, sole para). Art. 79 states in its items which conditions shall be given priorities, which can be summarized to: integrated regions (municipalities which decided to share a regional service), segregated collection with participation of scavengers and/or cooperatives, and/or public consortia. For the States, there is also the compulsory updates of its SW information on SINIR (National System of Solid Waste Information).

Articles 80-81 determine a variety or economic tools to promote the objectives of this Presidential Decree and respective law, including donating recyclables from the governmental offices to WPAs (art. 80, item III) and payment for environmental services (art. 80, item IV). Art. 81 allows federal financial institutions to create special financing programs for WPAs, for recycling or reusing of solid waste, or innovation and development related to SWM, and lastly for projects that invest in solid waste management.

The final part of this Presidential Decree changes Presidential Decree No. 6,514/2008, which fixates the administrative (environmental) offenses and sanctions. Article 84, paragraphs 2-4 imposes fines to consumers who repeatedly do not comply with the reverse logistics system, although this fine may be converted to services for environment preservation. Article 85 also changes the Presidential Decree No. 6,514/2008 and sets a fine to whoever imports dangerous substances (or substances that may damage the environment), even if it was imported for the purpose of treatment. This penalty is due to NaPS (article 49) expressly prohibiting the importing of hazardous waste and that which may damage the environment.

3.2 Ceará (State) Norms

For the purpose of this study, only two kinds of legislations of the Ceará State are relevant: those concerning the IQM ("índice de qualidade do meio ambiente," i.e., the environmental quality indicator) and the "auxílio-catador" (State Law No. 17,677/2020), aside from the State SWM Plan (CESPS). Many norms on the topic of SWM were excluded because, as the capital of the state, Fortaleza has relative financial independence and thus, for the most part, does not require assistance from the State. Nonetheless, it would be remiss not to mention that the state of Ceará pursued sorted waste collection policies much earlier than NaPS (Secretaria das Cidades, n.d).

State Laws No. 12,225/1993 and 16,032/2016 (CESPS)

The state had initially considered SWM in State Law No. 12,225/1993. This norm defined recycling as "ecological activities of social relevance and of the public interest of the state." This first article's sole paragraph sets the law's three objectives: to reduce the environmental costs and damage of waste [disposal], to save natural resources, and to provide some income to the unemployed. It then sets as a responsibility of the State the implementation of actions to this effect, to be undertaken with the cooperation of the municipalities, under eight guidelines, amongst which: the designation of areas and procedures for waste [disposal] by considering, for example, proximity to groundwater resources, especially of the hospital and toxic types; educational campaigns for social awareness; and incentives to the private sector for recycling.

Ceará had already established a State Plan on SWM via State Law No. 13,103/2001, later replaced by State Law No. 16,032/2016 to adapt to NaPS. Its article 31 determines that manufacturers, importers, distributors and sellers are responsible for (I) developing, investing and circling products that (I, b) result in less waste. Item II also attributes to the same actors the

spreading of information on how to avoid, recycle or eliminate the SW resulting from their respective products.

The structure of the CESPS has much in common with NaPS, but there are a few points where they differ. Topics such as the principles (art. 6), objectives (art. 7), waste hierarchy (art. 9), waste categories (art. 13), shared responsibility for products and their waste (art. 30), and RL (art. 33) are almost identical, with very little practical differences, if any. Some of the differences include the addition of a few more objectives, mainly: stimulate WM research (XVI), promote the development of environmental and business management that have improved production processes and reuse of resources (XIX), and promoting inter-municipal cooperation, especially consortiums (XXIII).

Regarding MIS, the CESPS contains a few more details than NaPS. Paragraph 1 of article 18 determines that a specialized technician must be involved in the elaboration, implementation, operating and monitoring of any MIS (or regional SW plan). Paragraph 3 also facilitates access to State Government funds for municipalities that implement taxes or other economic incentives that help "financially sustain" the MSWMSs (III), or that exempt from Service Taxes[15] the activities related to waste picking, waste collection, recycling, remanufacturing or reusing otherwise discarded materials (IV).

Lastly, Ceará's SW Policy adds one more category to NaPS list of products that require mandatory RL schemes in CESPS' article 33, item VII: medicines and other health-related prime materials. The other items in NaPS lists such as mercury-containing lamps, batteries and electronics, for example, are all present in CESPS list of mandatory RL schemes as well.

[15] ISS = "Imposto sobre Serviços," or Service Tax. It is a constitutionally established tax on any service executed within the limits of a city.

State Laws No. 12,612/1996 and 14,023/2007, and State Decrees No. 29,306/2008 and 35,051/2022 (IQM)

The Federal Constitution establishes 13 mains taxes, 7 of which are federal (art. 153), 3 are State/Federal District taxes (art. 155), and 3 are municipal (art. 156). Out of the 3 state taxes, the ICMS[16] (art. 155, item II) is possibly the most controversial. It is roughly considered the country's consumption tax, and, under Article 158, item IV, of the Federal Constitution, 25% of the total amount collected as the ICMS should be distributed amongst the municipalities of the State.

Ceará's, State Law No. 12,612/1996 regulates how the State redistributes this capital amongst its municipalities, although many modifications have since then followed (State Law No. 14,023/2007, State Decree No. 29,306/2008 and State Decree No. 35,051/2022). Article 1, item IV of State Law No. 12,612/1996 dictates that 2% of the ICMS will be distributed according to the Municipal Indicator of Environment Quality (IQM). In other words, the State of Ceará sets parameters every three years (State Law No. 14,023/2007, art. 4) to measure the quality of the environment, one of which is whether the municipality has submitted its MIS. In fact, even before NaPS, Ceará was already pushing for integrated regional SWM, conditioning the IQM to whether the municipalities submitted and later implemented their Plans for Integrated Urban Solid Waste Management (State Decree No. 29,306/2008), which, after NaPS, became the equivalent of MIS or its interregional equivalent (NaPS, art. 18, item I). The funds received under IQM are obligatorily designated to environmental issues, and in the case of Fortaleza, in 2022, they added up to BRL377,8844.44 (SEMA, 2023). Lastly, after the pinnacle of the 2020 COVID pandemic,

[16] ICMS = "Imposto sobre Circulação de Mercadorias e Serviços." It is a constitutionally created tax imposed on any services or goods transported into the territory of the respective State.

State Decree No. 35,051/2022, Article 3, determined that these funds may only be used to implement NaPS, partly guaranteeing capital to encourage better SWM and environment quality.

3.3 Fortaleza (Municipal) Norms

The city of Fortaleza already had MSWM laws in place before the enactment of NaPS in 2010. In 2009, for example, a series of ordinances were issued on the topic, regulating different categories, and then again in 2018. Fortaleza has also enacted laws on water management (e.g., Ordinance No. 10,363/2015) and low carbon (Ordinance No. 10,586/2017), amongst other topics, all of which can relate to CE. As explained in the introduction, this study focuses on WM, and so this and the following section summarize the most relevant municipal WM norms.

Pre-NaPS WM Legislation in Fortaleza and NaPS-spurred Modifications: Ordinances No. 8,408/1999 and 10,340/2015 (Large emitters), Municipal Decree No. 13,732/2015 (PlaSMs requirements), and 2009 Recycling Laws

Fortaleza's 1999 law regulated "large" emitters as well as those who emit "septic" and dangerous waste (Ordinance No. 8,408/1999, art. 1). The 2015 modifications adapted this pre-existing norm under NaPS, establishing, for example, that any person or business that emits daily more than 100L of non-dangerous waste or 50L of construction waste is labeled a large emitter, and is, thus, charged with storing, collecting, transporting, treating, and final destination of the produced waste. Under the 2015 modification, some categories of waste must undergo treatment before they can be sent to their final disposal site. Amongst such types of waste are those from ports, or those from hospitals and health establishments. The municipal incinerator receives some of the hospital waste, although another part is illegally sent directly to landfills, without prior

treatment.

Large emitters bear many responsibilities, including presenting a mandatory Waste Management Plan (art. 3, para 1). All the obligations of large emitters are likewise attributed to emitters of dangerous waste, as well as to manufacturers, importers, distributors and sellers of the types of waste that require RL schemes under NaPs, as listed in its article 33.

It should be noted that articles 11-27 list a series of offenses against this law, for which the respective administrative penalties are also defined. Such infractions range from abstaining from submitting a Plan of Solid Waste Management (PlaSM) (II), attempting to divert from the submitted PlaSM by submitting wrongful information or omitting it (III) or operating differently from the submitted PlaSM (IV), to directing emitted waste to the public MSW collection service amongst others in volumes or weight surpassing the legal maximum (X). One of the issues covered is that of transportation (XI-XIX), including unlicensed/unauthorized transportation of waste (XI-XII). Penalties also differ depending on the degree of seriousness, but all infractions incur at least a fine, often accompanied by at least one more consequence.

Municipal Decree No. 13,732/2015, heeding NaPS as well as other federal institutions, sets the minimum requirements for the establishment of the PlaSMs that article 20 of NaPS requires from certain emitters. Targeted subjects include those who, despite producing non-dangerous waste, do so in large quantities (item II-b), which seems to match the description of Fortaleza's Ordinance No. 10,340/2015. The Decree's 7th article predicates that only technicians and professionals licensed by SEUMA are authorized to "elaborate, implement, operate and monitor all the stages of the PlaSMs," which includes the transportation of waste. However, article 9 states that in the case of those emitters who opt for recycling as final disposition of their wastes, the emitters may transport the waste themselves. Article 9 also states that only associations or

cooperatives of WPs that are registered with SEUMA or licensed recycling companies may be appointed as the recipients of this waste.

Under NaPS, the Union, all states and all cities (in the latter case, individually or jointly, as long as within the same state), are required to elaborate an integrated waste management plan (arts. 14-19), all three types with specific minimal requisites. These plans were due August 2012, although less than 50% of all the 5,570 Brazilian municipalities actually did so thus far (SNIS, 2021: 20). For the municipal plans (MIS), the requisites include, amongst others:

a) Identifying origin, volume and characteristics of the waste generated within its territory, and the respective treatment and final destination used;
b) Identifying environmentally favorable areas for adequate final destination;
c) Programs and actions for technical capacitation for implementation and operation;
d) Programs and actions for the participation of interested groups, namely, scavenger associations or similar institutions;
e) Set goals for reduction, reuse, sorted collection and recycling, in order to reduce the amount directed to final destination;
f) Revision periodicity.

Fortaleza submitted its MIS at the end of 2012 (O POVO, 2012). It consists of roughly 400 pages that could be rather classified as a technical analysis, similar to an environmental impact assessment. It does, however, present a lot of relevant information, set goals, predict a range of scenarios, from ideal to worst-case, and proposes two bills for new ordinances: one for a Municipal Policy of Sanitation (ACFor, 2012: 340), and another for a Municipal Policy on MSWM (ACFor, 2012: 356). It also seems to be the precursor of the Ecopoints program, as its proposal includes the installation of 40 Ecopoints throughout the town.

Even before the elaboration of Fortaleza's MIS, there were already many norms for WM in place. In 2009 two separate norms established rules for the recycling of domestic appliances (Ordinance No. 9,536/2009), of batteries, lights and any other device containing mercury or another heavy metal (Ordinance No. 9,506/2009). A third law deemed sorted collection mandatory for condominiums (residential or not) and established the sorted recyclables should got to WPAs registered at SEUMA (Ordinance No. 9,544/2009). However, as stated in the city's MIS, despite pre-existing legislation, Fortaleza's MSWM underperforms, especially since many measures were not yet implemented (ACFor, 2012: 54).

Post-NaPS Legislations: Fortaleza City Tax Code (Supplementary Law No. 159/2013); Ordinance No. 10,183/2014 (Environmental Certification) and Specific Items (Ordinances No. 10,520/2016; 10,692/2018; 10,694/2018; 10,700/2018; 10,957/2019)

The previous section showed some adaptations that NaPS provoked in Fortaleza's pre-existing norms. This section introduces new legislation enacted after NaPS, starting with Supplementary Law No. 159/2013. This norm establishes the city's Tax Code. Its chapter VII regulates payment and reduction of property taxes (IPTU), and article 293 established that a citizen who sorts his or her waste and donates it to a WPA earns the right to a 5% discount on their property tax fees. Based on the wording "contribuinte," which means "taxpayer," it is possible to interpret that this applies to legal entities as well.

In 2014, Ordinance No. 10,183 introduced the seal "Friendly Business to the Environment of the City of Fortaleza" (article 1) and the Certificate of Environmental Kindness" (article 4). The latter targets businesses such as cafes, restaurants and others that sell food using recyclable or biodegradable containers and packaging, while the latter targets any legally constituted enterprise.

Both aim to encourage businesses to help educate the citizens, as well as inform customers what the business is doing to keep the city clean and the environment protected (article 2, item I, c and d, and article 4 items I and II).

In 2016, the short but objective Ordinance No. 10,520/2016 established that cell phone batteries cannot be discarded in commercial or domestic waste (art. 1). The companies that sell cell phones or their batteries must also, free of charge, offer a collection service for the discarded batteries and direct them to the manufacturers, suppliers or distributors (art. 2, items I and II), or to a specialized recycling business (art. 3, item I, c). The sellers must likewise keep a monthly record of collected batteries (art. 2, item III), as well as store them adequately, avoiding toxic leakages (art. 3, items I and II).

The year 2018 was a prolific year in Fortaleza for WM norms: at least three categories of waste were covered: plastics and tires (Ordinance No. 10,692/2022), electronics – including batteries and domestic appliances – (Ordinance No. 10,694/2022), and PET bottles and plastics in general (Ordinance No. 10,700/2022). Ordinance No. 10,694/2018 targets electrical and electronic devices, including batteries. Although there are similarities between Ordinance No. 10,520/2016 and No. 10,694/2018, the latter attributes a "solidary" responsibility to a wider range of businesses, namely manufacturers, importers and sellers (art. 1, sole paragraph). In other words, each business is responsible for the correct treatment or final destination of not only their own products, but any electrical or electronic appliances. Article 5 further dictates that these businesses must maintain collection points to receive the technological waste discarded by consumers. Another difference is that, while both norms recognize recycling as a viable option (if safely executed), Ordinance No. 10,694/2018 also includes partial or total reuse as an alternative (art. 3, item II), and the latter also allows for partnerships with WPAs, educational institutions and other social organizations (Article

8). Lastly, Ordinance No. 10,694/2018 is a bit more descriptive regarding information to the consumers:

> Art. 4 Electrical and electronic products and components sold in the city of Fortaleza must prominently indicate, on the packaging or on a label, the following information to the consumer:
>
> I – warning that they should not be disposed of in common waste;
>
> II – guidance on technological waste drop-off points;
>
> III – address and telephone number of those responsible for the disposal of material in disuse and subject to final disposal;
>
> IV – warning about the existence of heavy metals or toxic substances among the components of the product.

Fortaleza's Ordinance No. 10,692/2018 has double targeted products: plastics and tires, including via "solidary economy" (art. 1). In the case of plastics, it specifically targets and attributes a responsibility for the final destination of bottles and packaging to manufacturers and distributors of: drinks of any kind; fuel oils, lubricants and similar products; cosmetics; and hygiene and cleaning products (art. 2, items I-IV). The same article in its sole paragraph recognizes as adequate final destinations for the above items recycling or reuse. Article 3 mandates that the businesses described in Article 1 will jointly create and manage takeback procedures for bottles post-consumption. Lastly, it is the only legislation cited here with scheduled targets: takeback 50% of the bottles within a year of the enactment of the Ordinance, 75% in 2 years, and 90% within 3 years (art. 6, items I-III). Regarding tires, the same Ordinance (No. 10,692/2018) has slightly similar – if simpler – instructions: all manufacturers, importers, distributors and sellers are jointly responsible for the final destination, as well as establishing takeback schemes and collecting the

tires (art. 7). Article 8 also prohibits discarding tires in the environment, including in water bodies (item I, d), as well as burning them (item II), a practice still common today.

Out of the three highlighted 2018 norms, Ordinance No. 10,700/2018 might be the least innovative. Its objects are bottles, both PET bottles and those made of other plastics. Article 1 targets manufacturers, distributors and fillers, and dictates that they will create and maintain recycling, reuse and repurposing programs for bottles made of PET or other plastics. Article 3 also requires the same companies to maintain adequate disposal bins and collections services. Lastly, like the previous norms, Ordinance No. 10,700/2018 also requires the targeted businesses to include information on the bottles regarding their disposal, as well as the damages they may cause the environment (art. 2).

Perhaps reflecting the overall global trend on abolishing single-use plastics, and because Fortaleza is a popular tourism destination thriving on its beaches, the municipality enacted Ordinance No. 10,957 in 2019, banning in its first article the use of plastic straws and similar single-use plastics in many establishments throughout the city, from beach huts, dance clubs and hotels, to bakeries, soccer stadiums and others. It is not the manufacturing that is prohibited; the norm prohibits the establishments from offering such items to their customers. Ordinance No. 10,957/2019 also encourages in its second article the use of biodegradable or reusable items, e.g., glass or stainless steel.

Post-COVID Fortaleza Legislation: Ordinances No. 11,220/2021 (Fortaleza Cidade Limpa), No. 11,323/2022 (Waste Tax), and No. 11,324/2022 (Fortaleza Plus)

The data gathering of this research was held in 2019, shortly before the 2019 COVID pandemic struck. For chronological logic, the data gathering was originally limited to the end of

2019, or 2020 at the latest. However, because Fortaleza (and Ceará) enacted many CE-related legislations during and after the pandemic, the researcher added this section, considering the relevance of the topic to the ultimate object of the case study, the transition in Fortaleza.

The 2019 COVID pandemic spread throughout the planet, and in many countries including Brazil, only "essential service workers" were allowed outside during the peak of the shutdowns. This limited list included waste workers, highlighting their importance and bringing them out from their previously obscure existence. In Fortaleza, the Ecopoints were authorized to continue functioning as well (Prefeitura de Fortaleza, 2020).

Perhaps it was because the importance of waste workers was called to light that the debate on charging a waste tax resurfaced. This topic was also mentioned by Fortaleza's MIS, alleging that, because of the service's gratuity, there is a lack of citizen cooperation, causing the many "waste spots throughout the city (ACFor, 2012: 38) where voluminous waste such as furniture and bicycles are illegally dumped (2012: 59).

In 2021, the city's legislative assembly approved Ordinance No. 11,220, which set a deadline of half a year (until June 30th, 2022) for the mayor to submit a bill for "Fortaleza, Clean City," the government's MSWM program. Article 2 of Ordinance 11,220/2021 authorized charging the waste tax, but article 1 listed the minimum content of the program. It determined that the bill should contain at least 12 topics, amongst which: participatory practices; reduction of pollution and environmental damage; development of the market, production and consumption of products derived from recycled and recyclable materials; tariff reduction policy for the low-income population; encouragement and support for WPs and their associations; expansion of the Ecopoints network so as to cover all neighborhoods of Fortaleza; implementation of a network of voluntary drop-off points in public areas and/or in partnership with the private sector, aiming for the

collection of recyclables and stimulating the environmental awareness of the population; environmental education in the municipal public school system; and a program for the expansion of vegetation coverage, expansion of green areas and recovery of environmental liabilities. Although the law is new and therefore its results are likely not yet knowable, the intention of the legislator is clear: Fortaleza aims to become a sustainable city, and much of this norm already seems to conform with CE.

Ordinance No. 11,324/2022 (further regulated by Municipal Decree No. 17, 626/2023), is the only one out of all the cited norms that explicitly refers to CE. This ordinance is a response to the previous one (11,220/2021), and establishes the new MSWM program entitled "Fortaleza Mais [Plus]," centered around three central ideas: infrastructure & technology, social inclusion, and environment. It incorporates previously existing programs such as: Re-ciclo and e-catador (Ordinance No. 10,975/2019), both of which were created to help WPAs by registering them in digital platforms created by the municipality, and, in the case of Re-ciclo, by donating or ceding equipment; Recicla Fortaleza, by which citizens receive a discount in their electricity bills based on the recyclables they bring to the Ecopoints (Prefeitura de Fortaleza, 2023); and others. The objectives are listed in its initial article:

> Art 1 The Fortaleza Plus Program is hereby established, with the objective of implementing integrated solid waste management with a focus on the concepts of circular economy, sustainability and recycling.
>
> § 1 The Fortaleza Plus Program will be structured in three (3) axes: Infrastructure and Innovative Technology, Social Inclusion and Education, and Environment.
>
> § 2 The Fortaleza Plus Program includes the following main specific objectives, notwithstanding others that may be incorporated:

I - promote practices, habits and actions that incorporate the concept of circular economy;

II - establish goals and encourage increase in recycling rates;

III - promote the integration of data, the use of targets and indicators, and the implementation of innovative infrastructures and technologies as means for integrated solid waste management;

IV - promote social inclusion, especially with a focus on waste pickers' associations;

V - to promote reverse logistics practices;

VI - stimulate policies and actions on education and environmental awareness.

As seen above, the Fortaleza Plus Program holds many objectives, including some related to information and monitoring, promoting RL, behavioral change and environmental awareness. The program also predicts an integration of the MSWMS and an expansion of the infrastructure for voluntary returns, and partnering with the private sector. Additionally, the program aims to encourage and therefore expand sorted collection habits and business chains:

Art 3 An integrated network of collection points should be implemented with a focus on recycling and the circular economy, including Ecopoints, mini-Ecopoints, itinerant collection structures, voluntary drop-off points (PEV) and other related equipment, covering all neighborhoods of the city.

§ 1º For the expansion of the integrated network of collection points, partnerships with the private sector will be considered, notwithstanding other strategies.

§ 2º The infrastructures and equipment of the integrated network of collection points must be distributed in the territory of the city according to technical criteria, such as waste production, land use, movement of people, accessibility, among other applicable criteria.

§ 3º The integrated network of collection points should incorporate programs to encourage and subsidize selective collection.

Ordinance No. 11,324/2022 also focuses special attention on WPs. This is most obvious in its articles 8-10, roughly translated below, which incorporate the already active Re-ciclo program as well as the e-catador program, which existed even before Re-ciclo. The Re-ciclo program initially required the development of an app and partnerships with specific WPAs, and was only available at a limited number of Ecopoints/neighborhoods. It expanded since then, and while it still requires scheduling, the registered WPs receive a motorized bicycle that allows them to go farther and pick up more volumes of recyclables, including at the donator's residence, if it is within the current established range.

Art 8 The sorted collection program called Re-ciclo, which includes providing a digital platform for scheduling collection by the population and the use of electric tricycles by accredited waste pickers' associations, should be expanded to all regional administrative offices.

Sole paragraph. Notwithstanding other strategies, partnerships with the private sector will be encouraged to support the Re-ciclo Program.

Art 9 The Sustainability Agent Program will be implemented, including a financial subsidy in amounts and conditions defined in a decree of the Executive Branch, to be paid by the City of Fortaleza to the waste pickers registered in the program.

Art 10 The e-Catador Program is established for the purchase of recyclables collected by waste pickers at the Ecopoints network.

Lastly, regarding information, Ordinance No. 11,324/2022 also established that a report on the topic of waste will be made public annually. Since not much information on waste is currently available to the public, these upcoming reports are a step forward.

> Art 14 The Municipality of Fortaleza, through the Authority for the Regulation, Inspection and Control of Public Environmental Sanitation Services (ACFor), shall prepare and publish annually an analytical report on solid waste management in the city, containing, among others, results, goals, indicators, actions developed, challenges and other relevant information related to the theme of solid waste management, with a special focus on the concepts of circular economy and recycling.
>
> Sole paragraph. The report shall be prepared by the end of the first quarter of each year, referring to the previous year, and must be sent to the City Council of Fortaleza.

3.4 Summary and Additional Comments

Chapter 3 focused on the documental research that forms the background information for the case of CE transition in Fortaleza. The researcher examined norms on all three national levels relevant to the case study: federal, State and municipal. This chapter presented the legal clauses that directly relate with or otherwise influence(d) the empirical data from the interviews.

While Brazil has much legislation on environmental issues, it has yet to enact federal legislation devoted to a CE policy, although the national congress currently discusses a bill on the topic.[17] Nonetheless, there are individual norms related to CE, such as the National Energy Policy, the National Policy on Climate Change, and the National Policy on Solid Waste. Additionally,

[17] Proposta de Lei (Bill Proposal) No. 1,874/2022.

norms on a wider range of issues such as the Federal Constitution (of 1988) and the Environmental Crimes Act are also related, although on a smaller scale, yet no less important. This chapter explained which laws were considered essential for the analysis in chapters 4 and 5, focusing less on "purely" environmental issues such as Climate Policies and more on norms that related to materials and resources, mainly NaPS.

The National Policy on Solid Waste Management is currently considered the main CE policy of Brazil. It presents the legal definitions of terms such as resources, waste, and reverse logistics, while also setting up a framework for better management of resources. Another innovative NaPS trait is that it places WPs in a more inclusive position in MSWMSs, as opposed to the usual periphery (informal) role they assume, although most of NaPS' dispositions regarding WPs are recommendations, none being mandatory. While NaPS is not the first national legislation to systematically consider WPs as part of WM in Latin America (LATAM), it is the first to do so in Brazil. In other words, the main CE legislation in Brazil already includes some level of social inclusion.

In terms of State-level norms, few were considered relevant to the topic. Amongst the selected is the norm that establishes a redistribution of up to 2% of the ICMS to cities of Ceará that reach certain targets concerning WM, such as registering the Municipal or Regional Consortia Plans on Integrated Waste Management. These plans were originally set as mandatory by NaPS, and the State of Ceará made use of positive economic incentives to encourage the municipalities to comply. The other significant State legislations analyzed in this chapter were both related to WPs, and were established during and after the COVID-19 pandemic. They established the conditions for registered WPs to receive auxiliary income as compensation for environmental services.

There were many municipal norms, demonstrating that Fortaleza is active regarding WM (and the material aspect of CE). The most relevant norms are the ones that establish big emitters, the many laws regarding the WM and recycling of different materials, and the general policies on WM such as Fortaleza Mais (Plus) and the Ecopoints policy. The consistent pursuit in improving WM norms demonstrates that Fortaleza is actively concerned about the destination of the materials and waste produced within the city. Whether intentionally or not, this also implies that the municipality is – at least at some level – pursuing CE. However, what kind of CE is the city of Fortaleza shaping cannot be grasped simply looking at the laws and policies; it is also necessary to look at the real circumstances.

The norms in this section have direct or indirect influence on the principle of elimination of waste and pollution, C1. Despite the misleading description, C1 is not the simple removal of refuse or litter from the public spaces, but instead relies on more fundamental ways that ultimately alter behaviors or manufacturing processes. The National Congress currently discusses a CE policy that should encourage such changes, while also integrating with already enacted policies such as the National Energy Policy, NaPS, the Biodiversity Act, and so on. If the final approved text places priority on encouraging zero-waste processes, especially planning new production methods that do not generate (much) waste, it would become a good example of a proper C1-centered norm.

The closest norm to a C1-centered policy that this study found was NaPS. It was also repeatedly considered the closest thing to a CE policy in Brazil at the time of writing of this thesis. However, this national policy is predominantly about circulation (C2), not reduction (C1), although its article 30, item III, expressly mentions “reduce the generation of solid waste, the wasting of resources, pollution and environmental damages” (NaPS, 2010). Therefore, most of the policies that have a certain degree of C1 presented here are the type of norms that relate to the

increase of awareness or education, or that impose economical burdens or rewards, since all of these influence a behavior shift that may reduce the generation of waste at its source.

Many CE publications revolve around materials and their reusability without decreasing value (C2), as revealed by the many reviews of CE literature from different analytical viewpoints (see Chapter 2). Both the literature review as well as the legal background research for the case study confirmed C2 to be the most robust amongst the three EMF principles. Much of this chapter presented the norms that mostly focus on WM and recycling, as these seem to be the predominant topic under CE currently enacted concerning the city of Fortaleza, and likely in Brazil as well.

Some – if not all – of the environmental federal legislation can be misunderstood as C3-related policies, which might make C3 the most difficult CE principle to analyze. At first glance, it seems any environmental initiative or legislation would qualify as C3. However, CE requires systems-thinking (EMF, 2015a: 2, 8), therefore. CE (policies) must be designed with C3 measures put in place along with production or services (C1 and C2). In other words, C3 (and CE) cannot be simple end-of-pipe (EOP) measures. Under this perspective, there is currently very little legislation on C3 in Brazil. This thesis, especially this chapter and the next, only presents the norms and policies related to the case study, but none can be considered real C3 measures.

The next chapters examine what was actually happening in 2019 in Fortaleza via information derived from interviews. Complementing the norms presented in this Chapter (3) with the interviews, Chapters 4 and 5 analyze the combined data via the proposed CE-EJ framework.

4. The Case of Fortaleza through the CE LENS

There are at least two ways policies come to be: top-down, or bottom-up. Some policies arise bottom-up, meaning that society or a segment of it push for them, such as CE policies in the EU (Ghisellini et al., 2016: 18). Alternatively, a government may promote a policy in top-down style, be it from the executive branch or the legislative, such as CE in China (Ghisellini et al., 2016: 18). Policies are often planned, but that certainly does not mean they do not fail, perhaps by poor implementation or inadequate designs. Government agencies, politicians and policymakers are tasked with the hard job of tackling or even predicting a diverse range of problems and their respective solutions. This challenge also applies to CE policies.

This chapter summarizes the author's observations on the most relevant issues that arose during the data gathering (Chapter 3) and from the interviews conducted in Fortaleza in 2019 (section 4.1). Both this chapter and the next one analyze – or, in Walker's terms, diagnose – a real case: the transition of CE in the city of Fortaleza, capital of the state of Ceará, located in northeastern Brazil. Both chapters are heavily based on the empirical data obtained via interviews and other sources such as legislations and public documents, most of which chapter 3 introduced. Chapter 4 looks at the information from a CE point of view, using the three EMF CE principles as the analytic lens. Chapter 5 then presents an additional point of view, EJ, as the second step of the diagnosis, demonstrating the usefulness of EJ as a constituent of CE policies – at least for LMCs.

The present chapter uses the three EMF principles (labeled C1, C2 and C3) presented in Chapter 2 to analyze the data from the interviews and the relevant legislation that was presented in Chapter 3. Following the definitions that Table 2-1 provided, the activities and initiatives identified in the field study were categorized under the C1, C2 and C3. Identifying the blurred limits between principles presented a tough challenge, since the encountered situations are parts

of a real case, as opposed to being purely hypothetical, and therefore naturally presented more complexity. In this sense, while Chapter 3 was concerned with "what should be," or as Walker (2012: 17) states, the normative ideas such as SD, what Chapter 4 pursues is "what is."

As mentioned before, the three principles are not entirely independent. Pursuing even one of the 3 EMF CE principles impacts the other two, as they are separate gears working somewhat in tandem with one another. A high performance of one principle likely results in strong influence over the others. For example, if a region is able to circulate materials and products at the highest rate possible (C2), then, barring a rebound effect, there should be less pollution and waste emitted (C1). Additionally, there would also be less pressure on natural resources, allowing natural systems and stocks ample chance of recovery (C3), even if slowly. However, intentionally chasing after all three principles would likely accelerate a CE transition while also recoiling from planetary boundaries that humanity has yet to transgress beyond the irreparable limit.

4.1 Background: Actors and Activities Concerning WM in Fortaleza

The study focused more on WPs after the first interview. Based on this initial conversation and on the information previously gathered via the initial documental research up until the year 2019, when the interviews were conducted, it was clear that the WPs are very relevant actors for CE, yet suffer from a variety of issues delineated further down.

Government agencies of two levels – state and municipal – are represented in this case study due to their closer proximity to a real-case scenario. The national congress currently discusses a CE National Policy,[18] but, as of 2023, it has yet to be voted in Congress. While the

[18] Article 4 of the initial bill delineates the 11 principles of the proposed National CE Policy. The first three correspond to the 3 EMF CE principles. The last principle can be somewhat linked to both social justice and environmental justice

federal level is responsible for nation-wide legislation and control, it is often on broader topics such as biodiversity and funding. While these issues are related to CE, they were avoided since they would greatly increase the scope of this study, which is limited by time and resources. Moreover, during the interview with the two state agencies, while many promising initiatives were disclosed, few were related to the city of Fortaleza. Both agencies stated that the capital is rather independent, and there was thus far rarely any necessity for the state to intervene (COSAN staff member, personal communication, September 6, 2019; CODES staff member, personal communication, September 9, 2019). Therefore, the information provided by SEUMA, the Municipal Bureau of Urbanism and Environment, the municipal agency responsible for the environment and urbanization (SEUMA staff member, personal communication, August 30, 2019) is the main source of primary governmental data.

The state of Ceará had already tried to sort out its waste policies even before the enactment of NaPS, according to COSAN staff member (personal communication, September 6, 2019). However, as WM is legally attributed to municipal governments (CF, art. 30, V), there is a limit to how much the state government could intervene. Since 2010, NaPS set forth on a widespread responsibility, and even attributed some tasks to all stakeholders, including the different levels of governments, and the scenario gradually changed. According to COSAN staff member (personal communication, September 6, 2019), the toughest job was to convince mayors of different smaller cities and – more importantly – different political parties to work together to achieve the goals set by NaPS within the deadline. There are financial penalties for not achieving the objectives, and some of the municipalities were already paying fines (COSAN staff member, personal

as well, as it is "promote a just transition." There is no explanation of what a "just transition" entails, but the intention is clear.

communication, September 6, 2019). On the other hand, the state government was providing financial incentives (IQM) and technical support, so the consortiums proposed by the state government of Ceará eventually started taking shape and becoming a reality (COSAN staff member, personal communication, September 6, 2019).

However, the city of Fortaleza is not part of these consortiums, since its government has its own plan and more financial independence. According to SEUMA staff member (personal communication, August 30, 2019), the municipal government was able to obtain a loan of BRL 600,000,000 from BIRD/WB, and for the first time such a sum was exclusively for environmental purposes (SEUMA staff member, personal communication, August 30, 2019). Such a loan will finance projects that include clean-ups for the city's waters bodies and building more Ecopoints stations (SEUMA staff member, personal communication, August 30, 2019).

The Ecopoints are the city's recycling program, as there is no door-to-door sorted collection for recyclables (SEUMA staff member, personal communication, August 30, 2019). Under NaPS, the life cycle of materials is a shared responsibility of everyone (art. 6, VII) – citizens, government, businesses, etc - and so SEUMA argues that the Ecopoints "empower" the citizens to give the correct destination to their waste (SEUMA staff member, personal communication, August 30, 2019). The material is collected by ECOFOR and resold to recycling companies (ECOFOR administrative staff member, personal communication, September 9, 2019). This operation represents an almost threefold advantage for the WM company, since ECOFOR earns income from the WM contract with the municipal government (Public Bidding 001/2002), managing the Ecopoints (ACFOR, 2017), and by selling the materials, and likely also by spending less resources going to the drop-off points than it would going door-to-door. There are not enough Ecopoints yet to make them within walking distance to all Fortaleza inhabitants (SEUMA staff member, personal

communication, August 30, 2019), and this may be one of the reasons why recyclables often still end up in ordinary waste – which is collected door-to-door (ACFor, 2012: 60). The city offers an economic incentive to increase the turnover of materials: based on the weight of the materials brought, citizens get a discount on energy bills or e-currency (SEUMA staff member, personal communication, August 30, 2019).

According to SEUMA staff member (personal communication, August 30, 2019), Fortaleza also holds many afforestation projects, offering young tree saplings of local species to be planted. They are free of charge, but require signing a term of responsibility. The saplings can be collected at SEUMA's headquarters, or via one of the tree-planting programs (SEUMA staff member, personal communication, August 30, 2019). One of the possibilities is via the PEV schools,[19] where sorted waste collection stations are built within certain municipal schools. Environmental education programs are also provided, as well as events promoting both sorting waste and offering tree saplings (SEUMA staff member, personal communication, August 30, 2019). Some municipally managed maternities also offer tree saplings to new mothers. When one adopts a tree from SEUMA, there is both an explanation on how to care for the chosen (local) species, as well as follow-up visits to check on it (SEUMA staff member, personal communication, August 30, 2019). The city plans to restore some of the original fauna that urbanization decimated. Although the author has not inquired whether this initiative was successful, to the author's eyes, Fortaleza does seem greener than before.

The SEUMA interviewee also cited many instances in which the city attempts to include

[19] The PEV schools act as multipliers for environmental education via programs the municipality implements there. They are originally municipal public schools chosen by the municipal government where the latter installs a physical infrastructure of at least 10-20m^2 voluntary drop-off points ("pontos de entrega voluntária," hence PEV) for recyclables (SEUMA staff member, personal communication, August 30, 2019).

and support WPs. Aside from the PEV schools which donate the collected items to local WPs and/or WPAs, the city frequently tries to hire WPAs (by competition/tendering) for the sorted collection of events (SEUMA staff member, personal communication, August 30, 2019). The cooperative and at least two of the interviewed associations (Coopmares, ASCAJAN, Maravilha) are based in municipal land that was ceded by the city to the associations; some of the association bills are also paid, and there is a truck for waste collection that runs Monday-Friday collecting different materials from different places for different associations (SEUMA staff member, personal communication, August 30, 2019). Even the Ecopoints were originally designed for WPs (SEUMA staff member, personal communication, August 30, 2019). However, according to the interviewed University faculty member (personal communication, September 20, 2019), ECOFOR protested against this, and, moreover, most of the WPAs did not have the organizational structure deemed necessary to be able to operate an Ecopoint (SEUMA staff member, personal communication, August 30, 2019; University faculty member, personal communication, September 20, 2019).

Finally, SEUMA, COSAN (the Sanitation Department of Ceará) and CODES (the Department of Sustainable Development of Ceará) mentioned or even emphasized the role that the Ministério Público (MP, the Prosecutor's Office)[20] plays regarding the pursuit of RL and NaPS (SEUMA staff member, personal communication, August 30, 2019; COSAN staff member, personal communication, September 6, 2019; CODES staff member, personal communication,

[20] Ministério Público is a public institution that is independent of the three powers (executive, legislative and judiciary), but is considered as attached to the judiciary. Its role is to supervise that the government is doing its job, to protect the rights of both the government and that of weaker members of society such as minors, to supervise that a legal suit is conducted under due diligence and so on. It is a complex organization with many goals, but it basically assures that laws are observed.

September 9, 2019). The state of Ceará is pursuing different strategies to realize the goals of NaPs, although the creation of consortiums seems to be the basic form, since it allows for smaller and poorer cities to work together and achieve the said goals and avoid fines (COSAN staff member, personal communication, September 6, 2019). Following the obligations NaPS sets requires economic and technical resources that many of these cities cannot provide (COSAN staff member, personal communication, September 6, 2019; CODES staff member, personal communication, September 9, 2019), hence the intervention of the state government and the (State) MP in convincing the cities to cooperate. NaPS also requires that the producers of some items such as tires and electronics elaborate an RL strategy (art. 33), something the MP has been adamant about (SEUMA staff member, personal communication, August 30, 2019).

The government of Fortaleza hires a single company under a concession contract to collect the waste and treat it. In the case of Fortaleza, treatment mostly means landfill, with the exception of hospital waste and other hazardous waste, which is incinerated (ACFor, 2012: 49). Both the municipal incinerator and the landfill site are managed by the same company, Marquise, parent company of ECOFOR, which was established to specifically take care of the municipal waste of Fortaleza (Marquise Ambiental, n.d.).

As happens in many cases where informal recycling is dominant, there are many middlemen and shops that buy small quantities of recyclables, then amass, prepare and organize to resell them in bigger quantities to larger companies (e.g., Sasaki & Araki, 2013; Asim, Batool and Chaudhry, 2012). Due to time constrictions, this study only interviewed ECOFOR.

ECOFOR has a 20-year contract with the municipality of Fortaleza to collect the city's domestic waste (Fortaleza, 2003, May 21) and it is currently responsible for managing the Ecopoints (ACFOR, 2017, Feb 9), which means they currently collect more recyclables than

before construction of the Ecopoints. According to the representative, ECOFOR does not process these recyclables in any way, simply accumulating them to resell to intermediate buyers – not recycling or manufacturing companies (ECOFOR staff member, personal communication, September 5, 2019).

Additionally, ECOFOR also assists WPs, especially by collecting waste donations for them due to municipal order (ECOFOR staff member, personal communication, September 5, 2019),[21] indirectly contributing to informal material circulation (ECOFOR staff member, personal communication, September 5, 2019). ECOFOR also supports WPs from time to time in different ways, such as with technical assistance, or donations of recyclables from "big events" outside of the monthly donations of 50 tons (ECOFOR staff member, personal communication, September 5, 2019). Other companies classified as big emitters such as the national supermarket chain Pão de Açúcar and local hotels also rely on ECOFOR to collect the materials and distribute the materials to one of the three WPAs of their choice: ASCAJAN, Maravilha and Bonsucesso (ECOFOR staff member, personal communication, September 5, 2019). According to the ECOFOR interviewee, these were the three WPAs that had volunteered for Fortaleza's sorted collection, and thus were benefitted by the new amendment of the contract (ECOFOR staff member, personal communication, September 5, 2019).

As of 2015, the company also started promoting environmental education programs in some public schools and at the Ecopoints, aiming for the better segregation of recyclables at the source (ECOFOR staff member, personal communication, September 5, 2019). ECOFOR also

[21] The interviewee mentioned that the Municipal Government conditioned the 2013 renovation of the contract with ECOFOR to a monthly donation of 50 tons of recyclables to the three WPAs that had volunteered for the sorted collection program: ASCAJAN, Maravilha and Bonsucesso (ECOFOR staff member, personal communication, September 5, 2019). The researcher was unable to procure any document that confirms such an amendment.

occasionally contributes a truck for beach cleanups, but such events are often organized by third parties (ECOFOR staff member, personal communication, September 5, 2019).

Lastly, ECOFOR's participation in decision-making within Fortaleza is unquestionable. Given their recognized status as the sole service provider, it is likely that consulting the company is necessary for issues related to MSWM while the contract lasts. Additionally, on the one hand, as pointed out by ECOFOR staff member (personal communication, September 5, 2019), the company also holds monthly meetings with the WPAs they assist in order to improve their collaboration. On the other hand, as pointed out by University faculty member (personal communication, September 20, 2019), every decision the Fortaleza municipal government makes needs to be approved by ECOFOR, which seems to hinder some social initiatives.

ECOFOR and other companies are not the only ones dealing with waste in Fortaleza. Aside from the formal WM companies (ECOFOR, GERDAU, Braslimp, amongst others), the informal sector is also present. In fact, it is not uncommon to spot WPs sharing a car lane with vehicles while carrying their recyclables on carts, sometimes pulled by an animal. Additionally, some WPs formed or joined associations, although it is a small percentage of this population that have done so (CESPS: 36). At the time of conducting the interviews, there were 9 regularly registered WPAs: Acores, ASCAJAN, Brisamar, Maravilha, Moura Brasil[22], Reciclando, Rosa Virgínia, SOCRELP and Viva a Vida. Additionally, there was also an umbrella association called REDE – a network of the 26 WPAs in Ceará – and a cooperative called Coopmares, which also involves the WPAs of Fortaleza and that of some satellite cities. Interviewees were usually the former, current or future

[22] The author was not able to contact or find the physical location of the Moura Brasil Association, and it is therefore excluded from this study.

leaders of these associations.

WPs spend most of their time collecting and sorting waste, and as reported by many of the interviewees and the literature, their needs are immediate as they are usually working for their survival (e.g., Wilson et al., 2006: 798; Zolnikov et al., 2018). Environmental concerns are usually not their direct priority, although there is no doubt that they contribute significantly to the quality of the environment. Additionally, some representatives mentioned they are proud to improve the environmental quality (WP association S member, personal communication, September 3, 2019; WP association U member, personal communication, September 5, 2019; WP association J member, personal communication, September 6, 2019).

REDE and Coopmares have a more expansive reach given their formative composition as networks, and occasionally their members are invited as speakers, or promote environmental education programs. Roughly 90% of all the materials in Brazil are recovered by WPs (MNCR, 2021). This statistic may be different in Fortaleza due to the establishment of the Ecopoints, but, as far as the author of this thesis knows, no such data is yet available. Traditionally, WPs sell to a small intermediate buyer that pays them a lot less than market prices due to the low quality and small quantity of the materials WPs can sell (R3 staff member, personal communication, August 30, 2019; Government educational program member C, personal communication, September 3, 2019; WP association U member, personal communication, September 5, 2019; REDE staff member, personal communication, September 6, 2019). However, REDE and Coopmares can skip a few intermediate buyers and sell directly to recycling companies or, more often, the last intermediate buyer before the actual recycling industries themselves (Government educational program member C, personal communication, September 3, 2019; REDE staff member, personal communication, September 6, 2019).

WPs have a long history of fighting for rights and recognition, especially in LATAM countries (WIEGO, n.d.). In Brazil, their fight has already rendered WPs an official labor category under Brazilian legislation, which is a step closer to obtain the right to a retirement pension. Although no such legislation regarding WP retirement exists yet, there is a national movement in this sense, which REDE is a part of. Some states in Brazil have already approved payments for environmental services, including the state of Ceará (Governo do Estado do Ceará, 2020).

REDE follows market-based economy externally, but follows a "solidarity economy approach internally" (REDE staff member, personal communication, September 6, 2019). As far as the researcher could comprehend from other snippets of the interview, this means that, differently from most of the WPAs, the income is divided equally amongst members, not by amount or hours contributed. Furthermore, as a consequence of the norm requiring large emitters to properly dispose of their waste (Ordinance No. 8,408/1999, modified by 10,340/2015) – and, more importantly, the Municipal Decree that allowed WPAs to issue declarations on the proper disposal of waste – the amount of donations to WP increased, and more materials become more income.

Most WPAs are self-regulated, without direct intervention from the government or REDE, with internal elections held when necessary. The same applies to REDE and Coopmares, although many interviewees related a recent internal strife that resulted in a change of executive members (SEUMA staff member, personal communication, August 30, 2019; Government educational program member C, personal communication, September 3, 2019; Government educational program member T, personal communication, September 4, 2019; WP association A member, personal communication, September 5, 2019; WP association J member, personal communication, September 6, 2019; REDE staff member, personal communication, September 6, 2019). Some

reported external influences, but the decisions were ultimately the WPs'. Externally, the associations make it possible for WPs to have easier access to services or even the government, but REDE provides a stronger voice, especially when it comes to fighting for collective rights such as the retirement pension issue. The REDE representative mentioned that informal exchanges with the municipal government is somewhat frequent, but also expressed the desire for "participative management" (REDE staff member, personal communication, September 6, 2019).

4.2 C1: Designing out Waste

CE advocates often prescribe that to eliminate waste, a joint effort between businesses and government is necessary, preferably involving the public too (Bocken et al., 2014: 44; Ghisellini et al., 2016: 16; Halog & Anieke, 2021; Lehmann et al., 2014: preamble). Other sources, partly leaning on the literature and practice of extended producer responsibility (EPR), tend to attribute such responsibilities almost exclusively to businesses, since, ultimately, it is the business sector that decides how a product or service is made and, more importantly, how they are designed (Ghisellini et al., 2016: 16). Businesses, thus, have much larger if not exclusive decision-making power, such as reducing (or eliminating) packaging, compensating or replacing negative outputs in the production process with positive ones, etc (EMF, 2013a: 16). This is especially true of big businesses, which Chaturvedi et al. claim much of the CE literature has pointed as responsible for "solving the problem" (Chaturvedi et al., 2019: 26).

One problem Brazil faces is its 8.5 million km^2 (IBGE, 2022) and its regional differences, especially the economical, given the social-economic disparities amongst populations of different areas (WB, 2024). Most of the country's industrial production is concentrated in one center: the southeastern region, mainly the state of São Paulo (IPEA, 2022). The case of glass manufacturing

in Brazil illustrates this barrier well, since most of the companies are located in São Paulo (Abividro staff member, personal communication, August 30, 2019), but their products are sold all over the country, which makes recovering these heavy and dangerous materials all the more difficult. Often only small quantities are collected locally, increasing the challenge since transporting from so many different cities in a continental-size country to a central manufacturing center is only cost-effective if there are medium or large quantities. The fact that most of the domestic transportation is executed by trucks (Araújo et al., 2013: 151) crowns the difficulty of returning materials back to manufacturing cycles due to the expenses.

The business sector is not the only one with a role in CE; the general public – or, in a reductionist view, the consumers – should also play a part. The latter might be similar to civil disobedience: it is up to the consumers to inform businesses of the former's desire for less waste, including eliminating needless packaging, less or no pollution, and zero exploitation of human lives or labor. At least, according to Hobson and Lynch (2016: 18), that is the role many policies assume consumers will play. However, it is also a fact that consumers are trapped by what is available (Hobson, 2020: 3). In this sense, there is no study showing whether Fortaleza consumers have the awareness or even the leisure of worrying about such issues, although there might be changes in the future due to the municipal legislators approving the Waste Fee Act (Municipal Ordinance No. 11.323/22) in 2022, which allows the municipality to charge a fee for waste collection. Before 2023, public waste collection of domestic waste was not directly charged, and was instead funded via the taxes imposed on property over real estate.

One of the differences between developed and underdeveloped areas is the level of cleanliness. Realistically, there are many cities in HICs that do not live up to such expectations, and there are also cities in LMCs that do meet high standards of hygiene (e.g., Curitiba (Prefeitura

Municipal de Curitiba, 2023)). Fortaleza is not amongst the latter group, but the last municipal government terms seem to pile improvements regarding litter. There is less waste on the streets, even though there are still quite a few small illegal dumping spots. There are likely competing factors for this, such as some government policies, e.g.: Ecopoints, and the increase of actions from the private sectors – formal and informal – which pick up much of the discarded materials. It is difficult to determine whether awareness amongst the general population rose, although there is more talk about the issue and even TV campaigns.

There were few C1 initiatives from the government sphere pertinent to the case of Fortaleza, as of 2019, except for the pressure the MP puts on the interviewed levels of government, namely state and municipal. Some of the interviewees complained that the MP only pressures, but offers no suggestions (SEUMA staff member, personal communication, August 30, 2019). The recently enacted Ordinance No. 11,324/22 allowing the city government of Fortaleza to charge a waste services fee might help improve C1 since the economic incentive may force customers to consider the amount of waste they produce and thus actively attempt to reduce it. However, the fee may also have the opposite effect by instilling a "license to pollute" mentality due to payment (EEA, 2023), e.g., PAYT schemes. Regardless, there is not yet much result as that Ordinance is quite new.

As mentioned before, Ceará already had a State Plan on SWM (CESPS), initially State Law No. 13,103/2001, which was then adapted to NaPS under the guise of State Law No. 16,032/2016. Its article 31 prescribes actions more closely related to C1, namely placing manufacturers, importers, distributors and sellers responsible for (item I) developing, investing and circling products that (item I, b) result in less waste. Its item II also assigns these stakeholders the duty of making accessible the information on how to deal with the post-consumption stage of their products. While this law had no effect on the case study detectable by the interviews, there is

no doubt that, if properly executed or implemented, then this legislation will have direct impact on products manufactured in the State of Ceará and Fortaleza, as well as on their respective economic settings.

The newly enacted laws (Post-COVID) showed some promise on the matter as well. Particularly of note is Fortaleza Ordinance No. 11,220/2021 (Fortaleza Cidade Limpa), whose first article already includes an item (III) that encourages the use of technologies to avoid, reduce, reuse and recycle SW. Perhaps more importantly, the norm prescribes that these technologies are meant to create changes of habit towards the actions listed above (art. 1, item III).

The presence of C1 regarding ECOFOR is questionable, depending on the considered level of involvement. That will be the case for most interviews in this study, since none of the interviewees are manufacturers and thus have little say in how to design products with reduced/no waste. ECOFOR's contribution primarily consists of removing waste from the streets, and while waste collection does reduce waste from the urban environment, the main objective of C1 is a planned elimination of the amount of post-consumption waste. Since the key word is "design," as a MSWM company, ECOFOR's role only takes place after consumption, and can thus be considered an end-of-pipe (EOP) measure.

Article 13 of the Environmental Education Law (Federal Law 9,795/1999) includes informal environmental education, which the government should spur by involving, amongst others, both the business sectors and schools. Whether voluntarily or pressed by the municipal government, ECOFOR began promoting environmental education programs in 2015, especially in some public schools and at the Ecopoints, and this is a possible contribution to waste reduction. Although the influence on the reduction of waste is again limited and perhaps impossible to quantify, it is possible that the children and citizens who benefit from these programs might cause

a partial avoidance of the production of waste by instead directing such materials toward a new cycle. In such a case, ECOFOR would have further impact under C1, especially considering the current disparity of collected waste/resources volumes: 371,679 tons collected door-to-door via ECOFOR, 399,810.24 tons removed from irregular and therefore illegal dump spots, and only 64,199.54 tons correctly discarded resources were collected from the Ecopoints (Prefeitura de Fortaleza, 2023). Clearly, there is still much work to be done in terms of both eliminating waste and circulating materials, and environmental education is likely a well-needed weapon in this battle.

From the viewpoint of C1, the role of WPs is similar to that of ECOFOR: their influence in the design stage (pre-production/consumption) is limited. As WPs essentially pick up what is left of the post-consumption stage, their role is also an end-of-pipe one. In this sense, WPs only score under item C1 if removing waste from the (urban) environment is considered part of this factor. However, as a network, REDE and Coopmares have a more expansive reach, and occasionally its members are invited as speakers or promote environmental education programs. If these are directed to manufacturing companies as was the case of Reciclando Sueños in Buenos Aires (Gutberlet et al., 2017), then their influence under C1 would increase.

4.3 C2: Circulating Materials Longer

When it is not possible or feasible to eliminate waste or reduce the use of a material, the next best outcome is to extend its life for as long as possible (EMF, 2013a). Circulating a material longer has a threefold positive outcome: a) it decreases the possibility of becoming a source of pollution; b) it helps increase the durability of landfills since there is a decrease of the volumes that go to such sites, both organic and otherwise; and c) it might even decrease the extraction of

raw materials, including energy (EMF, 2015a). While eliminating waste at its source is essentially a business incentive that might or not be stimulated by government policies, circulating materials is an activity any member of society can do. Reusing an item, refurbishing, fixing or even recycling are all ways of extending the life cycle of a product or of a material. In a CE, products should be designed to be easily circulated or fixed, refurbished or recycled, but currently most products (and packaging) do not yet follow such a rule. The state of a post-consumption item and its materials therefore more often than not is a landfill in many countries.

One big issue regarding material circulation is who has the responsibility of post-consumption processes, and who has the responsibility of transporting post-consumption products and packaging. It is often the responsibility of the consumer to bring an item or packaging back into circulation. Depending on a country's legislation, to whom the consumer need bring post-consumption resources may vary: it could be any deposit station, it could be to a collection site run by the manufacturer or a consortium of manufacturers, it could simply be the local waste collection services, or alternative destinations (such as WPAs). Whichever the case, it is an essential part of the CE that the materials be brought back to circulation, usually by some sort of EPR scheme.

In Fortaleza, as happens in most Brazilian cities and even in many developing countries, most of the recovered non-organics are done so by WPs. Since the municipal government implemented the Ecopoints programs, however, the percentage recovered by WPs most likely changed, since there are economic incentives to bring recyclables to the Ecopoints. Programs such as the Ecopoints and the previous ECOELCE - which was run by the local Electrical Energy Company and offered discounts on energy bills based on how many recyclables consumers brought to the collection points - are common positive incentives to stimulate a culture of not throwing away materials that can still be circulated. The Ecopoints offers the same benefits to the volunteers

as ECOELCE did.

While the Ecopoints program is basically a WM program, and it is thus related to CE, the Ecopoints program alone cannot be considered a CE policy, although it can certainly integrate one. The collected recyclables are sold to scrap deposits and/or recycling companies (ECOFOR staff member, personal communication, September 5, 2019), which extends the life cycle of the materials a little longer, but under the CE principles, this is only a temporary measure. Many of these materials, such as the empty PET bottles or other kinds of plastic end up downcycled when they are recycled, but most end up landfilled (SNIS, 2021). Another issue is glass: there are only 6 companies in Brazil that produce (and recycle) glass, 5 of which are located in the lower half of the country (Abividro staff member, personal communication, August 30, 2019), far from Fortaleza. Since the transport of glass is costly and long, glass is another material that tends not to be reinserted into the production cycle – even though it is one of the few materials that does not need be downcycled: broken glass is used to make new glass of the same quality, but consuming far less energy (Abividro, n.d).

Glass is not the only material that does not get recycled within the city or even the state boundaries, and since most of the transportation in Brazil is done by trucks, there is great cost both environmentally and economically. In other words, creating circular businesses or stimulating recycling industries within Ceará could potentially increase the profitability of circular businesses. In this sense, COSAN conducted a study and found that the state already has the business capacity to absorb and process most of the recyclables it produces (COSAN staff member, personal communication, September 5, 2019). Currently the main barrier is that most of these materials are exported to other states, but creating incentives to keep materials circulating within state borders should help local businesses and simultaneously decrease impacts such as CO_2 emissions.

Chapter 3 and this section show that the government has many C2-related initiatives, and it is not a surprise since C2 is the most prominently pursued aspect of CE, especially WM/recycling, as mentioned before. From the PEV schools to the Ecopoints, many of the CE-related initiatives concern C2. These initiatives relate to non-organics, i.e., the technical cycle of the Butterfly Diagram and C2C. The city does not yet have a wider program for the biological cycle (COLIMP, personal communication, December 19, 2023), but there are some efforts that take place in the city's landfill. A pilot project composts organic waste from the Municipal Market and produces fertilizers (Colimp,[23] personal communication, December 19, 2023). Additionally, due to a multilateral partnership among the municipal government of Fortaleza, the Ceará State government, and both public and private businesses, the gas from the city's landfill is converted into "biomethane" via separation of carbon dioxide and methane and removal of contaminants, resulting in renewable natural gas that is then consumed by cars, homes, businesses and industry (Falcão, August 13, 2021).

ECOFOR also relates to C2 by assisting WPs, especially by collecting donations for them due to municipal order, and since the WPs greatly contribute to the circulation of materials, ECOFOR indirectly contributes like this as well. ince it is the company that manages the Ecopoints, ECOFOR also helps recirculation when they sell the received materials to the recycling companies.

In the case of WPs, the strong presence of C2 is undisputable. Their work centers on redirecting materials to a new production chain, and, as mentioned before, roughly 90% of all the materials in Brazil are recovered by WPs (MNCR, 2021). This statistic may be different in

[23] Colimp (*Coordenadoria Especial de Limpeza Urbana*) is the Special Department of Urban Cleaning, which is a subdivision within the municipal government that is specifically responsible for urban cleaning services, e.g., sweeping and waste collection.

Fortaleza due to the establishment of the Ecopoints, but, as far as the researcher knows, no such data is yet available. However, it is possible that whatever the numbers may be, future legislation of Fortaleza inspired by São Paulo's 2020 Municipal Law No. 17,471 may change that statistic. Authorized by NaPS (arts. 31-36), the city of São Paulo and the business sector signed a "sectorial agreement"[24] and expanded the list of categories established by NaPS' art. 33 (see chapter 3) that requires items such as tires and mercury-containing lights to have mandatory RL schemes. As São Paulo is one of the legislative trailblazers in Brazil given its economic significance, it is not uncommon for other cities to follow with similar norms. If Fortaleza also enacts a mandatory RL scheme similar to that of São Paulo, collected volumes of waste and the respective waste streams will surely undergo changes. Regardless of whether such changes benefit consumers, WPs, the government, business or any other stakeholder would have to be considered, but there is not a doubt that, under a C2 perspective, Fortaleza's performance would further improve.

As shown in Chapter 3, Fortaleza already has some recycling laws in place, but no sectorial agreement yet. While legislation is essential, especially in a top-down approach, Fortaleza's RL norms are still quite green and somewhat general, with limited effects. A sectorial agreement is not only the form that NaPS endorses, but also a product of direct debate with the local private sector. This means that sectorial agreements are more detailed and perhaps more likely to be complied with since businesses are part of their discussion.

[24] In Portuguese, "acordo setorial". It holds one of the lowest hierarchical positions in Brazilian legislation, but it is still considered mandatory once established. It is an agreement between a level of government (federal, state or municipal) and one or more business sectors.

4.4 C3: Regenerating Natural Systems

It is deceptively easy to consider governmental environmental initiatives as C3 policies, but most often they are not so. Environmental conservation and recovery actions, while undeniably related to regeneration, do not hold the distinctive characteristic of CE's C3 principle, which is to part from an economic design that plans to regenerate natural systems. Yet it cannot be denied that conservationist or preservationist EOP actions have some impact over regeneration efforts and, therefore, C3, making it difficult to distinguish between them.

The third principle of CE seems to be the most often relegated, as it is the least discussed in the literature that the author of this thesis had access to, similar to what happens to the social pillar of SD. When the environmental pillar of SD is invoked in CE academics, it is usually referring to preserving natural stocks, conserving the environmental services, or pollution prevention as consequential of CE initiatives. The EMF also recently published a study fully dedicated to the third principle (EMF, 2021), perhaps noticing most of its previous publications had a tendency to focus more on the other two principles.

There is little written in CE literature about actively restoring what has already been damaged. In this sense, CE literature generally presents a utilitarian point of view regarding nature and the environment. Regeneration of the natural environment and its systems is not only a CE principle, but also in the very definition presented by the EMF (2014: 14). As Nageler-Petritz defends in an online article regarding sustainability in WM:

> [R]educing the impact on the environment is no longer sufficient on its own. It is now necessary to start regenerating it in order to ensure that land, sea and related ecosystems are once again healthy and resilient, to guarantee quality products and services, and to address the current and future essential needs of biomass and raw materials. (Waste

Management World, 2022)

A regenerative approach is necessary if the goal is sustainability, SD, or even the continued existence of humanity (and other species), regardless of what prism the issue is examined under – be it preservationist, conservationist, utilitarian, etc. It is well known that when C1 and C2 are fully effective, the burden on the environment decreases and allows for recovery. Yet actively pursuing the regeneration of natural systems is a step further that the current environmental crisis urgently requires.

As with the previous CE principles, the same question regarding responsibility applies to C3. In this case, is it the responsibility of everyone, of the government, of businesses that pollute/cause damages, or is the Polluter Pays Principle enough to satisfy the all the requirements of who effectively needs to be held responsible for the restoration of natural systems? In the case of Brazil, the right to a clean environment is guaranteed under the Brazilian Constitution for every citizen (CF, 1988, art. 225), and the same norm also applies a legally co-shared responsibility to preserve it. In 1988 when the CF was promulgated, restoration efforts of "ecological processes" befell the public sphere. EnCA (1998) later placed the responsibility of recovering polluted/damaged environments upon the polluter, usually the industries that caused or contributed to the pollution/deforestation, etc. In 2010, NaPS then ascribed to citizens, government and businesses a co-shared responsibility over material cycles. These gradual changes might eventually culminate in a co-shared responsibility to restore natural systems well.

Brazil has complex legislation on the preservation of its natural systems and stocks, although recently much weakened, but there is not much on restoration. In the case of environmental crimes, most often the penalties do not include an obligation to restore any damage, although most include the possibility of being fined. Enacting and enforcing legislation that

requires businesses to offset environmental degradations or designing preventive measures against pollution and degradation would be one way the government could be more proactive regarding C3. Although EnCA predicts penalties for polluters, it is more remedial and EOP instead of pre-production planned.

The city of Fortaleza houses an extensive shoreline, many water bodies, marshes, and one of the largest urban natural reserves in the country, the Cocó Park. In other words, there are many sensitive environments that require extra protection and permanent care, and also some restoration efforts. As happens in many cities – developed or not – many of the water bodies are polluted and filled with discarded trash. As a remedial measure, the government occasionally conducts clean-ups, and sometimes there are volunteers cleaning up a beach. However, as far as this author knows, there is little motivation outside of the public sphere to regularly maintain or clean common or public environments, and even less for restoration purposes. Nevertheless, the municipality created some incentives for improving (urban) environmental conditions, such as a 5% discount on property tax for those who donate their recyclables to WPs (Fortaleza, LC 159/2013, art. 293), and a policy for promoting sustainable or greener businesses and constructions (Fortaleza Ordinance #10,183/2014, which creates the 'Friend of the Environment Business' seal), amongst others. While these initiatives have greater effect on the urban environment than the natural systems, there are benefits to the latter as well, even if they are a consequence of measures that are more EOP than proper C3.

In the case of ECOFOR, a similar argument on responsibility for C1 follows regarding C3. From the viewpoint of C1, ECOFOR is not responsible for product manufacture design, only for removal and collection of waste from public spaces. It is likewise not in charge of restoring natural environments. When such a service is necessary, it is usually executed by SEUMA, likely by hiring

private businesses. Although ECOFOR occasionally contributes a truck for beach cleanups, that is not a direct contribution to restoration, but merely for maintenance. Thus, ECOFOR only has influence regarding C3 if environmental maintenance is considered part of the third CE principle. When the currently used landfill managed by ECOFOR reaches full capacity, the company will likely be required to restore the area.

Like C1, C3 is not directly present in the case of the WPAs. Although they actively remove waste from the (urban) environment to sell the recyclables for income, and although these actions result in better environmental quality, such activities often do not result in the recovery of natural environments, but in the maintenance of the urban environment.

4.5 Fortaleza's Transition to a CE [Conclusion]

Most of the waste in Fortaleza is collected by ECOFOR, a subsidiary of a sanitation conglomerate. Similar to Recology in the US city of San Francisco (UN-Habitat, 2010: 78), ECOFOR also monopolizes solid waste collection and urban cleaning services, but there is no direct fee required from the consumers. The subsidiary collects household waste door-to-door, but it does not specifically collect source-separated materials – Fortaleza offers this service via its Ecopoints program, which are also managed by ECOFOR, who sells the recyclables to interested industries. The Ecopoints consist of over 60 small drop-off spots for recyclables throughout the city (Fortaleza Municipal Government, 2023), with many more planned for the upcoming years.

Fortaleza is a developing city in the northeast of Brazil, a region traditionally classified as poor, although there is a strong middle social class in the capital of Ceará (Moura Jr. & Portela, 2022). This northeast state increasingly pursues SD initiatives such as a diverse renewable energy matrix (solar, wind and hydrogen) and environmentally-sound MSWM solutions such as the multi-

city MSWM consortiums. Fortaleza also increasingly pursues SD initiatives, and the concept of CE is gradually growing in this capital as well. Although most of Brazil's legislation and policies are planned from an SD point of view – including Fortaleza's – there is much that relates to CE.

This chapter presented the results of the interviews with CE-related stakeholders in Fortaleza, mainly government, businesses and WPAs. It then used the CE lens of the CE-EJ framework to shed some light on where some related policies and initiatives are succeeding, and where they are lacking from a purely CE point of view.

Table 4-1 below shows the highlights of the findings based on the interviews and policy documents. Table 4-1. Highlights of Fortaleza's CE Transition Using the CE Principles

	CRITERIA	CASE STUDY RESULTS
Circular Economy Principles	DESIGN OUT WASTE (C1)	MP is pressuring for RL schemes; Both the government and REDE promote environmental education programs.
	KEEP PRODUCTS AND MATERIALS IN USE (C2)	Ecopoints program seems to circulate more materials; PEV schools encourage kids to bring recyclables to school, and turn the students into multipliers of good sorting behavior; Although not in Fortaleza, the intermunicipal WM consortiums model promoted by Ceará is improving WM in Ceará municipalities that previously had no sorted collection; Fortaleza Municipal Law No. 11.324/22 establishes a Waste Services Fee which theoretically encourages citizens to become more aware of the importance of collection services and thus correctly use them; Compostation pilot project in the city's landfill to close the biological cycle.
	REGENERATE NATURAL	The municipality has many environmental initiatives, but no proper C3 policy with regenerative effects. These initiatives include: Afforestation programs; *Remove accumulated waste thrown on common urban environments

SYSTEMS (C3)[25]	such as streets and parks; clean up beaches; clean up water bodies.

Source: Field work conducted in 2019.

The list featured in Table 4-1 is non-exhaustive, but, at the same time, it also includes initiatives that are questionably there, especially in C3. This is because C1 and C2 are more closely related to WM policies, which is traditionally considered the core of CE. However, C3 is comparably less about WM and more about the environment. The initiatives directly related to the environment were not strictly considered part of CE policies, but as they share a connection with C3, these initiatives were included under C3 in this study, albeit with some reservation.

As shown in Table 4-1, the first part of the study revealed that Fortaleza is fairly active under the CE principles, although there is also room for improvement. The limited number of businesses interviewees might explain why C1 [Eliminate waste] performs inadequately in this analysis of the case of Fortaleza. However, the MP seems quite active in the pursuit of C1, and some environmental education initiatives – both by the municipal government and by the WPAs have the potential to improve this.

C2 [Circulate materials longer] is currently the most frequently pursued CE principle, and in the case of Fortaleza as well. All three categories of interviewees presented initiatives under C2, most notably the Ecopoints polices and PEV schools (municipal government); MSWM consortiums (State government); receiving and selling recyclable materials (ECOFOR); and collecting, sorting, sometimes processing, and selling materials (WPs). The State government emphasized the complexity of the MSWM consortiums and their potential stimulus towards a CE.

[25] The initiatives marked with (*) are actually considered EOP or remedial, and not quite C3. They are mostly maintenance, which, while not regenerative themselves, may indirectly contribute to regeneration. As they have a connection to C3, as explained in section 4.4, they were thus included in Tables 4-1 and 6-1.

Additionally, the role of WPs in LMCs is not negligible, especially in Brazil where they are comparatively well-organized and contribute to anywhere between 30-90% of all recycled materials. Due to the Ecopoints policy in Fortaleza, the role of WPs in C2 has likely diminished in recent years.

Table 4-1 presented different results regarding C3 [Restore natural systems] comparing to C2 and C1. The 1988 Brazilian CF is originally clear regarding the responsibility for restoring "ecological processes," which it attributes to the government, but subsequent legislations such as ECA and NaPS might be clouding such responsibility. The main criticism here is that C3 should stem from a pre-planned systemic measure that includes both economic and environmental concerns at the very least, if not equity as well. However, the observed actions in the case of Fortaleza consisted of EOP environmental measures. The municipal government presented different clean-up initiatives that aim to fix current issues, but do not prevent future repetitions; ECOFOR merely contributed to maintenance (not restoration) of urban and natural environments; and although the WPs might arguably contribute the most to the quality of the urban environment, they are understandably more interested in their own needs than that of the natural environment.

Given the above, C3 may have the most potential to grow, not just in the case of Fortaleza, but possibly in general as well. While the initial definition of C3 targeted, for example, promoting circular food systems (EMF, 2015b), including soil regeneration (EMF, 2015a: 13), and agroforestry (EMF, 2015b: 73), an updated C3 may have the most to contribute to SD by adding aspects such as inclusion of indigenous knowledge (and the rights of indigenous people) and unification of humans and nature under the same paradigm of existence, a sustainable one. It should be noted, however, that the limited number of business interviewees may explain why C3 had such a reduced role In this case study.

This chapter looked at the potential case of CE in Fortaleza using the CE principles (C1-C3) as the lens. As observed in Chapter 2, current HIC-based CE – including its three principles – do not include an explicit social concern. The analysis using the CE principles in Fortaleza confirmed that the main criticisms of CE in the Global South are also present there. Regardless of which principle is examined, be it eliminating waste (C1), circulating materials longer (C2) or recovering natural systems (C3), the main social problems are untouched, as becomes clearer in the next chapter. Chapter 5 presents the next stage of the analysis, focusing on the EJ lens as the social axis for CE, and then discussing the overall results.

5. The Case of Fortaleza through the EJ Lens

No development is durable (sustainable) if unjust social conditions persevere, as Middleton and O'Keefe mention (2001: 16). This is also true of institutional justice for businesses, since "[a]rguably it is the absence of such conditions, a chaotic situation 125aximizing uncertainty, which exacerbates conflict and makes it harder for corporations to do their job effectively," according to Low and Gleeson (1998: 18). In other words, a lack of justice at the foundation of CE policies might just be the root cause for its potential failure.

This chapter focuses on the second part of the CE-EJ analysis, the environmental justice lens, using Schlosberg's three EJ elements to provide the second type of diagnosis. Chapter 5 presents both a summary of the author's observations and as well as revamps relevant information from the interviews conducted in Fortaleza (see section 4.1) regarding the three elements of EJ.

5.1 J1: Recognition

The issues of recognition in the case of Fortaleza that were analyzed here are mostly related to WPs, their associations and also the Ecopoints. Young (1990) argues that domination and oppression cause many social disparities and injustices. At the same time, in any economy of today's complex world – circular or not – there are logically many groups of actors. Some of these groups have more active roles, and sometimes there might be groups who are undervalued. Although Brazilian Federal Law no. 12,305/10, also known as the (Brazilian) NaPS, requires that WPs be included in MSWM systems, this is less mandatory and more a recommendation. Waste-picking is often the sole alternative for the survival of impoverished families (IPEA, 2013: 5), especially in LMCs. These usually informal workers are common in many LMCs (e.g., Liu et al., 2023; Wilson et al., 2012), including in big cities. Though the work they conduct is essential to a

CE and to a clean environment, WPs are often overlooked, and subject to violent and unhealthy living environments, in addition to social injustices (Zolnikov, 2018; Liu et al., 2023).

NaPS, enacted in 2010, recognizes WPs as a marginalized group in need of legal protection. Since then, much progress has been made, such as closing over 200 illegal dumpsites (IPECE, 2019; Brazil, 2015), including Estrutural, the world's second largest open dumpsite (Cruvinel et al., 2019). Despite this, WPs remain social outcasts. This shows that there is much to be done towards the recognition of this group as "the 'invisible heroes' of informal waste management" (Gall et al., 2020).

Formal participation of WPs in waste collection services was responsible for 30.7% of all recovered recyclables in 2018 (Brazil, 2019). Yet, these neglected heroes are often not rewarded for this removal, possibly due to a lack of recognition of their contribution in both cleaning the environment and diverting recyclables from landfills by circulating the materials. Considering this, it should be noted that, as of January 2021, the state of Ceará approved a financial aid of 25% of the minimum wage to WPs in registered associations (O POVO, 2020). This economic benefit exclusive to WPs during the 2020 COVID pandemic became a permanent source of income soon after (Ceará State Law No. 17,377/20), in recognition of the significant role WPs have.

Following NaPS, the state of Ceará has since then promoted many benefits to WPs, including the one above. The incorporation of WPs in official MSWM systems is only a reality in a few selected cases, but not a widespread practice, including in the capital, Fortaleza. Thus, notwithstanding the aforementioned Ceará State Law no. 17,377/20, a general lack of recognition of their work, as predicted by Young, could potentially be at the root of the exclusion of WPs of Fortaleza from the economic system – and, by default, from the MSWM system as well. Figure 5-1 shows that most associations are based in wards of low HDIs, a possible indication of the

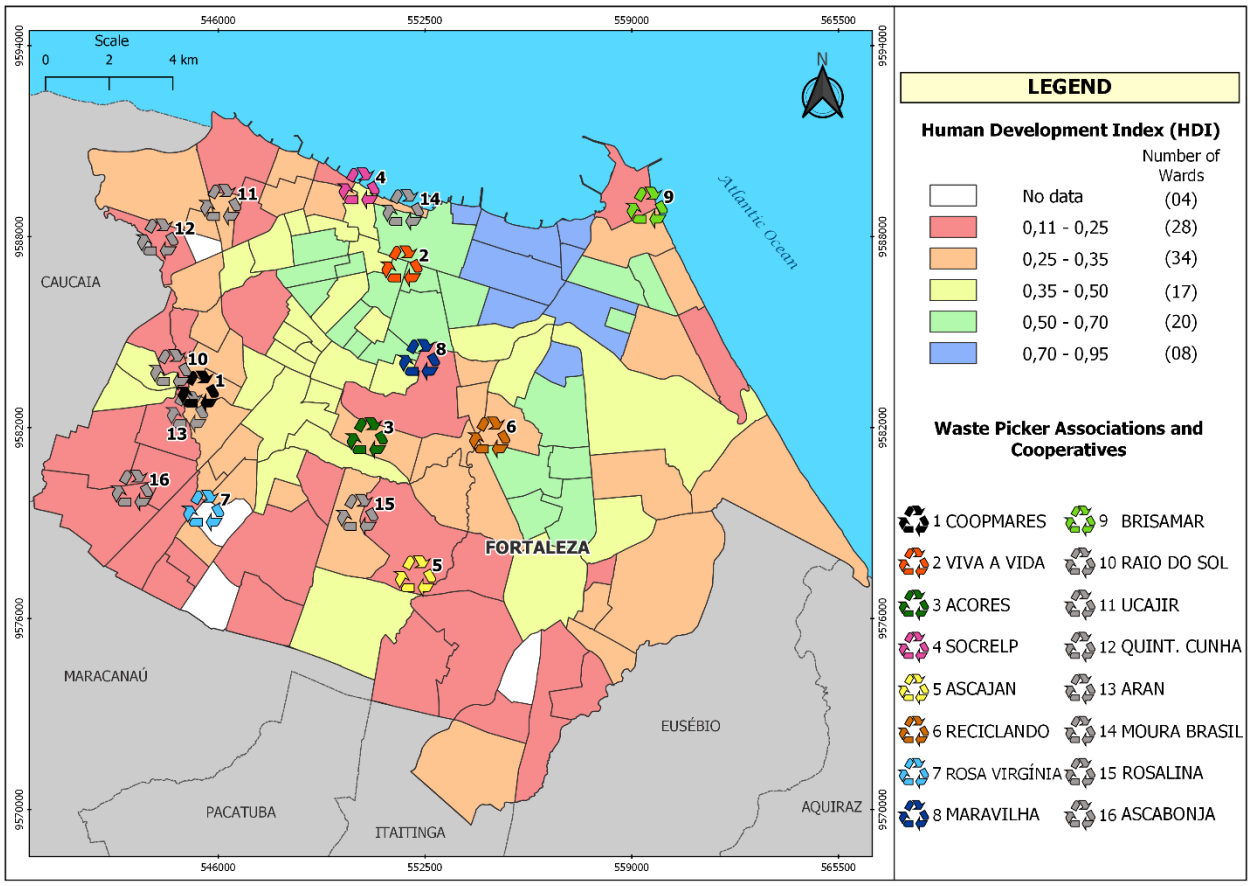
precarious conditions most WPs live in (Zolnikov et al., 2018; Gutberlet & Carenzo, 2020), and likely in line with their non-recognized status.

Ordinance No. 8,408/1999 makes it mandatory for certain businesses to correctly dispose of their "wastes," which these businesses need to declare and thus require proof of having adequately disposed (Fortaleza, Ordinance No. 8,408/99, art. 7). This same legal instrument made it possible for WPAs to offer documents proving the correct disposal to businesses that donated their wastes. According to some of the interviewed associations (e.g., WP association U member, personal communication, September 5, 2019), such a measure increased the amount of material donations. This ordinance was one of the ways the city tried to improve the situation of WPs within its boundaries.

NaPS requires local governments to formalize WPs whenever possible, and, according to the government officials, many opportunities were offered, e.g., hiring for big events such as the 2014 FIFA World Cup (SEUMA staff member, personal communication, August 30, 2019). Some WP associates also agree that their general situation improved since 2010, although not as much as they had hoped (REDE staff member, personal communication, September 6, 2019). Any improvements in the conditions of WPAs are likely due to measures that provide benefits to donators, such as property tax abatement under Municipal Supplementary Ordinance No. 196/2013 (art. 293) and the equivalent status of adequate final destination under Ordinance No. 8,404/99. Since then, according to the WP interviewees, more businesses donate their recyclables. However, many of these collectives are not registered, and some have spent considerable time attempting to complete the process in order to be able to apply for participation at events, positions and other benefits only – or, at least, preferentially – available to those with a legal status (e.g., Fortaleza Municipal Ordinance No. 10,975/2019). Registration or lack thereof is an issue which has much

influence over opportunities for these groups.

Figure 5-1. Fortaleza HDI by Wards and the Registered WPAs as of 2019.



Source: Fortaleza (2010); SEUMA (2016); IPECE (2019); IPLANFOR (2020).

The Catholic Church partnered with financial institutions and promoted workshops starting in 2007 to help WPs organize themselves into associations and, therefore, improve their working and economic conditions. At least half of the interviewed leaders of the registered associations attended these workshops and proudly mentioned these events, considering them an upgrade to their skills (WP association S member, personal communication, September 3, 2019; Government educational program member C, personal communication, September 3, 2019; Government educational program member T, personal communication, September 4, 2019; WP association U member, personal communication, September 5, 2019; WP association J member, personal

communication, September 6, 2019; REDE staff member, personal communication, September 6, 2019). As a result, several associations were legalized and attendees had a better grasp of business concepts. The local Catholic Church occasionally ceded space and/or recyclables to some of the associations (WP association V member, personal communication, September 4, 2019; WP association U member, personal communication, September 5, 2019).

NaPS was clear regarding its objectives, such as integrating WPs into policies that promote the circularity of materials (NaPS, art. 6-7), and that WPAs and cooperatives should have preference when hiring for services related to circularity, amongst other rights. In the case of the Ecopoints in Fortaleza, there was disagreement regarding the Ecopoints policy: including the REDE representative (REDE staff member, personal communication, September 6, 2019) as well as an ex-executive member or REDE and Coopmares (Government educational program member C, personal communication, September 3, 2019), all the WP interviewees mentioned that they were never asked to manage the Ecopoints. Government educational program member C (personal communication, September 3, 2019) mentioned that the WPs sought out the municipal government to manage the Ecopoints, but were denied it since the recyclables would be bought at lower prices and the municipality could not subsidize the price. Additionally, the municipal government considered the WPs "incapable of proper management" (Government educational program member C, personal communication, September 3, 2019; Government educational program member T, personal communication, September 4, 2019; WP association A member, personal communication, September 5, 2019). According to interviewee SEUMA staff member (personal communication, August 30, 2019), the city constantly attempts to hire the WPAs for big events that Fortaleza promotes. Since NaPS was not clear regarding how these services should be offered, hiring WPs is ultimately optional. The absence of WPs at the Ecopoints might also be a reflection

that there is room for improvement. In this sense, the role of REDE, which represents all the associations, is important to achieve better negotiation and status for the WPs, potentially increasing their recognition, although REDE still lacks the power to do so in the ideal scale.

WPs may also suffer from having even their work ignored, as happened at the Seminar on Reverse Logistics (2019) held by the State Prosecutors Office during the time of the interviews. The author of this thesis noted very few WPs were present, which was later confirmed by one of the interviewees who did go (REDE staff member, personal communication, September 6, 2019). The REDE interviewee was a presenter at the event, and alleged completely altering their speech after the previous speakers presented results that overlooked the contributions of WPs. This could have been a simple oversight, or perhaps just one more example of overlooking WPs as a group, which would fall back to the argument that J1 generates social injustice.

It is worth noting that recent programs such as Fortaleza Plus are gradually including the WPs in formal MSWM activities, though not in the Ecopoints policies (with a couple of exceptions). This long-awaited inclusion is a consequence of the recognition of the role these actors play in circularity and public health. The e-catador and Re-ciclo programs already existed before Fortaleza Plus, but were expanded by the latter (Fortaleza Ordinances No. 10,975/2019, art. 4 and No. 11,324/2022, art. 8). Re-ciclo provides clean vehicles similar to electric tuk-tuks to registered WPAs (Fortaleza Municipal Decree No. 17, 626/2023, art. 4-5)[26] or unassociated WPs endorsed by the registered associations (Fortaleza Municipal Decree No. 17, 626/2023, art. 6, para 1, item II), and promotion pictures suggest they also receive protective gear such as helmets and anti-UV shirts (Re-ciclo, n.d.). Using the provided motorized bicycles with trunks and with direct

[26] According to the Program's website, the registered WPAs are Moura Brasil, Raio de Sol and Acores (Re-ciclo, n.d.).

requests from citizens via the city's digital platform, it is likely that WP(A)s can increase the volume/weight they collect with less effort and exposure to the sun.

Some WPs argued that there are considerable preconceptions against them, even when properly organized into associations (WP association V member, personal communication, September 4, 2019), which is in line with most of the literature (e.g., Wilson et al., 2006; WIEGO, n.d.). Some WP interviewees mentioned never having experienced any prejudice (WP association M member, personal communication, September 4, 2019). However, all interviewed WPs mentioned feeling proud of their work, though they presented different reasons, such as dignity, funding their children's schooling, and contributing to improving the environment.

Aside from the issues presented above, which mostly related to the WPs, ECOFOR has no issues of recognition, as it is legally permitted to execute the MSWM and has done so without problems.

Lastly, the other J1 topic detected in the study: that of citizen involvement. As mentioned in Chapter 2, much of the CE literature is silent regarding the roles of stakeholders such as citizens and consumers. SEUMA staff member (personal communication, August 30, 2019) mentioned that the Ecopoints policies empower citizens to control the destination of their own waste. This demonstrates that the municipal government recognizes the importance of involving citizens into CE policies, following the directions of NaPS when it attributes co-shared responsibilities regarding material cycles. Recent innovations to the Ecopoints policies such as increasing the number of drop-off locations and the expansion of the e-catador program attempt to increase citizen participation.

5.2 J2: Distribution

Distributive justice is one of the most common and well-known types of justice. Its classic form is directly attributed to Rawls' veil of ignorance (Schlosberg, 2007: 12-13), whereby if those who elaborate the rules of a society were to not know beforehand what their social position is, they would almost certainly desire a more equal society in which all members help each other share equal burdens and privileges (Rawls, 1999). For EJ, distribution relates to the division of positive attributes, such as opportunities of growth and profit accrual, and negative attributes, such as bad living allocations and lower quality of services or environmental conditions (Fraser & Honneth, 2003: 17). Valencia et al. (2023: 2) go slightly further and rename distribution as "redistribution," emphasizing the restorative and regenerative powers of the CE in repairing the faults of the linear economy.

China's 2017 Waste Ban is a direct demonstration of unfairness in international distributional justice. Qu et al. (2019) explain the many factors of global distribution of waste by factoring in shipping rates, labor costs, and stringent environmental regulations, among other determinants related to the Ban. According to the authors, there is potential for both developed and developing countries to thrive from waste, but cheaper labor seems to offer the poorer group the advantage. Regardless, it is a sign that global circular transactions require change (Qu et al., 2019) to promote fairer trades (Blum et al., 2020). Indeed, it was the unjust export of harmful waste to LMCs that led to the Basel Convention (Schröder, Anantharaman et al., 2019: 11-12) and the Chinese waste ban, demonstrating that while supply chains and material cycles today go beyond national borders, so do externalities and those who suffer from them. CE cannot be an active perpetuator of such actions if the goal is SD. Agyeman "highlights the pivotal role that justice and equity could and should play" for a just SD (2005: 6), and, therefore, CE.

Prices of recyclables and internal revenue distribution

A just distribution stems directly from recognition, according to Young (1990) and Honneth (Fraser & Honneth, 2003: 113-114); so it is a logical inference that the unfair distributions observed in Fortaleza are likely a direct consequence of the social exclusion of this marginalized group. In the case of WPs, the immediate effect of such unfairness would be the lower prices for their recyclables and low economic bargaining power, leading to distributional shortcomings. WPAs also collect, compress and sell to the company or agent who will pay them the most or the quickliest, but the WPAs are usually at a disadvantage since recycling companies have requirements that the WP's capacity to collect, store and process either cannot fulfill (WP association U member, personal communication, September 5, 2019; REDE staff member, personal communication, September 6, 2019), or require longer periods to meet than formal businesses do, despite donations from companies and the government. In this scenario, the local network REDE has the potential to improve prices, as it collectively gathers higher quantities, providing slightly higher bargaining power and also enabling greater visibility to the work of WPs.

The exploitation of WPs by scrap dealers and the simultaneous dependence of WPs on these middlemen is one of the biggest challenges of WPs everywhere (IPEA, 2013: 19). WPs traditionally sell their materials to small intermediate buyers because the latter are often physically closer to the WPs, and likewise because payment is immediate (WP association U member, personal communication, September 5, 2019; REDE staff member, personal communication, September 6, 2019). These intermediate buyers, however, pay a lot less than actual market prices, since WPs often do not have ample space for storage to accumulate larger quantities that would invite higher prices, nor the possibility of waiting to get the income since they live payment-to-

payment almost on a daily basis (WP association U member, personal communication, September 5, 2019). Although such profits may be acceptable from a pure capitalist point of view, there is reason to question this behavior morally (socially), at the very least because "ensuring that the transition to a CE include these actors is essential to guarantee dignity and justice for those that have been affected by the linear economy" (Valencia et al., 2023: 1). This exploitation is partly possible due to the already-mentioned lack of recognition of WPs, or J1 affecting J2, which presupposes taking advantage of a comparatively weaker social group that has little chance to improve their reality.

The prices attributed to recyclables at the Ecopoints are subsidized by the city government, not by recycling or scrap businesses (SEUMA staff member, personal communication, August 30, 2019). Perhaps involving the latter in this system could offer an increased price, while also eliminating one, two or more middlemen that intermediate the path of a recyclable from WPs to the transformative industry. Currently, the recyclables brought to the Ecopoints are picked up by the same company that monopolizes the waste collection, and then sold to the buyer offering the highest price (ECOFOR staff member, personal communication, September 5, 2019). Ultimately, this yet again cuts WPs off from their source of income, and further exacerbates social economic disparities, upsetting distributional justice. This demonstrates the need to carefully and preventively plan distributional policies so that they do not produce results contrary to their very objectives, especially when the latter are meant to reduce inequalities or injustices.

The recompense the associations receive for the sold recyclables is usually split amongst the members who did work that month. Some associations keep track of who, when and how long their members worked throughout the month, so that the income is divided fairly according to these records (e.g., WP association S member, personal communication, September 3, 2019; WP

association J member, personal communication, September 6, 2019), and not *per capita* (WP association M member, personal communication, September 4, 2019). Since REDE receives recyclables from other associations to gather higher quantities and therefore expect higher prices, REDE controls every sale, and then the accounting team distributes the sales accordingly (REDE staff member, personal communication, September 6, 2019), although it takes about a month until the WPs receive the income. Nevertheless, since REDE and Coopmares can skip a few intermediate buyers and sell directly to recycling companies or, more often, the "last" intermediate buyer before the industries themselves (Government educational program member C, personal communication, September 3, 2019; WP association U member, personal communication, September 5, 2019; REDE staff member, personal communication, September 6, 2019), the prices are higher. This is likely a direct consequence of the improvement of J1 and consequently J2 in the case of networked associations and cooperatives such as REDE and Coopmares.

Transportation/Logistics

One of the main difficulties of WPAs is the logistics of collecting the recyclables (REDE staff member, personal communication, September 6, 2019). As mentioned in section 4.3, that difficulty also exists for implementing RL, be it by government or a private entity, or even by citizens. Perhaps that is the main difficulty of CE itself: the transportation of the materials back into their respective cycles (C2), which has a distributional effect in the case of WPs as well, requiring an additional measure to balance the unfair competition (J2).

Some of the locally-based companies regularly offer donations and support to the associations – for example, most of the representatives of the associations cited donations and additional support from Coca-Cola or other big companies (e.g., WP association S member,

personal communication, September 3, 2019; WP association V member, personal communication, September 4, 2019; WP association M member, personal communication, September 4, 2019; WP association U member, personal communication, September 5, 2019; WP association J member, personal communication, September 6, 2019). The WP interviewees also mentioned the difficulty of collecting these donations, given that most of these businesses donated the materials, but would not take the recyclables to the associations (e.g., WP association J member, personal communication, September 6, 2019).

Access to clean and re-circulative materials and how to take them back to their manufacturers is a quintessential issue of CE that requires careful measure. One game-changer in the case of Fortaleza is Ordinance No. 10,340/15 which modified Ordinance No. 8,408/99 to comply with NaPS. The modifications established mandatory declaration of waste management for businesses, i.e., businesses can no longer depend solely on the municipality to collect their wastes free of charge, forcing them to either reduce the volume, or search for alternatives (Fortaleza, Ordinance No. 10,340/2015, arts. 3rd and 7th). The expansion of the previously-existing e-catador program via the newer Fortaleza Plus program (Fortaleza, Ordinance No. 11,324/2022), although still a timid initiative, is an example of a (re)distributive action that recognizes the role of WP(A)s and attempts to include them in official MSWMSs.

NaPS set WPs as providers of services of proper waste destination, and this inclusion as a formal receiver likely increased the associations' access to recyclables. Since the WPs do not charge to receive the materials as many WM companies do, many businesses prefer to use the services of WPAs (WP association U member, personal communication, September 5, 2019). The number of businesses turning to the WPAs to take care of their unwanted materials increased according to many WP interviewees (e.g., WP association M member, personal communication,

September 4, 2019; WP association U member, personal communication, September 5, 2019), since the law allowed legally organized and registered associations to emit declarations accepting such materials.

Stakeholder initiatives and relationships

Table 4-1 showed that the municipality created some initiatives that allowed distribution of responsibilities and resources. One example is the PEV schools, which educate both the students and parents on environmental issues, especially the importance of proper WM. The PEV schools also reroute recyclables to local WPs, increasing the latter's access to clean materials and, consequently, their income. Their key objective is to be the bridge between the community and the environment (SEUMA staff member, personal communication, August 30, 2019).

SEUMA staff member (personal communication, August 30, 2019) further mentioned how the city of Fortaleza makes an effort to stimulate the inclusion of WPs, such as advising residential condominiums to get to know their local WPs and donate their recyclables to them (SEUMA staff member, personal communication, August 30, 2019). The Fortaleza city government also frequently hires WPAs for waste collection during big events, such as Fortal, an annual concert organized by the municipality, which reached its 30th anniversary in 2023 (July). Fortal is also the biggest musical event in Northeast Brazil (Fortal, n.d.), with hundreds of thousands of spectators every year (G1 CE, 2022b). With so many visitors – including from other states – and so many vendors, there is bound to be a lot of recyclables to collect, and, thus, it is an excellent opportunity for WPs.

The State Government of Ceará created the IQM to stimulate its municipalities to improve

their environmental conditions. A city receives up to 2% of the ICMS State tax [27] whenever it meets the requirements, and the process repeats annually. The city of Fortaleza often complies, and in 2022, according to SEMA (SEMA, 2023), the capital earned BRL 377,884.44 for it. One of the requirements is the elaboration of the Municipal or *In Consortia* Plan for Sorted Waste Management (SEMA, 2023), as mentioned by SEUMA staff member (personal communication, August 30, 2019), COSAN staff member (personal communication, September 6, 2019) and CODES staff member (personal communication, September 9, 2019). The latter interviewee also explained that the IQM's current (2019) objective is to reproduce and implement the consortiums methodology. Considering that these consortiums directly require the work of WPAs, the redistributed IQM income likely affects the involved WPs as well. As explained by the government-academia program members, the WPs in the consortiums they were training seemed to be developing better than those in Fortaleza (Government educational program member C, personal communication, September 3, 2019; Government educational program member T, personal communication, September 4, 2019; WP association A member, personal communication, September 5, 2019).

Regarding ECOFOR, as mentioned, the company is currently responsible for the Ecopoints, so it is free to resell the received recyclables. Before managing the Ecopoints, however, most of the domestic waste it collected was landfilled, and ECOFOR did little sorting and reselling, since the waste was then weighed, dumped and buried (Technical visit at ASMOC, personal communication, June 2010). Managing the Ecopoints likely increased the income of the MSWM company, while also probably reducing the quantities of recyclables brought to WPAs. None of

[27] See footnote in Section 3.2.

the WP interviewees were able to precisely demonstrate this information, with some not feeling harmed by the municipal government (WP association U member, personal communication, September 5, 2019), and others mentioning that there is less material going to the associations now (WP association A member, personal communication, September 5, 2019).

ECOFOR monopolizes waste collection in Fortaleza. A similarly monopolist yet renowned case is San Francisco (USA), about which it has been argued that a monopoly over the collection and treatment services was a definite positive factor (CNBC, 2018). However, in the case of ECOFOR, while the additional recyclables are accruing the company's monthly profits, they are also helping to propagate income disparity. The representative of the company, however, cited that they often support the WPs too: twice a week, ECOFOR offers a small truck to pick up donations from other companies and bring those to the associations (ECOFOR staff member, personal communication, September 5, 2019). The company also prioritizes hiring WPs, but alleges they often quit (ECOFOR staff member, personal communication, September 5, 2019).

The creation of the Ecopoints initially proposed a win-win scenario: the registered WPs would be hired as formal workers – a measure recommended by authors such as Medina (2020), Aparcana (2017) and Gutberlet et al. (2017). Once hired, they would then be trained and posted along the many drop-off points, thus having easier access to recyclables and less harsh labor. The interviewee from the municipal government confirmed an unprecedented 1.5-million-dollar funding from the World Bank in 2019 for its environmental projects, including the Ecopoints (SEUMA staff member, personal communication, August 30, 2019). Citizens can volunteer their recyclables at any of these spaces, where the material is separated, weighed and credited based on the market prices displayed at the station. As of yet, there is no cash-back option, but once the benefit is calculated, the contributors may choose between a discount on their electricity bills, or

credit with the municipal public transportation system (Vieira et al., n.d.), or virtual money, the latter being a recent possibility due to a partnership with a local community bank (SEUMA staff member, personal communication, August 30, 2019). The WPs, however, are not operating at the Ecopoints, with the few exceptions mentioned in Section 5.1.

The Ecopoints are currently the city's main waste-related initiative (SEUMA staff member, personal communication, August 30, 2019) aside from the door-to-door municipal waste collection, a service also monopolized by ECOFOR. There were more than 60 functioning Ecopoints at the time of the interviews (SEUMA staff member, personal communication, August 30, 2019; ECOFOR staff member, personal communication, September 5, 2019), but there were over 80 either built or underway (Prefeitura de Fortaleza, 2020). Nevertheless, there is potential for the Ecopoints to offer more social benefits if the associations were involved.

5.3 J3: Participation

Participation is the element of EJ that mostly examines who are the decision-makers and who are not (Schlosberg, 2004). It is related to distributive justice and Rawl's veil of ignorance: if decision-makers were made unaware of who would shoulder burdens and it could be themselves, the negative and positive attributes of a society would most likely be equally spread between its members (Rawls, 1999: 118-119). This means that J3 is can also find the roots of its issues in J1. However, decision-makers are commonly not part of the social groups who deal with the worst consequences of urban planning, such as lack of sewage, or the presence of incinerators or waste dumps. Although there are pinpoint initiatives to the contrary, WPs often do not participate in decision-making even when regarding waste-related issues, despite the important role they play in this field.

The inclusion of WPs in decision-making is also scarce, and the same happens in many countries (Wilson et al., 2006). In a study about the progress of CE in Europe, Ivanova mentions that a successful transition requires all stakeholders to get involved and to cooperate with each other (Ivanova & Chipeva, 2019). In Brazil, the list of interested actors should without a doubt include the WPs, given not only their already considerable contribution towards CE, but also their large numbers and relatively advanced level of coordination.

All interviewed WPAs mentioned that they were neither invited to participate in the Ecopoints initiative, nor were they called upon to give their opinions on the matter. According to the municipality, the Ecopoints were originally designed to be managed by registered WPAs (SEUMA staff member, personal communication, August 30, 2019). However, the associations allegedly showed no interest in this formal work, and were also deemed incapable of properly managing the Ecopoints stations (SEUMA staff member, personal communication, August 30, 2019). The municipal government argues that they called for WPs to register for the Ecopoints, yet not one did, possibly due to the prices for the collected recyclables being lower than the market price. From that shortcoming, some miscommunication between these two stakeholders is evident, and to realize a socially just CE in Fortaleza, bridging this gap becomes essential. Regardless, it is clear that the WPs had no participation in planning the Ecopoints policy, even though they are significant stakeholders.

Aparcana (2017) mentions in her review on case studies of WPs worldwide that the most frequent barriers are the political and institutional ones, reflected by the conflicts between public authorities and the WPs such as this case. Despite there being many opportunities and channels for WPs to communicate with the officials of the city government, there seem to be very few chances for the WPs to participate in elaborating the decisions on waste, with a few interviewees citing that

one their difficulties is access to the government, as “there are many intermediaries” (WP association A member, personal communication, September 5, 2019), or much bureaucracy. One example of the lack of communication between government and WPs is the ongoing Ecopoints debate.

On the other hand, University faculty member (personal communication, September 20, 2019) – a former government staff – pointed out that any WM-related decision involved ECOFOR. If true, this could point to potentially biased participation in decision-making in the city of Fortaleza. ECOFOR staff member (personal communication, September 5, 2019) did mention the company was involved in elaborating the Municipal WM Plan, while none of the WPs mentioned being invited or involved with it.

The kind of participation the WPs are involved in is their internal elections. Most of the associations seemed to have decided their leaders by directly voting on them. One exception at the time of the interviews was REDE and Coopmares, which had suffered changes in leadership that were not quite democratic, with the previous leaders being kicked out due to alleged corruption (Government educational program member C, personal communication, September 3, 2019). There were multiple accounts of this incident, and municipal environmental bureau staff mentioned that the relationship between the WPs and the municipal government seems to have “cooled down” since then, especially because the previous leaders were more “engaged,” proactively seeking communication with the municipal government (SEUMA staff member, personal communication, August 30, 2019). This does not seem to be true regarding the new leaderships of REDE and Coopmares. Finally, ECOFOR holds monthly meetings with the WPs to talk about the “services” the company does for the WPs (ECOFOR staff member, personal communication, September 5, 2019), which mostly consists of the ceded truck, but none of the

WPs mentioned such meetings.

Officials of the city government cited other conflicts, such as the lack of willingness of the WPs to accept a clock-in and clock-out time. When asked, however, most of the interviewed WP representatives disagreed with such claim (e.g., WP association S member, personal communication, September 3, 2019; WP association M member, personal communication, September 4, 2019; WP association J member, personal communication, September 6, 2019). This disagreement was not the only one detected during the interviews.

Another unresolved issue is the role of the municipality regarding the associations. Most representatives alleged strained relations with the city government (e.g., Government educational program member T, personal communication, September 4, 2019; WP association A member, personal communication, September 5, 2019), some were indifferent (WP association U member, personal communication, September 5, 2019), and other representatives stated getting little help from the municipal administration (e.g., WP association M member, personal communication, September 4, 2019). Nevertheless, at least three of the associations were located in public property (SEUMA staff member, personal communication, August 30, 2019; WP association M member, personal communication, September 4, 2019; WP association J member, personal communication, September 6, 2019) ceded by the government, including Coopmares, and many are benefitted with a small truck for collecting recyclables and/or space to work – the municipality allegedly pays for the fuel (SEUMA staff member, personal communication, August 30, 2019).

The representative of the city government further pointed out other initiatives, such as one that directly benefits unassociated WPs who live close to public PEV schools (SEUMA staff member, personal communication, August 30, 2019). The city is also stimulating closed residential communities to engage with their local associations or unassociated WPs, thus rerouting domestic

recyclables to these informal workers (SEUMA staff member, personal communication, August 30, 2019). Considering the economic benefits of the Ecopoints for the volunteers, however, it is possible the latter PEV campaign for engagement is failing.

Lastly, two issues are worth mentioning, the first being the WP-directed program Re-ciclo. Providing low carbon footprint mobility to WP(A)s required a lot of dialogue between the WPs and the project managers, according to the Transformative Urban Mobility Initiative (TUMI Initiative), which provided technical assistance (TUMI, n.d.). "We listened. We had to learn that we were the outsiders and that our ideas cannot be imposed, but rather discussed and improved collectively with active participation and with input from the waste collector and the associations," (TUMI, n.d.). From this quotation, it is clear that it was a two-way conversation, and that this communication – or, in other words, inclusive participation – was key to the completion of the project that TUMI believes is both successful and replicable (TUMI, n.d.).

The second issue is the case of the Ceará WM consortiums which present a new kind of participation worth mentioning. The consortium model consists of different cities jointly managing WM systems and facilities (Ceará, 2019: 16-19). Achieving this partnership amongst the cities was not an easy feat, according to the COSAN interviewee (personal communication, September 6, 2019): WM issues (and perhaps environmental issues in general) were widely disregarded, since they often require high costs, wield little political return, and there is not much follow-up by the federal government. The latter fact made it easy for non-compliance to go unpunished.

Much changed after the enactment of NaPS, and the state government of Ceará became invested because, on one hand, it wanted to avoid the financial penalties, and, on the other hand, the state government wanted to seize the opportunity to finally tackle the issue of WM using the financial incentives of the federal government (COSAN staff member, personal communication,

September 6, 2019). Consortium-related decisions are jointly made by the cities involved – without input from the state government except for technical advice when necessary (COSAN staff member, personal communication, September 6, 2019). According to COSAN, one of the positive results was that the necessary cooperation amongst cities governed by different parties forced them to mature in terms of dialogue, so that they can work together regardless of political backgrounds (personal communication, September 6, 2019). Additionally, Inter-American Development Bank (IDB), who loaned the funding for some of these projects, is keeping an eye on the consortiums model of the state of Ceará, according to COSAN (personal communication, September 6, 2019). If successful, the IDB intends to use it as a standard case study for MSWM projects (COSAN staff member, personal communication, September 6, 2019).

5.4 The Relevance of an EJ Analysis [Conclusion]

As seen in chapter 4, from a purely classic CE point of view, the case of Fortaleza is promising, since the municipality is steadily dedicated to increasing the circularity of materials via recycling, pursuing RL, while also pursuing SD with actions such as improving public transportation and "greening up" the city by encouraging the planting of trees and cleaning up public spaces. Likewise, the state of Ceará, of which Fortaleza is the capital, also pursues SD, notably via clean energies initiatives (wind, solar and hydrogen) and WM facilities via consortiums. Although neither Fortaleza nor Ceará can truthfully declare they have reached a CE, there is continuous progress in that direction.

Contrastingly, the city of Fortaleza did not perform as well when analyzing the same initiatives with an EJ lens. Table 5-1 represents a summary of the most important issues under the EJ lens that surfaced during the field work and data collection.

Table 5-1. Highlights of Fortaleza's CE Transition Using Schlosberg's EJ Elements.

	CRITERIA	CASE STUDY RESULTS
Schlosberg's EJ	RECOGNITION (J1)	Stakeholders: government, citizens/consumers, WPs, businesses (manufacturing & services including WM & SMEs), yet WPs are often overlooked, ignored, or excluded; Ceará State Law 17.677/2020: payment of ecological services to WPAs recognizes the value or the work of WP(A)s; {Ceará consortiums focused on WPs}.
	DISTRIBUTION (J2)	Collection of recyclables greatly executed by WPs, but not fairly recompensed; Ecopoints decreased the recyclables to WPAs, demonstrating a need for a social balance in the Ecopoints policy; ECOFOR collects domestic waste & manages Ecopoints [triple gain] Ceará State Decree No. 29.306/08 & 35.051/22: Good IQM performance by meeting the State SWM requirements triggers financial benefits to be used for environmental or SWM.
	PARTICIPATION (J3)	Public hearings; WPs did not make decisions regarding the planning of the Ecopoints policies; Re-ciclo: constructive dialogue with WPAs.

Source: Fieldwork conducted in 2019.

Policies related to the case of Fortaleza that have demonstrated some level of success in the transition towards CE from a CE perspective do not necessarily hold the same level of success under an EJ perspective. Positive aspects of these policies include the recognition or the work of WPs under State law, namely the active inclusion of WPs in the integrated SWMSs via the consortiums (J1). The creation of policies instigating end-users to return their products and/or the packaging to appropriate sites, be they the drop-off points for RL schemes or the Ecopoints for recyclables is another positive aspect derived from both Federal (NaPS) and State (CESPS) norms, and so is the good performance of Fortaleza towards the IQM, meaning the indicators or requisites of the CESPS are gradually being complied with (J2). The expansion of the Re-ciclo program likely stems from a restarting constructive dialogue with WP(A)s, which would indicate that the participation of at least some WP(A)s is being favored (J3).

From a social/environmental justice perspective, there is still much room for improvement.

Some of the negative points detected in the EJ analysis include, for example, the triple-income ECOFOR receives by not only collecting the city's domestic waste, but also managing the Ecopoints is the main controversy detected in this study (J2). Since ECOFOR manages the Ecopoints, by default it means the WPs do not, which demonstrates an unbalance amongst active players in the case study, perhaps resulting from an as-of-yet low level of recognition (J1). Additionally, although some public hearings on topics such as recycling and WM do exist, the public is often unaware, i.e., they are not active participants in the related decision-making process regarding these issues (J3).

In the case of Fortaleza, even though it is not an industrial city, it is still possible for WPs to play an important role due to the presence of manufacturing companies and recyclers that exist in the municipal outskirts and in nearby cities. There are also other industries within the limits of the State of Ceará, which would still be closer than the southeastern São Paulo, Rio de Janeiro and Minas Gerais, where most of the businesses tend to be located. Avoiding such distant transport and instead supporting local businesses and entrepreneurs with a CE mindset would improve local economy. With an EJ layer to such policies, they could improve social equity as well.

Overall, the main problem detected via the EJ analysis in the case of Fortaleza is the lack of proper inclusive policies, especially regarding WP(A)s, although chapter 3 revealed progress in this aspect. EJ analyses will often find the marginalized groups, and in this case, it is the WPs. While that is not a specific finding of EJ, given that other studies with different viewpoints already highlighted the importance of WPs to CE, the contribution of the EJ analysis using Schlosberg's understanding of the concept lies within the three elements of his definition. Starting from the assumption that recognition is the root of social unfairness – or social injustice – EJ pointed out that most of the problems found from a social perspective could indeed be traced back to

recognitional issues. By promoting CE policies that can reduce or prevent social injustices, including by avoiding or eliminating unintentional negative effects of other policies aimed at promoting social fairness, such social problems may be preemptively managed in a CE. In the case of Fortaleza, this would mean improving conditions so that fair competition may exist, instead of exclusion (of WPs).

Only a few Ecopoints are under the management of WPs, although future developments of the Fortaleza Plus program could increase this number. There already are dozens of Ecopoints spread citywide, with many more on the way. If at least a more significant quota of these were managed by the associations and appointed as the city's official drop-off points, it would certainly increase the amount of clean materials collected by the associated WPs and, therefore, their income.

Placing each registered association in charge of 1 or more Ecopoints, depending on their management capabilities, would likely reduce the unfairness caused by the Ecopoints. If the WPAs are lacking in management capabilities, as was initially commented by the SEUMA interviewee (personal communication, August 30, 2019), providing technicians that could train the members would be a possible solution, similar to what happens at the consortiums. More distributional inclusivity (J2) in this sense could potentially make it possible for the associations involved to accept more WPs, decreasing the number of unassociated WPs and, thus, possibly both reducing their littering of the city – which could contribute to a better perception of their work and improve recognition (J1) – as well as contributing to poverty alleviation (SDG1). All in all, the Ecopoints hold the potential to promote both circularity and real social equity in Fortaleza, but only if another front is added to its strategy, one which would consider more than just economy and environment, but also equity. EJ could certainly fill this gap.

In Brazil, WPs are estimated at 400,000-600,000 by IPEA (2012), a number which, if

correctly organized and supported could collect in a wider area without much cost to the municipalities. Diverted costs could instead be directed at financing WP-friendly market regulations on the prices of commodities. Although CE does not necessarily prescribe that more WPs are the key to a transition, related policies do need to consider this considerable population and their contributions to the environment and to a CE. Thus, WPs can be looked at as a strength in the transition process, not a weakness.

The analysis in this research refers to Fortaleza and Brazil, yet there is no doubt that some of the issues raised here may also apply to other locations and circumstances, especially LMCs. Policies that do not include significant stakeholders in their elaboration, or CE initiatives that perpetuate a linear capitalist perspective and that, worse, might instead widen the pre-existing social disparities, for example, are high risks of a none-inclusive CE. The case of unassociated WPs is elucidating, as they occupy an even more fragile social position than their associated counterparts, working more hours to collect a sufficient amount of material, compared to those who join a registered and active association who gain by scale. Unassociated WPs are also subject to more prejudice, which further complicates their access to the materials they need for survival. Additionally, unassociated WPs are also more susceptible to exploitation by middlemen and companies than their associated counterparts, and this is true of other cities (Sasaki et al., 2014; Ezeah et al., 2013; Wilson et al., 2009).

The role of WPs in increasing circularity is vital and indisputable, perhaps more so in LMCs, where the activity is often not just economic, but for subsistence. Enacting strong social measures to guarantee schooling, opportunities, health and dignity to such populations, in order to raise them from poverty and promote their social inclusion is recommended. Such procedures, however, often occur over long periods of time, yet their necessities are immediate. Fundamentally,

improving the social standing of WPs by recognizing their contributions to both the environment and the economy might prove most effective.

Despite the challenge, the numbers of WPs in many developing countries reach thousands, which can be interpreted as a clear advantage for such countries. Regions like Pune (Gokaldas, n.d.) and Mumbai (Tangri, 2012), both big Indian cities, have already seen improvements in the lives of these groups, but, predominantly, WPs are socially excluded, despite being responsible for much of the waste flow in India and, indeed in LMCs in general (Chaturvedi et al., 2019: 27). WPs may be essential during the process of implementation of a just CE in LMCs, and their large numbers as collectors of reusable materials might be the missing link to finally close the loop. This might be especially true for Brazil, a country where WPs are highly organized and included in the main legislation enacted thus far, however subpar the enforcement. Finding ways to balance their numbers favorably without compromising social wellbeing is one of the challenges LMCs will face in transitioning to a just CE. Including the marginalized stakeholders in decision-making is a related challenge that will need to be tackled as well.

As long as CE continues to ignore social considerations, current CE cannot be anything but a perversion of the much fought-for principle of SD. Economic sustainability without the equivalent social improvements does not last (Schröder, Anantharaman et al., 2019: 15), and, for LMCs, social aspects are especially crucial, given their already low HDIs. The local characteristics of different regions and those shared by most LMCs require different adaptation and flexibility strategies for CE. However, many of these countries have a significant number of WPs. The current CE might worsen their conditions by eliminating or drastically reducing their source of income – discarded recyclables. The chasm between these stakeholders and the rest of society is detrimental to a just CE, and will only bring forth weak sustainability. Avoiding such destination is but one of

the advantages of embedding EJ within the concept of CE.

6. Conclusion & Final Remarks

The analysis under the proposed CE-EJ tool has shown that without a social tool such as EJ, CE may repeat the faults of a linear model that perpetuates disparities and inequalities, not innovating in its three principles. CE literature is unanimous in pointing out that the current (linear) economic model is no longer an option. Despite CE's direct and simple three principles according to the EMF – eliminate waste and pollution, circulate products and materials whilst maintaining their highest quality, and regenerate nature – CE is actually complex, as illustrated by the Butterfly Diagram. Though a transition to CE requires new directions and risk-taking to provoke the necessary changes, it is even risker to continue to follow the existing, simpler, traditional linear economic model. The complexity of the current economy is such that even a close cooperation amongst the partners would not be sufficient to avoid the risk of continuity in the linear model. Without a social dimension, such as EJ, it is possible, perhaps even likely, that CE may not achieve SD in LMCs.

The study applied the proposed CE-EJ framework to look at the transition to CE of the city of Fortaleza, capital of the state of Ceará in Northeastern Brazil. Empirical data was obtained via interviews, with the interviewees initially chosen after the study on normative background (Chapter 3) based on their roles in CE policies and, later, snowballing. The research used a two-step analysis, looking at the information first from a CE perspective, and then with an EJ perspective. The different results of the two perspectives demonstrated the usefulness of adding an EJ lens to understand the social problems in CE policies, at least for LMCs.

Chapter 1 is introductory, and it explained the main gap in CE literature, as well as the research questions and the methodology. The case study was also explained in detail in this chapter, including a brief description of how the interviews were conducted and who were the interviewees.

Discretion was prioritized and names were not disclosed, only the names of the legal persons involved.

In Chapter 2, this research pointed out the social gap in CE literature that is especially relevant to the Global South, and this thesis proposes to fill it by adding an EJ perspective layer to the concept of CE. The study follows Schlosberg's EJ tripartite theory, which identifies three components to analyze conflicts (recognition, distribution, and participation/procedural), and then employs them where CE has difficulties in its daily practices in the Global South.

Chapter 3 is a preparatory chapter for the case study, and it focuses on the legislation of Fortaleza, the city examined in this study. Although the geographical limit is that of a municipality, the legislation that affects the area includes international, national, regional and local legislation. Only the latter three were considered here, and even then the norms presented were limited by the author's understanding of the three EMF CE principles (see Table 2-1). NaPS is considered the main CE norm in Brazil, but it is ultimately a norm that focuses mostly on the second principle (material circulation). As this seems to be the case in many CE studies, the following chapters focused mainly on WM policies and issues, while also trying to incorporate CE-related policies as much as possible. Although the author conducted the interviews in 2019, legislation from beyond this period was mentioned since many recycling laws were enacted after the COVID-19 pandemic.

Chapters 4 and 5 respectively answered sub-questions 1 and 2. They are summarized below in greater detail, with the answers to the sub-questions in the last paragraph of each section. The main research question is answered in section 6.3, and section 6.4 presents the final remarks of this thesis, namely its contributions, limitations and potential future research.

6.1 From a Traditional CE Perspective, How Are Cities in LMCs Transitioning to a CE?

In Chapter 4, sub-question 1 leads the study: "from a traditional CE perspective, how are cities in LMCs transitioning to a CE?" In the case of Fortaleza, the analysis under the CE lens showed that much has improved in terms of extending the life cycle of diverse materials via initiatives such as the Ecopoints and the PEV schools. Under the CE lens, there was a positive outcome under the C2 (circulate) principle, since the quantity of materials diverted from landfill to proper recycling companies increased. This translates as progress in terms of C2 while also showing that the city of Fortaleza mostly focuses on the CE principle of circulating materials (C2). It was also noted that, due to the Ecopoints policy in Fortaleza, the role of WPs in C2 (circulate) has likely diminished in recent years.

There are some initiatives under the other two principles as well. However, the analyzed CE policies performed inadequately as far as C1 (eliminate) is concerned, since there are few initiatives planning waste reduction or elimination during the pre-consumption stage. The same conclusion resulted from C3 (restore), since, although the municipality had many recovery initiatives, most were not pre-planned, and instead functioned as EOP measures. It may be indicative that creating policies or product/service designs that intentionally eliminate or reduce waste in the pre-consumption stage (C1) while also providing a regenerative effect on the environment (C3) might be the biggest challenge for cities in LMCs. As this probably cannot be done by a single government agency, it will thus require cooperation amongst the ones that are responsible for the different topics.

The case study here answers Q1, the first sub-question, as Fortaleza represents a typical case of a relatively big LMC city pursuing SD. It showed that via the CE lens, LMCs are likely transitioning to CE mostly via a C2 pathway, while C1 and C3 remain in the background. In other

words, there may be much room for improvement in the transition to CE by adapting the systems thinking perspective that CE requires in order to plan the elimination of negative externalities, as well as the regeneration of natural systems.

6.2 From an EJ Perspective, what Challenges Do Cities in LMCs Face in the Transition to a CE?

Chapter 5 answered sub-question 2, "from an EJ perspective, what challenges do cities in LMCs face in the transition to a CE?" Using the CE-EJ framework, namely Schlosberg's three elements, the analysis showed that, as far as EJ is concerned, the first of its elements was essential for the understanding of CE failures, strongly indicative that Schlosberg's theory regarding recognition (J1) often being the cause of (environmental) injustices is correct. For instance, the usually informal workers (WP), who are common in many LMCs, especially in big cities, were rarely recognized as main players in Fortaleza, despite their important roles.

As some authors argued, a just distribution (J2) stems directly from recognition (J1); unfair divisions or, in this case, lower prices, may be due to a weak social inclusion. WPs often have no option but to sell to middlemen who pay below-market prices for the materials, and then resell them at a much higher price than what the WPs were paid. This exploitation is partly possible due to the previously mentioned lack of recognition for WPs.

The distribution of resources amongst government agencies as well as among the different members of society were also detected during the J2 analysis. It showed that, on the one hand, some policies such as an IPTU (real estate tax) discount and Fortaleza Plus are in place to stimulate donations to the WPs. On the other hand, their access to the recyclables that become their source of income is blocked or decreased by a reduced capability of transportation and logistics. At the same time that WP(A)s have difficulty in gathering donated recyclables that are not brought to

them by the donators, most consumers likely prefer to take their discarded materials to the Ecopoints, despite other legal incentives. While the motivation for such a choice regarding the destination of recyclables by consumers is economical and cannot be begrudged them, the policies that provoke these decisions were likely not considered under a systems thinking view or holistic perspective, thus producing these clashing results. Furthermore, having ECOFOR further accrue profits by managing the Ecopoints and reselling the collected materials further exacerbates the unjust distribution detected in the case study.

Finally, participation (J3) is the element of EJ that relates to decision-making. In the case of Fortaleza, especially regarding the WPs, J3 showed that the important players, such as the WPs, were often excluded from important decisions. The municipal government claimed to have initially planned the Ecopoints policies for the WPs – which would align with the objectives of NaPS. The WPs, however, stated that they were never consulted or asked to manage the Ecopoints; in fact, some mentioned that they were refused the management of the Ecopoints on the grounds that the WPs lacked the capacity to do so. Given that J3-based injustices also stem from J1, there is likely a causal relationship between both elements.

Perhaps the main problem identified is the imbalance between the roles played and the benefits and burdens received. The presence of a marginalized group is automatically a social issue to be solved, but in the case of Fortaleza, and likely of other medium and big cities in LMCs as well, this group, the WPs, play an important role in the transition to a CE, yet they are inhabiting some of the neighborhoods with lowest HDIs in the city. WPAs offer their affiliated members a relatively safer work environment, especially when the association completes the bureaucratic process of formalization, but they cannot yet provide a fairer distribution of social benefits such as fairer income and adequate welfare.

Overall, the analysis here indicates that the exclusion of relevant players in CE policies and initiatives should not be overlooked, but should instead be considered more justly. This might be especially relevant for LMCs, where non-inclusive CE policies might further exacerbate social inequalities, compromising a sustainably circular future. This might be the case, for example, of policies promoting CE-related jobs such as car-sharing or repair, but that do not include aspects such as safe environments of fair wages.

A better, fairer transition to CE would require acknowledging all stakeholders and their respective roles, fairly distributing burdens – including environmental burdens when these are unavoidable and benefits – as well as ensuring that all stakeholders have access to decision-making powers and information. Considering Fortaleza as a typical case, then, in the case of WPs, there is a need to improve their social identity by improving recognition (J1), especially by highlighting their importance to the (circular) economy and the environment. Once this is achieved, it is probable that other aspects which depend on recognition will follow, mainly: better access to recyclables, health and social welfare (J2), as well as participation in decision-making conversations and access to information (J3).

Drawing from the case study, the answer to Q2, the second sub-question, can be derived. While looking at all three elements of EJ, different issues were found, and need to be overcome to achieve a fair or socially just CE. If overlooked, CE might become the root cause of increasing social inequalities, such as widening the gap between those with less material resources (i.e., the poor) and those who have ready access to the latter, namely the more opulent social classes. Widening the poverty gap, for example, is not CE's objective, and it should not be an unintentional consequence either. This can be avoided if policies take into account preventive measures that aim to avoid such consequences, or even repair one or more pre-existing social issues.

6.3 How Can the Concept of EJ Support LMCS Toward a Better Transition to CE?

Table 6-1 presents a summary of the use of the framework in the appointed case study based on Chapters 4 and 5. Issues highlighted by both the CE lens, such as the promotion of environmental education programs and the Ecopoints policy increasing the recycling rates, as well as those highlighted by the EJ lens are showcased. The latter showed that despite the circularity improving, social aspects are not following and thus need to be addressed.

Table 6-1. CE-EJ Key Issues Found by the CE-EJ Framework under SD Norms for Fortaleza Based on the 2019 Fieldwork.

	CRITERIA	CASE STUDY RESULTS
Circular Economy Principles	DESIGN OUT WASTE (C1)	MP is pressuring for RL schemes; Both the government and REDE promote environmental education programs.
	KEEP PRODUCTS AND MATERIALS IN USE (C2)	Ecopoints program seems to circulate more materials; PEV schools encourage kids to bring recyclables to school, and turn the students into multipliers of good sorting behavior; Although not in Fortaleza, the intermunicipal WM consortiums model promoted by Ceará is improving WM in Ceará municipalities that previously had no sorted collection; Fortaleza Municipal Law No. 11.324/22 establishes a Waste Services Fee which theoretically encourages citizens to become more aware of the importance of collection services and thus correctly use them; Compostation pilot project in the city's landfill to close the biological cycle.
	REGENERATE NATURAL SYSTEMS (C3)	The municipality has many environmental initiatives, but no proper C3 policy with regenerative effects.
Schlosberg' s Environmental Justice Elements	RECOGNITION (J1)	Stakeholders: government, citizens/consumers, WPs, businesses (manufacturing & services including WM & SMEs), yet WPs are often overlooked, ignored, or excluded; Ceará State Law 17.677/2020: payment of ecological services to WPAs recognizes the value or the work of WP(A)s; {Ceará consortiums focused on WPs}.
	DISTRIBUTION (J2)	Collection of recyclables greatly executed by WPs, but not fairly recompensed; Ecopoints decreased the recyclables to WPAs, demonstrating a need for a social balance in the Ecopoints policy; ECOFOR collects domestic waste & manages Ecopoints [triple gain] Ceará State Decree No. 29.306/08 & 35.051/22: Good IQM performance by meeting the State SWM requirements triggers financial benefits to be used for environmental or SWM.
	PARTICIPATION (J3)	Public hearings; WPs did not make decisions regarding the planning of the Ecopoints policies; Re-ciclo: constructive dialogue with WPAs

Source: Fieldwork conducted in 2019.

With the two sub-questions answered, the research may finally provide one to the main research question, "How can the concept of EJ support LMCs toward a better transition to a CE?" What this research provides is a framework that offers an additional lens to CE, expanding its

scope. As seen in the study, although the city of Fortaleza had a partly positive outcome under a CE lens, it did not perform as well when analyzing the same initiatives with an EJ lens. Notwithstanding the success of some of Fortaleza's policies, EJ revealed that they still have room for improvement from a social/environmental justice perspective.

Using the CE-EJ tool proposed in this thesis, EJ can effectively assist CE in the Global South. The proposed framework indicates where injustices may be present (or might occur in the future), especially when it considers all stakeholders involved, and then searches for the root of the problem (recognition, distribution, and/or participation). The study points out the intrinsic changes that CE will need to undergo to be effective in the LMCs. These changes will not be easy or fast, due to the nature of both the economy and of the natural processes in LMCs' societies.

Sustainability, including economic sustainability, does not exist if there are no concurrent social improvements. This is especially true for LMCs, where HDIs are usually low, and, therefore, improving social indicators is also a priority. CE requires a tool to adapt to the circumstances of LMCs, including regional specificities. Since EJ looks at both the environment – not just natural but other categories of environment also – as well as equality, EJ already has an underlayer of SD that automatically provides CE with a level of social consideration this concept had generally lacked. Furthermore, the analytical power of EJ consists of looking at what is happening and, most importantly, why it is happening. Providing a deep understanding of local conditions is vital to a successful CE transition.

Cooperation (in all stages) might be one of the keywords of the CE-EJ framework. Different agencies and institutions are responsible for planning and implementing the diverse fields that would fall under such an extensive scope as the CE-EJ framework requires. Therefore, it is also likely that, to better perform under C1 and C3, a more intense cooperation of different

levels of government (federal, for example) and society sectors (e.g., businesses and NGOs) is necessary throughout different stages of policy-making, but perhaps especially the planning stage. Not only these actors, it will likely become increasingly necessary to stimulate public participation in such decisions, since scholars of EJ and of public policy as well present a growing number of studies on the issue of democratization of decision-making and public participation (e.g., WB, 2016).

Finally, CE likewise cannot ignore the local plight of some disenfranchised groups, such as WPs, who are numerous in LMCs. The current CE might worsen their conditions by eliminating or drastically reducing their source of income (discarded recyclables), so their roles need be considered in fair CE policies. This is one example of how CE can exacerbate social inequality instead of promoting welfare, which is often advocated CE will bring. The chasm between LMCs and HICs can be detrimental to the transition for a CE if the differences are not considered in future policies.

Therefore, the answer to the main research question is that EJ improves CE by looking at the relationships between actors as well as their relationship with the environment, recognizing the roles they play in a CE, and fairly balancing the distributions of burdens and benefits, including decision-making power. By taking the case of WPs as an example, this study looked at a common issue in LMCs related to CE, but certainly not the only one. In the case of WPs, improving J1 (and J3) might lead to positive developments in J2 and C2, thus covering all three pillars of SD and many SDGs, such as the 1st, the 10th, and the 12th, amongst others. Other examples of social issues EJ can be applied to within CE policies is gender equality, discriminations based on race or sexual orientation, safe working conditions, access to public health, etc.

6.4 Contributions and Limitations of This Research, and Future Applications

This study contributed to bridging the social gap and proposed a framework that will at the very least partially fill this gap. Bringing a social element to CE is vital to ensuring CE's durability (i.e.: its sustainability), and thus the significance of this research consists of the improvement of current CE literature and practices by offering the CE-EJ framework as an analytical tool for the implementation of CE within the SD perspective.

The CE-EJ framework provides a powerful policy design that meets CE expectations, but without compromising social balance. Incorporating social elements since its design stage is both necessary for CE policies that do in fact reach for SD, as well as for businesses that do not intend to forsake their sustainability. While other studies have mostly offered metrics, indicators or even case studies to bridge this gap, the CE-EJ framework offers a tool that can be used both for analytical purposes as well as for policy-designing. That is not to say that it rejects other studies, as it may well associate with the metrics proposed by the literature thus far, such as the work of Schröder et al. (2020), who propose using the HDIs to bridge the social gap of CE. Future research may find that combining both tools might be advantageous to the development of a more social CE. However, the biggest contribution EJ offers is its intrinsic ability to draw focus to the relationships between different social groups, and, most importantly, their respective relationships with the environment. It is also capable of offering two approaches: a preventive one that works well with policy planning, as well as an analytical one that offers remedial measures to tackle social and environmental issues.

There were some limitations in the development of this study. The interdisciplinary nature of this topic provides some difficulty in its research as well. While it is recommended to look at the whole system (holistic analysis), interviewing all stakeholders would be a herculean task.

Therefore, choosing the interviewees and then successfully gaining access to them is critical. However, the uncertain number of, for example, middlemen and SMEs involved in CE initiatives are a challenge, as well as the large number of end-users. These groups were mostly excluded from the interviews due to time constraints and difficulty in sampling, although the original research plan included interviewing more recycling companies and manufacturers. As the time available for interviewing was limited, the author of this research opted to limit interviewees to government staff that relate to WM policies and WPAs. Not interviewing upstream players might have influenced the results, especially regarding C1. Future research on a wider scale may potentially look at all the stakeholders of a CE, including the aforementioned groups.

This research employs case study design to investigate the situation of Fortaleza regarding its transition to a CE, and subsequently identify the characteristics of the case. Fortaleza is here considered a typical example of a relatively big (State) capital LMC city in search of sustainability, and thus it can represent other cities in similar conditions, increasing replicability. However, the intrinsic geographical limits might be hindering further results. Using case study design, the researcher may only draw a conclusion based on a single (or a few) examples and attempt to derive a general theory that will naturally be required to undergo further testing in future studies. Considering CE functions on different levels (local, regional, national and international), the perspective presented in the case study of a city might downplay factors that are not present on a smaller scale.

Whether the proposed CE-EJ framework is better suited to higher jurisdictions or larger scales is something future research may investigate. If applicable, a potential expansion of this research to a higher government level may be better suited to unlock the full potential of the CE-EJ framework, as C1 and C3 will likely be more detectable in, for example, the national level,

given their more holistic approaches. Extended research targets may be trans-sectoral and include, for example, economic policies and technical norms, industrial sectors, primary sectors (e.g., agroforestry), etc. Alternatively, future studies may use the CE-EJ framework in other cities to test its actual replicability.

References

Araújo, M. d. P. S., Campos, V. B. G., & Bandeira, R. A. M. (2013). An Overview of Road Cargo Transport in Brazil. *International Journal of Industrial Engineering and Management (IJIEM), 4*(3), 151-160. Retrieved May 7, 2024, from www.iim.ftn.uns.ac.rs/ijiem__journal.php

Associação Brasileira das Indústrias de Vidro [Abividro]. (n.d.). Guia Reciclagem do Vidro: 100% Puro. 100% Reciclável [Guide to glass recycling: 100% purê. 100% recyclable.]. Abividro, São Paulo. Retrieved October 22, 2021, from https://abividro.org.br/wp-content/uploads/2019/01/Abividro-Guia-Reciclagem-do-Vidro.pdf

Agência de Regulação, Fiscalização e Controle dos Serviços Públicos de Saneamento Ambiental de Fortaleza [ACFor]. (2012). PLANO MUNICIPAL DE GESTÃO INTEGRADA DE RESÍDUOS SÓLIDOS DE FORTALEZA ESTADO DO CEARÁ - RELATÓRIO IV. SANETAL – Engenharia & Consultoria [Municipal plan of integrated management of solid waste of Fortaleza State of Ceará – IV Report]. Prefeitura de Fortaleza. https://urbanismoemeioambiente.fortaleza.ce.gov.br/images/urbanismo-e-meio-ambiente/infocidade/plano_municipal_de_gesto_integrada_de_residuos_solidos_de_fortaleza.pdf

Agência de Regulação, Fiscalização e Controle dos Serviços Públicos de Saneamento Ambiental de Fortaleza [ACFor]. (2017, February 9). DÉCIMO-SEXTO ADITIVO AO TERMO DE CONTRATO DE CONCESSÃO, COM EXCLUSIVIDADE, DOS SERVIÇOS PÚBLICOS DE LIMPEZA URBANA, QUE ENTRE SI CELEBRAM O MUNICÍPIO DE FORTALEZA E A ECOFOR AMBIENTAL S/A [SIXTEENTH ADDENDUM OF THE CONCESSION CONTRACT, WITH EXCLUSIVITY, OF URBAN PUBLIC CLEANING SERVICES, BETWEEN THE MUNICIPALITY OF FORTALEZA AND ECOFOR AMBIENTAL S/A].

Agência Nacional de Energia Elétrica. (2023, November 19). Sistema de Informações de Geração da ANEEL – SIGA [Information System of Generation of ANEEL]. https://app.powerbi.com/view?r=eyJrIjoiNjc4OGYyYjQtYWM2ZC00YjllLWJlYmEtYzdkNTQ1MTc1NjM2IiwidCI6IjQwZDZmOWI4LWVjYTctNDZhMi05MmQ0LWVhNGU5YzAxNzBlMSIsImMiOjR9

Agyeman, J., & Evans, B. (2004). 'Just sustainability': the emerging discourse of environmental justice in Britain? *Geographical Journal*, *170*(2), 155-164.

Agyeman, J., Bullard, R., & Evans, B. (2002). Exploring the nexus: Bringing together sustainability, environmental justice and equity. *Space and Polity*, *6*(1), 77–90. https://doi.org/10.1080/13562570220137907

Agyeman, J., Schlosberg, D., Craven, L., & Matthews, C. (2016). Trends and directions in environmental justice: From inequity to everyday life, community, and just sustainabilities. *Annual Review of Environment and Resources, 41*: 321-340.

https://doi.org/10.1146/annurev-environ-110615-090052

Andersen, M. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science, 2*(1), 133-140. https://doi.org/10.1007/s11625-006-0013-6

Antunes, P. (2005). *Direito Ambiental [Environmental Law]*. 7th ed. Revista, Ampliada e Atualizada. Rio de Janeiro: Editora Lumen Juris.

Aparcana, S. (2017). Approaches to formalization of the informal waste sector into municipal solid waste management systems in low- and middle-income countries: Review of barriers and success factors. *Waste Management, 61*, 593–607. https://doi.org/10.1016/j.wasman.2016.12.028

Araújo, M. (2020). Economia circular à moda brasileira: um estudo exploratório a partir da interface entre economia circular e bem viver. In *Actas. IV Congreso Internacional de globalización, ética y derecho. Los desafíos de la globalización: respuestas desde América Latina y la Unión Europea* (pp. 1857-1882). Universidad Complutense de Madrid.

Asim, M., Batool, S. A., & Chaudhry, M. N. (2012). Scavengers and their role in the recycling of waste in Southwestern Lahore. *Resources, Conservation and Recycling, 58*, 152-162. https://doi.org/10.1016/j.resconrec.2011.10.013

Barral, V. (2018). The principle of sustainable development. In L. Krämer, & E., Orlando (Eds.). *Principles of environmental law* (pp. 103-114). Cheltenham: Edward Elgar. https://research.gold.ac.uk/id/eprint/26719

Bauman, Z. (2001). Excess: an obituary. *Parallax, 7*(1), 85-91. https://doi.org/10.1080/13534640010015962

Bauman, Z. (2007). *Consuming life*. Cambridge: Polity Press.

Beyerlin, U., & Marauhn, T. (2011). *International environmental law*. Bloomsbury Publishing.

Bhullar, L., Cullet, P., Lesniewska, F., & Ohdedar, B. (2019). Designing law and policy towards managing plastics in a circular economy. *Journal of Law, Environment and Development (LEAD), 15*(2), 89-93.

Blum, N. U., Haupt, M., & Bening, C. R. (2020). Why "Circular" doesn't always mean "Sustainable". *Resources, Conservation & Recycling, 162*, 105042. https://doi.org/10.1016/j.resconrec.2020.105042

Bocken, N. M. P., Olivetti, E., Cullen, J., Potting, J., & Lifset, R. (2017). Taking the circularity to the next level: a special issue on the circular economy. *Journal of Industrial Ecology, 21*(3), 476-482. https://doi.org/10.1111/jiec.12606

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to

develop sustainable business model archetypes. *Journal of Cleaner Production, 65*, 42-56. https://doi.org/10.1016/j.jclepro.2013.11.039

Brandão, M, Lazarevic, D., & Finnveden, G. (Eds.). (2020). *The handbook of the circular economy*. Cheltenham: Edward Elgar Publishing.

Braungart, M. [Ideia Circular]. (2020, August 4). *Entrevista Michael Braungart Parte 1.* [Video]. YouTube. https://www.youtube.com/watch?v=As4C4WZFVpc

Braungart, M. [Ideia Circular]. (2020, August 4). *Entrevista Michael Braungart Parte 2.* [Video]. YouTube. https://www.youtube.com/watch?v=c2aOq8Yd6DQ

Braungart, M. [Ideia Circular]. (2020, August 4). *Entrevista Michael Braungart Parte 3.* [Video]. YouTube. https://www.youtube.com/watch?v=ATInh-9hFhA&t=4s

Brazilian National Confederation of Industry [CNI]. (2020). *Circular Economy: strategic path for Brazilian industry*. https://static.portaldaindustria.com.br/media/filer_public/3a/a6/3aa67ad0-4e7c-46c8-8b10-0c6d097f35cf/circular_economy_-_interativo.pdf

Brundtland, G. (1987). Report of the World Commission on Environment and Development: Our Common Future. United Nations General Assembly document A/42/427. http://www.un-documents.net/our-common-future.pdf

Bryant, B. (1995). *Environmental justice: Issues, policies, and solutions*. Washington D.C.: Island Press.

Bryman, A. (2012). *Social Research Methods* (4th ed.). New York: Oxford University Press.

Bugaian, L., & Diaconu, C. (2020). Circular economy: concepts and principles. *Journal of Social Sciences*, *III*(2), 5-12. https://doi.org/10.5281/zenodo.3871301

Bullard, R. (Ed.). (2005). *The quest for environmental justice: Human rights and the politics of pollution*. San Francisco: Sierra Club Books.

Camacho-Otero, J., Boks, C., & Pettersen, I. N. (2018). Consumption in the circular economy: A literature review. *Sustainability (Switzerland), 10*(8). https://doi.org/10.3390/su10082758

Câmara dos Deputados. (2014, August 13). *Municípios reivindicam recursos federais para pôr fim aos lixões* [Municipalities request federal resources to end waste dumps]. Brasil. Agência Câmara de Notícias. Retrieved May 8, 2024, from https://www.camara.leg.br/noticias/411374-municipios-reivindicam-recursos-federais-para-por-fim-aos-lixoes

Campbell-Johnston, K., Friant, M., Thapa, K., Lakerveld, D., & Vermeulen, W. (2020). How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective. *Journal of Cleaner Production*, *270*, 122042. https://doi.org/10.1016/j.jclepro.2020.122042

Carroll, P. (2021, September 5). *Does capitalism really promote consumerism?* FEE Stories. https://fee.org/articles/does-capitalism-really-promote-consumerism/

Chaturvedi, A., Gaurav, J., & Gupta, P. (2019). The many circuits of a circular economy. In P. Schröder, M. Anantharaman, K. Anggraeni, & T. Foxon (Eds.). *The circular economy and the Global South: sustainable lifestyles and green industrial development* (1st ed., pp. 25-42). Routledge.

Chen, C.-W. (2021). Clarifying rebound effects of the circular economy in the context of sustainable cities. *Sustainable Cities and Society*, *66*, 102622. https://doi.org/10.1016/j.scs.2020.102622

Consumer News and Business Channel [CNBC]. (2018). How San Francisco became a global leader in waste management. USA. [Video]. YouTube. https://www.youtube.com/watch?v=vDMgMvcCm6w

Corona, B., Shen, L., Reike, D., Carreón, J., & Worrell, E. (2019). Towards sustainable development through the circular economy—A review and critical assessment on current circularity metrics. *Resources, Conservation and Recycling*, *151*, 104498. https://doi.org/10.1016/j.resconrec.2019.104498

Cruvinel, V., Marques, C., Cardoso, V., Novaes, M. R. C. G., Araújo, W., Angulo-Tuesta, A., … da Silva, E. N. (2019). Health conditions and occupational risks in a novel group: waste pickers in the largest open garbage dump in Latin America. *BMC Public Health*, *19*(581), 1–15.

da Silva, C. L. (2018). Proposal of a dynamic model to evaluate public policies for the circular economy: Scenarios applied to the municipality of Curitiba. *Waste Management*, *78*, 456-466. https://doi.org/10.1016/j.wasman.2018.06.007

Dawson, N. M., Grogan, K., Martin, A., Mertz, O., Pasgaard, M., & Rasmussen, L. V. (2017). Environmental justice research shows the importance of social feedbacks in ecosystem service trade-offs. *Ecology and Society*, *22*(3). https://doi.org/10.5751/ES-09481-220312

Demajorovic, J., Augusto, E., & Souza, M. (2016). Reverse logistics of e-waste in developing countries: Challenges and prospects for the Brazilian model. *Ambiente & Sociedade*, *19*, 117-136. https://doi.org/10.1590/1809-4422ASOC141545V1922016

Diário do Nordeste. (2019, November 07). *Fortaleza é escolhida como Cidade Criativa em design pela Unesco*. https://diariodonordeste.verdesmares.com.br/metro/fortaleza-e-escolhida-como-cidade-criativa-em-design-pela-unesco-1.2171970

Diário Oficial da União n.53 (2019). Brasil: https://www.ibge.gov.br/geociencias/organizacao-do-territorio/estrutura-territorial/15761-areas-dos-municipios.html?=&t=o-que-e

Diário Oficial do Município (2003, May 21). Contrato de Concessão. Fortaleza, Ano L, No. 12,586.

de Oliveira, C. T., Luna, M. M. M. M., & Campos, L. M. S. (2019). Understanding the Brazilian expanded polystyrene supply chain and its reverse logistics towards circular economy. Life Cycle Assessment Research Group (CICLOG). *Journal of Cleaner Production, 235*: 562-573. https://doi.org/10.1016/j.jclepro.2019.06.319

de Oliveira, F. R., França, S. L. B., & Rangel, L. A. D. (2018). Challenges and opportunities in a circular economy for a local productive arrangement of furniture in Brazil. *Resources, Conservation and Recycling*, *135*(January 2017), 202–209. https://doi.org/10.1016/j.resconrec.2017.10.031

den Hollander, M. C., Bakker, C. A., & Hultink, E. J. (2017). Product Design in a Circular Economy: Development of a Typology of Key Concepts and Terms. *Journal of Industrial Ecology*, *21*(3), 517-525. https://doi.org/10.1111/jiec.12610

Dinkel, F. (2021, June 04). *Extension of circular economy to achieve a more sustainable society.* Recycling Maganize. https://www.recycling-magazine.com/2021/06/04/extension-of-circular-economy-to-achieve-a-more-sustainable-society/

Dutra, R. M. de S., Yamane, L. H., & Siman, R. R. (2018). Influence of the expansion of the selective collection in the sorting infrastructure of waste pickers' organizations: A case study of 16 Brazilian cities. *Waste Management, 77*: 50-58. https://doi.org/10.1016/j.wasman.2018.05.009

Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Capstone Publishing. https://www.sdg.services/uploads/9/9/2/1/9921626/cannibalswithforks.pdf

Ellen MacArthur Foundation [EMF]. (2013a). *Towards the circular economy Vol. 1: an economic and business rationale for an accelerated transition.* https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an

Ellen MacArthur Foundation [EMF]. (2013b). *Towards the circular economy Vol. 2: opportunities for the consumer goods sector.* https://www.ellenmacarthurfoundation.org/towards-the-circular-economy-vol-2-opportunities-for-the-consumer-goods

Ellen MacArthur Foundation [EMF]. (2014). *Towards the circular economy Vol. 3: Accelerating the scale-up across global supply chains.* https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-3-accelerating-the-scale-up-across-global

Ellen MacArthur Foundation [EMF]. (2015a). *Towards a Circular Economy: Business Rationale for an Accelerated Transition*. https://ellenmacarthurfoundation.org/towards-a-circular-economy-business-rationale-for-an-accelerated-transition

Ellen MacArthur Foundation [EMF]. (2015b). *Growth within: a circular economy vision for a competitive Europe.* https://www.ellenmacarthurfoundation.org/growth-within-a-circular-economy-vision-for-a-competitive-europe

Ellen MacArthur Foundation [EMF]. (2016). *The New Plastics Economy: Rethinking the future of plastics.* https://ellenmacarthurfoundation.org/the-new-plastics-economy-rethinking-the-future-of-plastics

Ellen MacArthur Foundation [EMF]. (2018). *The circular economy opportunity for urban and industrial innovation in China.* https://ellenmacarthurfoundation.org/urban-and-industrial-innovation-in-china

Ellen MacArthur Foundation [EMF]. (2020). *Financing the circular economy - Capturing the opportunity.* Retrieved 2023. https://ellenmacarthurfoundation.org/financing-the-circular-economy-capturing-the-opportunity

Ellen MacArthur Foundation [EMF]. (2021). *The Nature Imperative: How the circular economy tackles biodiversity loss.* Retrieved May 08, 2024. https://www.ellenmacarthurfoundation.org/biodiversity-report

Ellen MacArthur Foundation [EMF]. (n.d.-a). *The butterfly diagram: visualizing the circular economy.* Retrieved May 8, 2024, from https://www.ellenmacarthurfoundation.org/circular-economy-diagram

Ellen MacArthur Foundation [EMF]. (n.d.-b). *What is a circular economy?* Retrieved 2023. https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Environmental Justice Atlas. (n.d.). https://ejatlas.org/

Environmental Justice Network. (1996, April 6). *Principles of Environmental Justice*. Retrieved 2023, January, from https://www.ejnet.org/ej/principles.html

Environmental Protection Agency [EPA]. *Environmental Justice*. USA. Retrieved May 8, 2024, from www.epa.gov/environmentaljustice

Environmental Working Group. (2007, October 2). *17 Principles of Environmental Justice*. Retrieved 2023, January, from https://www.ewg.org/news-insights/news/17-principles-environmental-justice

European Environmental Agency [EEA]. (2023, August 29). *Interview – Does the polluter pay?* Retrieved May 9, 2024, from www.eea.europa.eu/signals-archived/signals-2020/articles/interview-does-the-polluter-pay

Ezeah, C., Fazakerley, J., & Roberts, C. (2013). Emerging trends in informal sector recycling in developing and transition countries. *Waste management*, *33*(11), 2509–2519. https://doi.org/10.1016/j.wasman.2013.06.020

Fairphone. (n.d.). *We care for people and planet.* https://www.fairphone.com/en/story/?ref=header

Falcão, L. (2021, August 13). *Gás natural renovável distribuído pela Cegás diversifica a matriz*

energética cearense [Natural gas distributed by Cegás diversifies the energy matrix of Ceará]. Governo do Estado do Ceará. Ascom Casa Civil. Retrieved February 2, 2024, from https://www.ceara.gov.br/2021/08/13/gas-natural-renovavel-distribuido-pela-cegas-diversifica-a-matriz-energetica-cearense/

Ferri, G., Chaves, G., & Ribeiro, G. (2015). Reverse logistics network for municipal solid waste management: The inclusion of waste pickers as a Brazilian legal requirement. *Waste Management, 40*, 173-191. https://doi.org/10.1016/j.wasman.2015.02.036

Finkielsztein, M. (2022). Consumer boredom: Boredom as a subliminal mood of consumer capitalism. *European Journal of American Studies*, *17*(17-4). https://doi.org/10.4000/ejas.18977

Fraser, M., Haigh, L. & Soria, A. (2023). *The Circularity Gap Report 2023*, Circle Economy. Netherlands. https://policycommons.net/artifacts/3370831/63c5511395a3b8eba384baa9_cgr20202320-20report/4169635/.

Fraser, N., & Honneth, A. (2003). *Redistribution or recognition? A political-philosophical exchange*. Verso.

Friedman, M. (1970). The Friedman doctrine – The social responsibility of business is to increase its profits. *The New York Times*. September 13, 1970, Section SM, Page 17.

Friedman, M. (2007). The social responsibility of business is to increase its profits. In *Corporate ethics and corporate governance* (pp. 173-178). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-540-70818-6_14

Fortal. (n.d.). Home. https://fortal.com.br/

G1 CE. (2022a, December 26). *Fortaleza tem o maior PIB do Nordeste, e oitavo entre as capitais do Brasil, diz IBGE* [Fortaleza has the highest GDP in the Northeast, and the eighth among the capitals of Brazil]. https://g1.globo.com/ce/ceara/noticia/2022/12/26/fortaleza-tem-o-maior-pib-do-nordeste-e-oitavo-entre-as-capitais-do-brasil-diz-ibge.ghtml

G1 CE. (2022b, July 13). *Fortal 2022: mais de 30 atrações devem reunir 400 mil pessoas nos quatro dias de micareta* [Fortal 2022: more than 30 attractions should bring 400 thousand people in the four days of *micareta*]. https://g1.globo.com/ce/ceara/noticia/2022/07/13/fortal-2022-mais-de-30-atracoes-devem-reunir-400-mil-pessoas-nos-quatro-dias-de-micareta.ghtml

Gall, M., Wiener, M., de Oliveira, C. C., Lang, R., & Hansen, E. (2020). Building a circular plastics economy with informal waste pickers: Recyclate quality, business model, and societal impacts. *Resources, Conservation and Recycling*, *156*(November 2018), 104685. https://doi.org/10.1016/j.resconrec.2020.104685

Gedicks, A. (2005). Resource wars against native peoples. In R., Bullard (Ed.). *The quest for*

environmental justice: Human rights and the politics of pollution (1st, ed. pp. 168-187). San Francisco: Sierra Clubs Books.

Geissdoerfer, M., Bocken, N., & Hultink, E. (2016). Design thinking to enhance the sustainable business modelling process – A workshop based on a value mapping process. *Journal of Cleaner Production*, *135*, 1218–1232. https://doi.org/10.1016/j.jclepro.2016.07.020

Geissdoerfer, M., Savaget, P., Bocken, N., & Hultink, E. (2017). The circular economy – A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Georgescu-Roegen, N. (1986). The entropy law and the economic process in retrospect. *Eastern Economic Journal*, *XII*(1), 3-25.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, *114*, 11–32. https://doi.org/10.1016/j.jclepro.2015.09.007

Gibbons, L. V. (2020). Regenerative – The new sustainable? *Sustainability*, *12*, 5483. https://10.3390/su12135483.

Gokaldas, V. (2012). Waste picker-run biogas plants as a decentralized solution. Global Alliance for Incinerator Alternatives - GAIA. https://www.no-burn.org/wp-content/uploads/ZW-Mumbai.pdf

Governo do Estado do Ceará (2020, November 27). *Governo do Ceará envia à Assembleia projeto que torna Auxílio-Catador política permanente* [Government of Ceará forwards to the Assembly a project to turn Auxílio-Catador a permanent policy]. Ceará. Retrieved May 8, 2024, from https://www.ceara.gov.br/2020/11/27/governo-do-ceara-envia-a-assembleia-projeto-que-torna-auxilio-catador-politica-permanente/

Gregson, N., Crang, M., Fuller, S., & Holmes, H. (2015). Interrogating the circular economy: the moral economy of resource recovery in the EU. *Economy and Society*, *44*(2), 218-243. https://doi.org/10.1080/03085147.2015.1013353

Grupo Marquise. (n.d.). EcoFor. https://www.grupomarquise.com.br/negocio/ecofor/

Gursel, I., Elbersen, B., Meesters, K., & van Leeuwen, M. (2022). Defining circular economy principles for biobased products. *Sustainability*, *14*(19), 12780. https://doi.org/10.3390/su141912780

Gutberlet, J., & Carenzo, S. (2020). Waste pickers at the heart of the circular economy: A perspective of inclusive recycling from the Global South. *Worldwide Waste: Journal of Interdisciplinary Studies*, *3*(1), 6, 1–14. https://doi.org/10.5334/wwwj.50

Gutberlet, J., Carenzo, S., Kain, J.-H., & Mantovani Martiniano de Azevedo, A. (2017). Waste picker organizations and their contribution to the circular economy: Two case studies from a Global South perspective. *Resources*, *6*(52), 1–12.

https://doi.org/10.3390/resources6040052

Haas, W., Krausmann, F., Wiedenhofer, D., & Heinz, M. (2015). How circular is the global economy? An assessment of material flows, waste production, and recycling in the European Union and the world in 2005. *Journal of Industrial Ecology, 19*(5), 765-777. https://doi.org/10.1111/jiec.12244

Hajer, M. A. (1995). *The politics of environmental discourse: Ecological modernization and the policy process*. New York: Clarendon Press.

Halog A. & Anieke, S. (2021). A Review of Circular Economy Studies in Developed Countries and Its Potential Adoption in Developing Countries. *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-021-00017-0

Haughton, G. (1999). Environmental Justice and the Sustainable City. *Journal of Planning Education and Research, 18*(3), 233–243. https://doi.org/https://doi.org/10.1177/0739456X9901800305

Hobson, K. (2016). Closing the loop or squaring the circle? Locating generative spaces for the circular economy. *Progress in Human Geography, 40*(1), 88–104. https://doi.org/10.1177/0309132514566342

Hobson, K. (2020). 'Small stories of closing loops': social circularity and the everyday circular economy. *Climatic Change, 163*(1), 99-116. https://doi.org/10.1007/s10584-019-02480-z

Hobson, K., & Lynch, N. (2016). Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. *Futures, 82*, 15-25. https://doi.org/10.1016/j.futures.2016.05.012

Hobson, K., & Lynch, N. (2018). Ecological modernization, techno-politics and social life cycle assessment: a view from human geography. *The International Journal of Life Cycle Assessment, 23*, 456-463. https://doi.org/10.1007/s11367-015-1005-5

Holifield, R. (2012). Environmental justice as recognition and participation in risk assessment: Negotiating and translating health risk at a superfund site in Indian country. *Annals of the Association of American Geographers, 102*(3), 591-613. https://doi.org/10.1080/00045608.2011.641892

Hopkinson, P., De Angelis, R., & Zils, M. (2020). Systemic building blocks for creating and capturing value from circular economy. *Resources, Conservation and Recycling, 155*, 104672. https://doi.org/10.1016/j.resconrec.2019.104672

Inigo, E., & Blok, V. (2019). Strengthening the socio-ethical foundations of the circular economy: Lessons from responsible research and innovation. *Journal of Cleaner Production, 233*, 280-291. https://doi.org/10.1016/j.jclepro.2019.06.053

Instituto Brasileiro de Geografia e Estatística [IBGE]. (2017). *Panorama: Fortaleza.* Retrieved June 6, 2020, from https://cidades.ibge.gov.br/brasil/ce/fortaleza/panorama

Instituto Brasileiro de Geografia e Estatística [IBGE]. (2020). *IBGE | Projeção da população* [Population projection]. Retrieved May 23, 2020, from https://www.ibge.gov.br/apps/populacao/projecao/

Instituto Brasileiro de Geografia e Estatística [IBGE]. (2022). *Áreas territoriais* [Territorial area]. https://www.ibge.gov.br/geociencias/organizacao-do-territorio/estrutura-territorial/15761-areas-dos-municipios.html?=&t=sobre

Instituto de Pesquisa e Estratégia Econômica do Ceará [IPECE]. (2017). *Perfil municipal 2017: Fortaleza* [2017 municipal profile: Fortaleza]. Fortaleza. Retrieved January 2021, from https://www.ipece.ce.gov.br/wp-content/uploads/sites/45/2018/09/Fortaleza_2017.pdf

Instituto de Pesquisa e Estratégia Econômica do Ceará [IPECE]. (2019). Sistema de informações geossocioeconômicas do Ceará [System of geosocioeconomic information of Ceará]. Retrieved January 7, 2021, from http://ipecedata.ipece.ce.gov.br/ipece-data-web/

Instituto de Pesquisa Econômica Aplicada [IPEA]. (2010). *Pesquisa sobre pagamento por serviços ambientais urbanos para gestão de resíduos sólidos* [Research on payment for urban environmental services for solid waste management]. Rio de Janeiro. http://www.mma.gov.br/port/conama/processos/4E1B1104/EstudoIPEA_CS.pdf

Instituto de Pesquisa Econômica Aplicada [IPEA]. (2012). *Diagnóstico sobre catadores de resíduos sólidos* [Diagnosis of solid waste pickers]. Brasília. Retrieved February 17, 2023, from https://portalantigo.ipea.gov.br/agencia/images/stories/PDFs/relatoriopesquisa/120911_relatorio_catadores_residuos.pdf

Instituto de Pesquisa Econômica Aplicada [IPEA]. (2013). *Situação social das catadoras e dos catadores de material reciclável e reutilizável – Brasil* [Social situation of waste pickers of recyclables and reusables]. https://doi.org/10.1186/2036-7902-4-4

Instituto de Pesquisa Econômica Aplicada [IPEA]. (2022). *The role of industrial sector in the Brazilian territorial reconfiguration: New expressions for XXI century national dilemmas*. Retrieved May 8, 2024, from https://portalantigo.ipea.gov.br/agencia/images/stories/PDFs/TDs/ingles/dp_266.pdf

Instituto de Planejamento de Fortaleza [IPLANFOR]. (2020). Fortaleza em mapas - Informações georreferenciadas de Fortaleza. Retrieved January 7, 2021, from https://mapas.fortaleza.ce.gov.br/#/

Intergovernmental Panel on Climate Change [IPCC]. (2023, March 13). SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6). AR6 Synthesis Report: Climate Change 2023. Longer Report. https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_LongerReport.pdf

Ivanova, V., & Chipeva, S. (2019). Transition to a circular economy model in the European Union – State and outlook. *IJASOS- International E-journal of Advances in Social Sciences, V*(14), 694–701. https://doi.org/10.18769/ijasos.591425

Jabbour, C., Sarkis, J., de Sousa Jabbour, A., Renwick, D., Singh, S., Grebinevych, O., ... & Godinho Filho, M. (2019). Who is in charge? A review and a research agenda on the 'human side'of the circular economy. *Journal of Cleaner Production, 222*, 793-801. https://doi.org/10.1016/j.jclepro.2019.03.038

Karl, J., Karl, A. (2022). Circular economy in the Brazilian legal system: challenges for its institutionalization. *Revista S&G, 17*(1). https://revistasg.emnuvens.com.br/sg/article/view/1774

Khitous, F., Strozzi, F., Urbinati, A., & Alberti, F. (2020). A systematic literature network analysis of existing themes and emerging research trends in circular economy. *Sustainability, 12*(4), 1633. https://doi.org/10.3390/su12041633

Kirchherr, J., & Santen, R. (2019). Research on the circular economy: A critique of the field. *Resources, Conservation and Recycling*, *151*. https://doi.org/10.1016/j.resconrec.2019.104480

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*(September), 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005

Kirchherr, J., Yang, N., Schulze-Spüntrup, F., Heerink, M., & Hartley, K. (2023). Conceptualizing the circular economy (Revisited): An Analysis of 221 Definitions. *Resources, Conservation and Recycling*, *194*, 107001. https://doi.org/10.1016/j.resconrec.2023.107001

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics*, *143*, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544-552. https://doi.org/10.1016/j.jclepro.2017.12.111

Lahane, S., & Kant, R. (2022). Investigating the sustainable development goals derived due to adoption of circular economy practices. *Waste Management, 143*, 1-14. https://doi.org/10.1016/j.wasman.2022.02.016

Lederman, N., & Lederman, J. (2015). What is a theoretical framework? A practical answer. *Journal of Science Teacher Education*, *26*(7), 593-597. https://doi.org/10.1007/s10972-015-9443-2

Lehmann, M., Leeuw, B. D., Fehr, E., & Wong, A. (2014). Circular economy. Improving the management of natural resources. In *World Resources Forum: Bern, Switzerland*. http://www.wrforum.org/wp-content/uploads/2015/04/a-_CircularEconomy_English.pdf

Leite, F. (2022, September 29). *Ceará está entre os 10 maiores produtores de energia solar do país*. https://agenciabrasil.ebc.com.br/radioagencia-nacional/economia/audio/2022-

09/ceara-esta-entre-os-10-maiores-produtores-de-energia-solar-do-pais

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production, 115*, 36-51. https://doi.org/10.1016/j.jclepro.2015.12.042

Liu, Z., Schraven, D., de Jong, M., & Hertogh, M. (2023). The societal strength of transition: A critical review of the circular economy through the lens of inclusion. *International Journal of Sustainable Development & World Ecology*, 1-24. https://doi.org/10.1080/13504509.2023.2208547

Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., … Thomsen, M. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production, 139,* 361–371. https://doi.org/10.1016/j.jclepro.2016.08.024

Low, N., & Gleeson, B. (1998). *Justice, society and nature: An exploration of political ecology* (1st ed.). London and New York: Routledge.

Luthra, S., Kumar, A., Sharma, M., Garza-Reyes, J., & Kumar, V. (2022). An analysis of operational behavioural factors and circular economy practices in SMEs: An emerging economy perspective. *Journal of Business Research, 141,* 321-336. https://doi.org/10.1016/j.jbusres.2021.12.014

Marquise Ambiental. (n.d.). *Gestão de Operações*. https://www.marquiseambiental.com.br/gestao-de-operacoes/

Marshall, R., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste management*, *33*(4), 988-1003. https://doi.org/10.1016/j.wasman.2012.12.023

Martin, C., Upham, P., & Budd, L. (2015). Commercial orientation in grassroots social innovation: Insights from the sharing economy. *Ecological Economics*, *118*, 240-251. https://doi.org/10.1016/j.ecolecon.2015.08.001

Martinez-Alier, J. (2021). The circularity gap and the growth of world movements for environmental justice. *Academia Letters*, 334. https://doi.org/10.20935/AL334

Martínez-Martínez, S., Pérez-Villarejo, L., Eliche-Quesada, D., & Sánchez-Soto, P. J. (2023). New types and dosages for the manufacture of low-energy cements from raw materials and industrial waste under the principles of the circular economy and low-carbon economy. *Materials*, *16*(2), 802. https://doi.org/10.3390/ma16020802

May, T. (2011). *Social research: Issues, methods and process* (4th ed.). Buckingham: Open University Press.

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: remaking the way we make things*. New York: North Point.

Medina, M. (2000). Scavenger cooperatives in Asia and Latin America. Global Development Network. *Resources, Conservation and Recycling*, *31*, 51–69. http://www.inclusivecities.org/wp-content/uploads/2012/07/Medina_Scavenger_Cooperatives_in_Developing_Countries.pdf

Medina, M. (2008). The informal recycling sector in developing countries: Organizing waste pickers to enhance their impact. *GRIDLINES*. Washington DC. Retrieved October 1, 2014, from https://openknowledge.worldbank.org/bitstream/handle/10986/10586/472210BRI0Box31ing1sectors01PUBLIC1.pdf?sequence=1&isAllowed=y

Merenlender, A., Huntsinger, L., Guthey, G., & Fairfax, S. (2004). Patronatos Agrarios y Servicios de Conservación ¿Quién Está Conservando Qué para Quién? [Land Trusts and Conservation Easements: Who Is Conserving What for Whom?]. *Conservation Biology*, *18*(1), 65–76. https://doi.org/10.1111/j.1523-1739.2004.00401.x

Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production*, *178*, 703-722. https://doi.org/10.1016/j.jclepro.2017.12.112

Mhatre, P., Panchal, R., Singh, A., & Bibyan, S. (2021). A systematic literature review on the circular economy initiatives in the European Union. *Sustainable Production and Consumption*, *26*, 187-202. https://doi.org/10.1016/j.spc.2020.09.008

Middleton, C., Allouche, J., Gyawali, D., & Allen, S. (2015). The Rise and Implications of the Water-Energy-Food Nexus in Southeast Asia through an Environmental Justice Lens. *Water Alternatives*, *8*(1), 627–654.

Ministério das Cidades. (2023). *Manejo dos Resíduos Sólidos Urbanos* – 2014 [Urban solid waste management – 2014]. Sistema Nacional de Informações sobre Saneamento. https://www.gov.br/cidades/pt-br/acesso-a-informacao/acoes-e-programas/saneamento/snis/painel/rs

Ministério das Cidades. (2023). *Manejo dos Resíduos Sólidos Urbanos - 2018* [Urban solid waste management – 2018]. Sistema Nacional de Informações sobre Saneamento. https://www.gov.br/cidades/pt-br/acesso-a-informacao/acoes-e-programas/saneamento/snis/painel/rs

Ministério do Desenvolvimento Regional. Secretaria Nacional de Saneamento. (2019). *Diagnóstico do Manejo de Resíduos Sólidos Urbanos* [Diagnosis of urban solid waste management]. SNR/MDR. Brasília. https://doi.org/10.1017/CBO9781107415324.004

Ministério do Meio Ambiente. (2018, October 18). *54% dos municípios têm plano de resíduos sólidos* [54% of the municipalities have solid waste management plans]. https://www.gov.br/mma/pt-br/noticias/54-dos-municipios-tem-plano-de-residuos

Ministry of Economic Affairs and Employment. (2021, August 04). *Finland's Circular Economy*

Programme sets targets to curb overconsumption of natural resources. Ministry of the Environment. https://ym.fi/en/-/circular-economy-programme-sets-targets-to-curb-overconsumption-of-natural-resources

Moreau, V., Sahakian, M., Van Griethuysen, P., & Vuille, F. (2017). Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy. *Journal of Industrial Ecology, 21*(3), 497–506. https://doi.org/10.1111/jiec.12598

Mounier-Jack, S., Mayhew, S. H., & Mays, N. (2017). Integrated care: Learning between high-income, and low- and middle-income country health systems. *Health Policy and Planning, 32(suppl_4)*, iv6–iv12. https://doi.org/10.1093/heapol/czx039

Moura Junior, F. & Portela, F. F. (2022, March 24). The Brazilian middle class and its illusory search for an elite identity: Impressions from field research on the upper class in the Northeast. *Harvard Review of Latin America (ReVista).* Retrieved May 8, 2024, from https://revista.drclas.harvard.edu/the-brazilian-middle-class-and-its-illusory-search-for-an-elite-identity/

Movimento Nacional dos Catadores de Materiais Recicláveis (MNCR). (2021, December 02). *Quantos Catadores existem em atividade no Brasil?* [How many waste pickers in activity in Brazil?] https://www.mncr.org.br/sobre-o-mncr/duvidas-frequentes/quantos-catadores-existem-em-atividade-no-brasil

Murray, A., Skene, K., & Haynes, K. (2017). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics, 140*(3), 369–380. https://doi.org/10.1007/s10551-015-2693-2

Mutezo, G., & Mulopo, J. (2021). A review of Africa's transition from fossil fuels to renewable energy using circular economy principles. *Renewable and Sustainable Energy Reviews, 137*, 110609. https://doi.org/10.1016/j.rser.2020.110609

Muzaiek, S., & Merico, J. (2019). The Circular Economy: A path to sustainability? (Dissertation). https://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-44360

Natura. (n.d.). *Preserve the forest.* https://www.naturabrasil.fr/en-us/our-values/sustainable-development/preserve-the-forest

Nageler-Petritz, H. (2022, September 12). *How can the waste sector face the current challenges?* https://waste-management-world.com/resource-use/how-can-the-waste-sector-face-the-current-challenges/

Nobre, G., & Tavares, E. (2021). The quest for a circular economy final definition: A scientific perspective. *Journal of Cleaner Production, 314*, 127973. https://doi.org/10.1016/j.jclepro.2021.127973

Nogueira, A., Ashton, W., & Teixeira, C. (2019). Expanding perceptions of the circular economy through design: Eight capitals as innovation lenses. *Resources, Conservation and Recycling, 149*, 566–576. https://doi.org/10.1016/j.resconrec.2019.06.021

O POVO. (2012, December 07). *Plano para gerir resíduos sólidos é lançado em Fortaleza*. Retrieved May 8, 2024, from https://www.opovo.com.br/app/opovo/fortaleza/2012/12/07/noticiasjornalfortaleza,2967523/2012-0712cd1110-plano-para-gerir-residuos-solidos-e-lancado-em-forta.shtml

O POVO. (2020, December 31). *Auxílio-catador se torna permanente neste 1º de janeiro de 2021*. Fortaleza. https://www.opovo.com.br/noticias/ceara/2020/12/31/auxilio-catador-se-torna-permanente-neste-1---de-janeiro.html

O' Riordan, T. (1993) The Politics of Sustainability. In K. Turner (Ed.). *Sustainable environmental economics and management: Principles and practice* (pp. 37-69). Belhaven Press.

Okereke, C. (2008). *Global justice and neoliberal environmental governance: Ethics, sustainable development and international co-operation*. King's Lynn: Routledge.

Oliveira, W. C. (2018) *Uma análise da aplicação da legislação de resíduos sólidos da cidade de Fortaleza* [An analysis on the application of the solid waste legislation of the city of Fortaleza]. *Revista Jus Navegandi*, *23*(October), 5587. https://jus.com.br/artigos/66637

Orange, R. (2017, November 28). Waste not want not: Sweden to give tax breaks for repairs. *The Guardian.* https://www.theguardian.com/world/2016/sep/19/waste-not-want-not-sweden-tax-breaks-repairs

Organisation for Economic Cooperation and Development (OECD). (2020). *Environment at a Glance 2020*. OECD Publishing, Paris. https://doi.org/10.1787/4ea7d35f-en.

Padilla-Rivera, A., Russo-Garrido, S., & Merveille, N. (2020). Addressing the Social Aspects of Circular Economy: A Systematic Literature Review. *Sustainability*, *12*(September), 7912. https://doi.org/10.3390/su12197912

Paes, M. X., Campos-Silva, J. V., & de Oliveira, J. A. P. (2021). Integrating circular economy in urban Amazon. *npj Urban Sustainability*, *1*, 29. https://doi.org/10.1038/s42949-021-00031-z

Panchal, R., Singh, A., & Diwan, H. (2021). Does circular economy performance lead to sustainable development? A systematic literature review. *Journal of Environmental Management*, *293*, 112811. https://doi.org/10.1016/j.jenvman.2021.112811

Pearce, D. W., & Turner, R. K. (1989). *Economics of natural resources and the environment*. Johns Hopkins University Press.

Pesce, M., Tamai, I., Guo, D., Critto, A., Brombal, D., Wang, X., ... & Marcomini, A. (2020). Circular economy in China: Translating principles into practice. *Sustainability*, *12*(3), 832. https://doi.org/10.3390/su12030832

Pierce, R. (2008). *Research methods in politics: A practical guide*. London: SAGE.

Pitkänen, K., Karppinen, T. K. M., Kautto, P., Turunen, S., Judl, J., & Myllymaa, T. (2020). Sex, drugs and the circular economy: The social impacts of the circular economy and how to measure them. In M., Brandão, D., Lazarevic, & G., Finnveden (Eds.). *Handbook of the circular economy* (pp. 162-175). Cheltenham: Edward Elgar Publishing. https://doi.org/10.4337/9781788972727.00021

Polanyi, K. (2001). *The Great Transformation: The Political and Economic Origins of Our Times* (2nd ed.). Boston: Beacon Press.

Porter, G., & Brown, J. W. (1996). *Global Environmental Politics* (2nd ed.). Boulder: Westview Press.

Prefeitura Municipal de Curitiba. (2023, August 22). *Zelo pela cidade: saiba tudo o que é feito para tornar Curitiba modelo em limpeza pública* [Caring for the city: know all about what is done to make Curitiba a model clean city]. Curitiba. https://www.curitiba.pr.gov.br/noticias/zelo-pela-cidade-saiba-tudo-o-que-e-feito-para-tornar-curitiba-modelo-em-limpeza-publica/69789

Prefeitura de Fortaleza. (2010). *Desenvolvimento humano, por bairro, em Fortaleza* [Human development, by wards, in Fortaleza]. Fortaleza. https://en.calameo.com/read/0032553521353dc27b3d9

Prefeitura de Fortaleza. (2020, May 21). *Ecopontos de Fortaleza funcionam durante o isolamento social* [Ecopoints in Fortaleza functioning during social isolation]. https://www.fortaleza.ce.gov.br/noticias/ecopontos-de-fortaleza-funcionam-durante-o-isolamento-social

Prefeitura de Fortaleza. (2023, August 28). *Sarto lança Programa Mais Fortaleza com pacote de ações e projetos para incentivo ao descarte correto do lixo e coleta seletiva* [Sarto launches the Fortaleza Mais program with a package of actions and projects for incentivizing the correct disposal of waste and sorted collection]. https://fortaleza.ce.gov.br/noticias/sarto-lanca-programa-mais-fortaleza-com-pacote-de-acoes-e-projetos-para-incentivo-ao-descarte-correto-do-lixo-e-coleta-seletiva

Prefeitura de Fortaleza. Urbanismo e Meio Ambiente. (n.d.). Ecopontos. https://urbanismoemeioambiente.fortaleza.ce.gov.br/infocidade/402-ecopontos

Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *Journal of Cleaner Production, 179*, 605-615. https://doi.org/10.1016/j.jclepro.2017.12.224

Pullen, J. (2013). An essay on distributive justice and the equal ownership of natural resources. *American Journal of Economics and Sociology, 72*(5), 1044–1074. https://doi.org/10.1111/ajes.12035

Qu, S., Guo, Y., Ma, Z., Chen, W.-Q., Liu, J., Liu, G., … Xu, M. (2019). Implications of China's foreign waste ban on the global circular economy. *Resources, Conservation and Recycling, 144*, 252–255. https://doi.org/10.1016/J.RESCONREC.2019.01.004

Rau, S. (2019, December). Options for Urban Mining and Integration with a Potential Green Circular Economy in the People's Republic of China. *ADB Briefs* No. 124. http://dx.doi.org/10.22617/BRF190606-2

Rawls, J. (1999). *A theory of justice* (Revised edition). Cambridge/M Puppim assachusetts: Belknap.

Re-ciclo. (n.d.). *Recicle gratis sem sair de casa*. Retrieved January 28, 2024, from https://www.reciclofortaleza.com.br/

Reike, D., Vermeulen, W., & Witjes, S. (2018). The circular economy: new or refurbished as CE 3.0? Exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options. *Resources, Conservation and Recycling*, *135*, 246-264. https://doi.org/10.1016/j.resconrec.2017.08.027

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., de Wit, C., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P., Costanza, R., Svedin, U., … Foley, J. (2009). Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, *14*(2). http://www.jstor.org/stable/26268316

Rodríguez-Espíndola, O., Cuevas-Romo, A., Chowdhury, S., Díaz-Acevedo, N., Albores, P., Despoudi, S., ... & Dey, P. (2022). The role of circular economy principles and sustainable-oriented innovation to enhance social, economic and environmental performance: Evidence from Mexican SMEs. *International Journal of Production Economics*, *248*, 108495. https://doi.org/10.1016/j.ijpe.2022.108495

Rossi, E., Bertassini, A. C., dos Santos Ferreira, C., do Amaral, W. A, & Ometto, A. R (2020). Circular economy indicators for organizations considering sustainability and business models: Plastic, textile and electro-electronic cases. *Journal of Cleaner Production*, *247*, 119137. https://doi.org/10.1016/j.jclepro.2019.119137

Santiago, C. D., Marotti, A. C. B., Pugliesi, E., & Gonçalves, J. C. (2023). Política nacional de resíduos sólidos: Perspectivas após um decênio de sua promulgação [Brazilian national waste policy: Perspectives after a decade of its enactment]. *Desenvolvimento e Meio Ambiente [DeMA], 62*, 152-177. http://dx.doi.org/10.5380/dma.v62i0.81833

Sasaki, S., & Araki, T. (2013). Employer–employee and buyer–seller relationships among waste pickers at final disposal site in informal recycling: The case of Bantar Gebang in Indonesia. *Habitat International*, *40*, 51-57. https://doi.org/10.1016/j.habitatint.2013.02.003

Sasaki, S., Araki, T., Tambunan, A., & Prasadja, H. (2014). Household income, living and working conditions of dumpsite waste pickers in Bantar Gebang: Toward integrated waste management in Indonesia. *Resources, Conservation and Recycling*, *89*, 11–21. https://doi.org/10.1016/j.resconrec.2014.05.006

Sauvé, S., Bernard, S., & Sloan, P. (2016). Environmental sciences, sustainable development and

circular economy: Alternative concepts for trans-disciplinary research. *Environmental development, 17*, 48-56. https://doi.org/10.1016/j.envdev.2015.09.002

Schmidt, C., Begin, G., Houten, F., Close, C., McGinty, D., Arora, R., …, & Wijkman, A. (2020). The Circularity Gap Report 2020. Circle Economy. https://www.circle-economy.com/resources/circularity-gap-report-2020.

Schlosberg, D. (2004). Reconceiving Environmental Justice: Global Movements and Political Theories. *Environmental Politics*, *13*(3), 517–540. https://doi.org/10.1080/0964401042000229025

Schlosberg, D. (2007). *Defining environmental justice: Theories, movements, and nature*. Oxford: Oxford University Press.

Schöggl, J., Stumpf, L., & Baumgartner, R. J. (2020). The narrative of sustainability and circular economy-A longitudinal review of two decades of research. *Resources, Conservation and Recycling, 163*, 105073. https://doi.org/10.1016/j.resconrec.2020.105073

Schröder, P., Anantharaman, M., Anggraeni, K., Foxon, T. & Barber, J. (2019). Introduction: Sustainable lifestyles, livelihoods and the circular economy. *The circular economy and the Global South: sustainable lifestyles and green industrial development* (1st ed., pp. 3-22). New York: Routledge. https://doi.org/10.4324/9780429434006

Schröder, P., Anantharaman, M., Anggraeni, K., & Foxon, T. (Eds.). (2019). *The circular economy and the Global South: Sustainable lifestyles and green industrial development* (1st ed.). Routledge. https://doi.org/10.4324/9780429434006

Schröder, P., Bengtsson, M., Cohen, M., Dewick, P., Hofstetter, J., & Sarkis, J. (2019). Degrowth within–Aligning circular economy and strong sustainability narratives. *Resources, Conservation and Recycling, 146*, 190-191. https://doi.org/10.1016/j.resconrec.2019.03.038

Schröder, P., Lemille, A., & Desmond, P. (2020). Making the circular economy work for human development. *Resources, Conservation and Recycling, 156*, 104686. https://doi.org/10.1016/j.resconrec.2020.104686

Schroeder, P., & Barrie, J. (2022). Is going circular just? Environmental justice and just transition–key elements for an inclusive circular economy. *Field Actions Science Reports. The journal of field actions*, (Special Issue 24), 20-25. https://journals.openedition.org/factsreports/6864

Schroeder, P., Anggraeni, K., & Weber, U. (2018). The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology, 23*(1), 77-95. https://doi.org/10.1111/jiec.12732

Secretaria de Urbanismo e Meio Ambiente [SEUMA]. (2016). Fortaleza em Mapas - Informações Georreferenciadas de Fortaleza [Fortaleza in Maps – Georeferenced information of Fortaleza]. Retrieved January 7, 2021, from

https://mapas.fortaleza.ce.gov.br/#/

Secretaria do Meio Ambiente [SEMA]. (2019a). Plano Estadual de Resíduos Sólidos [State Solid Waste Plan]. https://www.sema.ce.gov.br/wp-content/uploads/sites/36/2019/08/Plano-estadual-de-residuos-solidos.pdf

Secretaria do Meio Ambiente [SEMA]. (2019b, June 04). Orientações sobre o Índice Municipal de Qualidade do Meio Ambiente – IQM 2019 [Guidelines on the Municipal Environmental Quality Index – IQM 2019]. https://www.sema.ce.gov.br/2019/06/04/orientacoes-sobre-o-indice-municipal-de-qualidade-do-meio-ambiente-iqm-2019/

Secretaria do Meio Ambiente [SEMA]. (2023). Repasse ICMS Socioambiental 2022 – Final [Redistribution of the socioenvironmental ICMS – Final]. https://www.sema.ce.gov.br/wp-content/uploads/sites/36/2023/03/REPASSE-ICMS-SOCIOAMBIENTAL-2022-final.pdf

Secretaria do Meio Ambiente e Mudança do Clima. (2023, June 27). Potencial da Hub de Hidrogênio Verde do Ceará é apresentado à Comissão Especial do Senado [The potential of the green hydrogen hub of Ceará is presented to the Special Commission of the Senate]. https://www.semace.ce.gov.br/2023/06/27/potencial-da-hub-de-hidrogenio-verde-do-ceara-e-apresentado-a-comissao-especial-do-senado/

Sikdar, S. (2019). Circular economy: Is there anything new in this concept? *Clean Technologies and Environmental Policy, 21*(6), 1173-1175. https://doi.org/10.1007/s10098-019-01722-z

Sistema Nacional de Informações sobre Saneamento [SNIS]. (2019). *Resíduos sólidos urbanos - indicadores municipais: Fortaleza* [Urban solid waste – municipal indexes: Fortaleza]. https://app.powerbi.com/view?r=eyJrIjoiNGVkYTRiZTktMGUwZS00OWFiLTgwNWYtNGQ3Y2JlZmJhYzFiIiwidCI6IjJiMjY2ZmE5LTNmOTMtNGJiMS05ODMwLTYzNDY3NTJmMDNlNCIsImMiOjF9

Sistema Nacional de Informações sobre Saneamento [SNIS]. (2021). *Diagnóstico temático manejo de resíduos sólidos urbanos: Visão geral ano de referência 2020* [Thematic diagnosis of urban solid waste management: General vision of referenced year 2020] Retrieved May 8, 2024, from https://www.gov.br/cidades/pt-br/acesso-a-informacao/acoes-e-programas/saneamento/snis/produtos-do-snis/diagnosticos/DIAGNOSTICO_TEMATICO_VISAO_GERAL_RS_SNIS_2021.pdf

Sistema Nacional de Informações sobre Saneamento [SNIS]. (n.d.). *Manejo dos resíduos sólidos urbanos - 2017*. Retrieved June 4, 2020, from http://www.snis.gov.br/painel-informacoes-saneamento-brasil/web/painel-residuos-solidos

Smith, M. H., Desha, C., & Hargroves, K. (2010). *Cents and sustainability: Securing our common future by decoupling economic growth from environmental pressures*. Earthscan.

Söderholm, P. (2011). Taxing virgin natural resources: Lessons from aggregates taxation in

Europe. *Resources, Conservation and Recycling*, *55*(11), 911-922. https://doi.org/10.1016/j.resconrec.2011.05.011

Sojamo, S. (2015). Unlocking the "prisoner's dilemma" of corporate water stewardship in South Africa-exploring corporate power and legitimacy of engagement in water management and governance. *Sustainability (Switzerland)*, *7*(6), 6893–6918. https://doi.org/10.3390/su7066893

SOS Mata Atlântica. (n.d.). *Mata Atlântica: A Mata Atlântica, uma das florestas mais ricas em diversidade de vida no planeta, é a razão de existir uma Fundação. Ela é nossa causa maior* [Atlantic Forest: The Atlantic Forest, one of the planet's richest forests in biodiversity, is the reason of existence of a foundation. It is our greatest cause]. https://www.sosma.org.br/causas/mata-atlantica/

Stahel, W. R. (2016). The circular economy. *Nature*, *531*(7595), 435-438. https://doi.org/10.1038/531435a

Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G., & Soto-Oñate, D. (2019). Operational principles of circular economy for sustainable development: Linking theory and practice. *Journal of Cleaner Production*, *214*, 952-961. https://doi.org/10.1016/j.jclepro.2018.12.271

Tangri, N. (2012). *Waste Pickers Lead the Way to Zero Waste*. Global Alliance for Incinerator Alternatives - GAIA. https://www.no-burn.org/wp-content/uploads/ZW-Pune.pdf

Taylor, D. E. (2000, January). The Rise of the Environmental Justice Paradigm: Injustice Framing and the Social Construction of Environmental Discourses. *AMERICAN BEHAVIORAL SCIENTIST*, *43*(4), 508-580. https://doi.org/10.1177/0002764200043004003

Temper, L., Demaria, F., Scheidel, A., Bene, D. Del, & Martinez-Alier, J. (2018). The Global Environmental Justice Atlas (EJAtlas): ecological distribution conflicts as forces for sustainability. *Sustainability Science*, *13*(3), 573–584. https://doi.org/10.1007/s11625-018-0563-4

Transformative Urban Mobility Initiative [TUMI]. (n.d.). RE-CICLO: Learning from Fortaleza's use of e-mobility to improve waste recycling. Retrieved January 28, 2024, from https://transformative-mobility.org/re-ciclo-learning-from-fortalezas-use-of-e-mobility-to-improve-waste-recycling/

Ulrich, Brand. (2012). Green economy – the next oxymoron? No lessons learned from failures of implementing sustainable development. *GAIA - Ecological Perspectives for Science and Society*, *21*(1), 28-32. https://doi.org/10.14512/gaia.21.1.9

Un-Habitat, & United Nations Human Settlements Programme. (2010). *Solid waste management in the world's cities: Water and sanitation in the world's cities 2010*. Earthscan.

United Nations Convention to Combat Desertification. (2014). *Desertification: The invisible*

frontline. Bonn. http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Desertification_The invisible_frontline.pdf

United Nations Development Programme [UNDP]. (2010). *Regional human development report for Latin America and the Caribbean 2010 – acting on the future: breaking the intergenerational transmission of inequality*. Human Development.

United Nations Development Programme [UNDP]. (2015). *Sustainable Development Goals.* https://www.undp.org/sustainable-development-goals

United Nations Environment Programme [UNEP]. (2019). *Waste to energy: Considerations for informed decision-making*. https://wedocs.unep.org/20.500.11822/28413

United Nations Environment Programme [UNEP]. (2022). *Environmental Justice: Securing our right to a clean, healthy and sustainable environment*. https://www.undp.org/sites/g/files/zskgke326/files/2022-06/Environmental-Justice-Technical-Report.pdf

United Nations University [UNU]. (2018, January 11). *New EU 'urban mining' tools map valuable resources in e-waste, scrap vehicles, mine waste.* Institute for Environment and Human Security. https://ehs.unu.edu/media/press-releases/urban-mining-tools.html

Uvarova, I., Atstaja, D., Volkova, T., Grasis, J., & Ozolina-Ozola, I. (2023). The typology of 60R circular economy principles and strategic orientation of their application in business. *Journal of Cleaner Production, 409,* 137189. https://doi.org/10.1016/j.jclepro.2023.137189

Valencia, M., Solíz, M. F., & Yepéz, M. (2023). Waste picking as social provisioning: The case for a fair transition to a circular economy. *Journal of Cleaner Production, 398*, 136646. https://doi.org/10.1016/j.jclepro.2023.136646

Van Vliet, A. (2014). *Case Study #3: Vrhnika*. https://doi.org/10.1016/S1360-8592(98)80013-2

Vanderwarker, A. (2012). Water and environmental justice. *A Twenty-First Century US Water Policy, 52,* 67.

Velicu, I. (2019). De-growing environmental justice: Reflections from anti-mining movements in Eastern Europe. *Ecological Economics, 159* (January): 271-278. 10.1016/j.ecolecon.2019.01.021

Velis, C. (2017). Waste pickers in Global South: Informal recycling sector in a circular economy era. *Waste Management and Research*, *35*(4), 329–331. https://doi.org/10.1177/0734242X17702024

Vente, J., Reed, M. S., Stringer, L. C., Valente, S., & Newig, J. (2016). How does the context and design of participatory decision making processes affect their outcomes? Evidence from sustainable land management in global drylands. *Ecology & Society, 21*(2), 24.

Vieira, A., Cavalcante, C., Rodrigues, T., Muniz, K., Lima, A., & Xavier, A. (2019). Resíduos sólidos: coleta seletiva e logística reversa em Fortaleza, Ceará [Solid waste: sorted collection and reverse logistics in Fortaleza, Ceará]. *Revista Educação Ambiental em Ação, 67*. http://www.revistaea.org/artigo.php?idartigo=3607

Vinante, C., Sacco, P., Orzes, G., & Borgianni, Y. (2021). Circular economy metrics: Literature review and company-level classification framework. *Journal of Cleaner Production, 288*, 125090. https://doi.org/10.1016/j.jclepro.2020.125090

Walker, G. (2010). Environmental justice, impact assessment and the politics of knowledge: The implications of assessing the social distribution of environmental outcomes. *Environmental impact assessment review*, *30*(5), 312-318. https://doi.org/10.1016/j.eiar.2010.04.005

Walker, G. (2012). *Environmental justice: Concepts, evidence and politics*. New York City: Routledge.

Walker, A., Opferkuch, K., Lindgreen, E., Simboli, A., Vermeulen, W., & Raggi, A. (2021). Assessing the social sustainability of circular economy practices: Industry perspectives from Italy and the Netherlands. *Sustainable Production and Consumption*, *27*, 831-844. https://doi.org/10.1016/j.spc.2021.01.030

Webster, M. (2021). The informal recycling sector – Environmental criminals or the future of the circular economy? In T., Tudor & C. J. C., Dutra (Eds.). *The Routledge handbook of waste, resources and the circular economy* (pp. 252-261). Abingdon: Routledge.

Webster, K. (2013). What might we say about a circular economy? Some temptations to avoid if possible. *World Futures*, *69*(7-8), 542-554. https://doi.org/10.1080/02604027.2013.835977

Weghmann, V. (2020, October 13). The 'circular economy'—neither safe nor sustainable. https://www.socialeurope.eu/the-circular-economy-neither-safe-nor-sustainable

Wilson, D., Araba, A., Chinwah, K., & Cheeseman, C. (2009). Building recycling rates through the informal sector. *Waste Management*, *29*(2), 629–635. https://doi.org/10.1016/j.wasman.2008.06.016

Wilson, D., Rodic, L., Scheinberg, A., Velis, C., & Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste management & research*, *30*(3), 237-254. https://doi.org/10.1177/0734242X12437569

Wilson, D. C., Velis, C., & Cheeseman, C. (2006). Role of informal sector recycling in waste management in developing countries. *Habitat International*, *30*, 797–808. https://doi.org/10.1016/j.habitatint.2005.09.005

Winans, K., Kendall, A., & Deng, H. (2017). The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews*, *68*, 825-833. https://doi.org/10.1016/j.rser.2016.09.123

Women in Informal Employment: Globalizing and Organizing [WIEGO]. (n.d). Waste Pickers. Retrieved May 8, 2024, from https://www.wiego.org/waste-pickers

World Bank [WB]. (1997). *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*. Environmentally Sustainable Development Studies and Monographs Series No. 17. Retrieved May 3, 2024, from https://documents1.worldbank.org/curated/en/555261468765258502/pdf/multi-page.pdf

World Bank [WB]. (2024, April 05). The World Bank in Brazil. Retrieved May 8, 2024, from https://www.worldbank.org/en/country/brazil/overview

World Economic Forum [WEF]. (2019, January). A New Circular Vision for Electronics: Time for a Global Reboot. Retrieved May 10, 2024, from World Economic Forum (weforum.org)

World Health Organization. (2019). *Case Study: Fortaleza*. https://www.who.int/ncds/publications/Fortaleza-case-study-final.pdf

Wright, C. Y., Godfrey, L., Armiento, G., Haywood, L. K., Inglesi-Lotz, R., Lyne, K., & Schwerdtle, P. N. (2019). Circular economy and environmental health in low-and middle-income countries. *Globalization and Health*, *15*(1), 1-5. https://doi.org/10.1186/s12992-019-0501-y

Wuyts, W., & Marin, J. (2022). "Nobody" matters in circular landscapes. *Local Environment, 27*(10-11), 1254-1271. https://doi.org/10.1080/13549839.2022.2040465

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Los Angeles: SAGE.

Young, I. M. (1990). *Justice and the politics of difference*. New Jersey: Princeton University Press.

Ziegler, R., Bauwens, T., Roy, M. J., Teasdale, S., Fourrier, A., & Raufflet, E. (2023). Embedding circularity: Theorizing the social economy, its potential, and its challenges. *Ecological Economics, 214*, 107970. https://doi.org/10.1016/j.ecolecon.2023.107970

Zolnikov, T. R., da Silva, R. C., Tuesta, A. A., Marques, C. P., & Cruvinel, V. R. N. (2018). Ineffective waste site closures in Brazil: A systematic review on continuing health conditions and occupational hazards of waste collectors. *Waste Management, 80*, 26–39. https://doi.org/10.1016/j.wasman.2018.08.047

Appendixes

Table A-1. 2019 Interview Questions to Government Agencies, Businesses and WPs, with Targeted Criteria and Coding

STANDARDIZED QUESTIONS FOR INTERVIEWEES
For the government staff interviewees
G1. What does the agency do? What about regarding WM and CE, what projects does the agency have?
G2. How are these projects financed?
G3. What are the main difficulties, and how does the agency plan on overcoming these difficulties?
G4. What is the agency's relationship with waste picker associations, if any?
G5. What is the agency's relationship with other agencies, if any, including with different levels of government?
G6. What is the desired future and what is missing to get there?
G7. Are you satisfied with your work? Do you like your work?
+G8. Please explain more about the IQM [asked CODES].
For the business interviewees
B1. What is the company's main activity?
B2. What is the company's relationship with the government, if any?
B3. Does the company have business outside of Fortaleza?
B4. What is the company's relationship with waste picker associations, if any?
+B5. How does the company view the municipal government's Ecopoints project?
For the waste picker associations interviewees
A1. What is the association's relationship with businesses or the government, if any?
A2. What happens to the materials the association receives?
A3. Reality x Dream: How are things for the association right now? What does the association aim for?
A4. What is missing to reach the desired goal/future? {How much depends on the association and how much depends on others?}

A5. What is the biggest impact personally?
A6. Are you proud of your work? Do you like your work?
+A7. What is the role of REDE from the association's point of view?
+A8. What was the impact of the CATAFORTE project(s)? How many members of the association attended?

Source: Preparation for field work conducted in 2019 (2018-2019).

Table B-1. CE-EJ Analysis of Findings from Interviews with Related Government Agencies as of August 2019 Using the Proposed CE-EJ Framework.

	SEUMA, COSAN and CODES
C1 [Eliminate]	Pursue RL *(MP!)*
C2 [Circulate]	RL [Fortaleza Municipal Law No.11.324/22]; Ecopoints; PEV schools; Stimulate donations to WPs; Remove waste from streets, rivers and beaches {Ceará: Consortiums}
C3 [Restore]	Water & sanitation restoration projects; Parque Raquel Queiroz; Afforestation projects
J1 [Recognition]	Citizens also responsible: "Empower" citizens to give their own waste a proper destination [NaPS: shared responsibility]; Inclusion of WPs and "barrel-wheelers'.
J2 [Distribution]	PEV schools; Stimulate WP inclusion
J3 [Participation]	Public hearings

Table B-2. Summary of Findings from Interviews with Related Businesses as of August 2019 Using the Proposed CE-EJ Framework.

	ECOFOR
C1 [Eliminate]	As of 2015, environmental education program on the correct sorting of waste [*limited influence]
C2 [Circulate]	Selling recyclables collected from the Ecopoints to manufacturers, recyclers or intermediate buyers;
C3 [Restore]	Collects materials and waste from trash bins, curbs and beaches*;* Operates the landfill and incinerator; Cede truck for occasional beach cleanups [*limited influence]
J1 [Recognition]	Officially recognized as the sole service provider; Occasionally helps WPs [municipal conditional]
J2 [Distribution]	Free collection of 50-54 tons/month of donations to (3) WPAs [municipality set as a "conditional" as of 2013]; Occasional technical assistance and cedes 1 small truck for exclusive use of the associations; Some companies use this service to donate recyclables to the WPs
J3 [Participation]	Monthly meetings with WPAs; Directly involved in the Fortaleza Municipal Plan on Waste Management; *A separate source stated that ECOFOR is heavily involved and even privileged in all the decisions related to MSWM

Table B-3. Summary of Findings from Interviews with Registered WPAs as of August 2019 Using the Proposed CE-EJ Framework.

	Associations	REDE & Coopmares
C1 [Eliminate]		Educational programs; Invited as speakers
C2 [Circulate]	Sell collected/donated materials to intermediate buyers	Sell collected/donated materials to intermediate buyers [or even directly to recycling companies] in large quantities and good/processed quality
C3 [Restore]	Remove recyclables from the environment [limited effect] Receive materials [limited effect]	Receive materials [limited effect]
J1 [Recognition]	Satisfaction; Better standing and better chances than when unassociated WPs; Despite the above, WPs still have little social recognition, because WPs are arguably the workers with the lowest social standing	More communication with the government and businesses; Fighting for payment for rendered environmental services [recognized by the Ceará government[28]]; Fighting for social security, namely a retirement pension
J2 [Distribution]	Declaration of correct "disposal" brings in more donations; Share profits with the members who worked that	Better prices (more volume, better quality); Fair distribution amongst associations; Better position to skip intermediate buyers and trying to sell directly to the

[28] See Ceará State Law No. 17.377/2020 ("Bolsa-catador").

	Associations	REDE & Coopmares
	month (some do not want to work, but still want to receive benefits); Reduction of materials since Ecopoints	recycling/manufacturing companies; Reduction of materials since Ecopoints
J3 [Participation]	Self-regulatory; Internal elections	Stronger voice to fight for collective rights*, though still not enough*; Internal elections Wishes for participatory management