



ELLEN MACARTHUR
FOUNDATION

**CLEAN
RIVERS**

CLOSING THE LOOP

**Transforming
urban waste
systems and
protecting
Brazil's rivers**

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ABOUT THE PAPER

WHY THIS PAPER

Addressing gaps in collection and recycling systems is one of three systemic barriers to tackle plastic pollution at scale, as identified in the Ellen MacArthur Foundation's 2030 Plastics Agenda for Business.

The Ellen MacArthur Foundation aims to work with its network to build on, and contribute to, the existing landscape of efforts addressing this gap. This report provides a first step to do so. It aims to provide the basis for a large-scale collaborative effort at city level, with a particular focus on developing sustainable financing mechanisms and generating practical learnings to inform national-level scale-up through policy change.

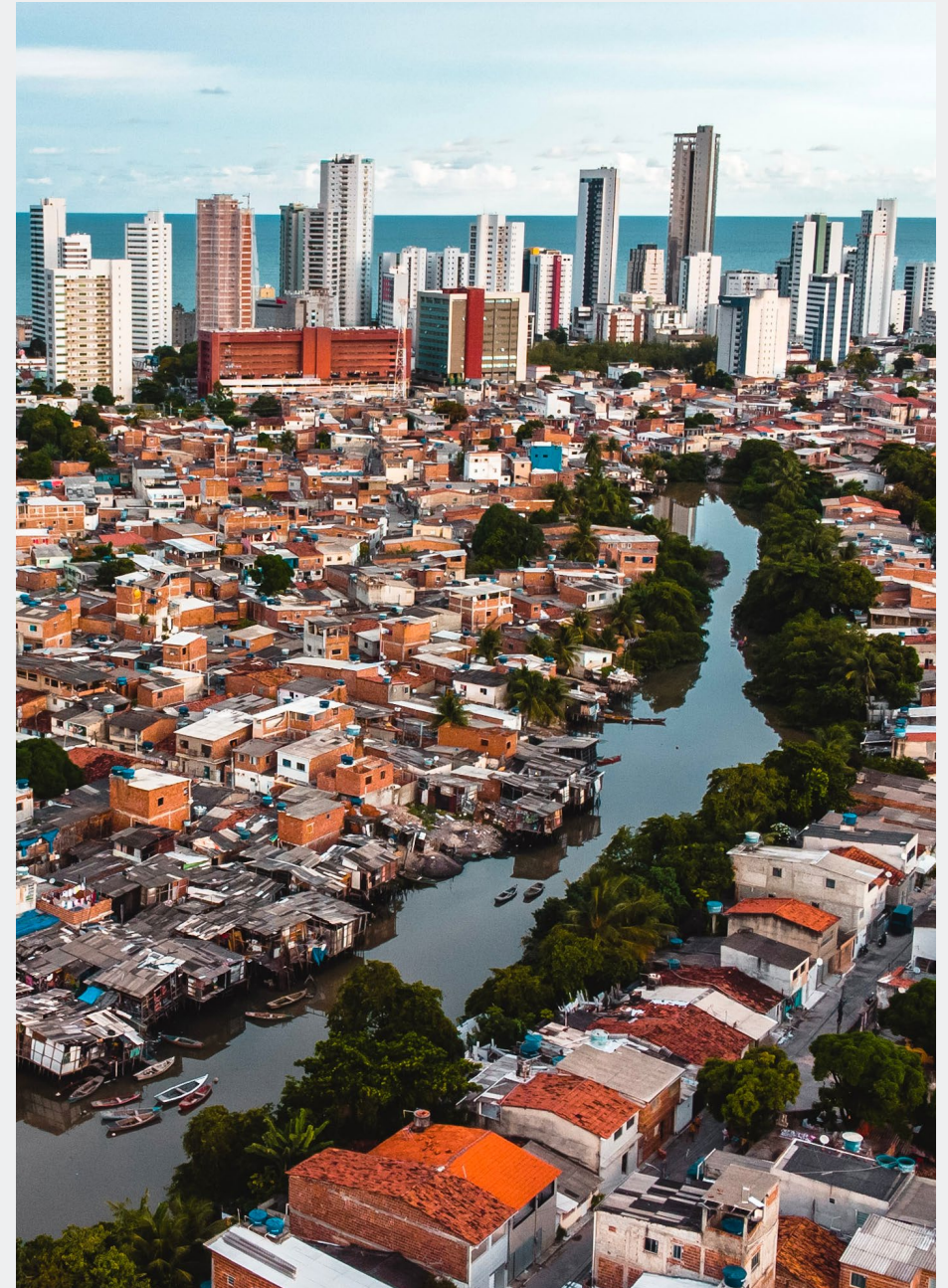
Clean Rivers sees this as a promising pathway to achieve its triple impact goal: reducing waste leakage into rivers while improving social and economic outcomes for the communities that depend on them.

Brazil was selected as the initial focus for this effort given the scale of the challenge and opportunity it represents. As one of the five largest generators of municipal solid waste globally, and home to the world's largest freshwater reservoir at 12% of the world's total, the stakes of inadequate waste management are uniquely high. It has many existing strengths to build on, including a comprehensive existing policy framework developed over a decade.

WHAT THIS PAPER AIMS TO CONTRIBUTE

This paper explores what a scalable transformation effort of urban waste systems could look like in Brazil. It:

- Establishes a baseline of where Brazil's cities stand today
- Sets out a vision based on principles for what a transformed system could achieve by 2040
- Provides an initial framework for the actions needed to get there



WHAT THIS PAPER IS NOT

This paper is not a comprehensive overview of circular economy approaches; rather, it focuses on collection and recycling systems. Other interventions such as reuse, redesign, and elimination are also essential components of a circular economy and are explored in greater detail in other publications.

The paper is not a prescriptive operational roadmap; rather, it serves as a foundation upon which future collaborative efforts can build. Its purpose is to develop a shared understanding of the current state of urban waste management in Brazil and a high-level vision for transforming these systems, acknowledging existing regulatory frameworks and national ambitions. The paper is informed by and indebted to the work of the many organisations working on this topic over many years.

The paper is not a definitive or universal blueprint for transforming urban waste systems; rather, it presents a perspective grounded in the Brazilian context. It is a working hypothesis for a longer collaborative process that will be refined through future learning and ongoing engagement with stakeholders, and whose applicability to other geographies should be assessed against local realities.

HOW THIS PAPER WAS DEVELOPED

This paper is the product of a six-month collaborative process led by the Ellen MacArthur Foundation and Clean Rivers, which convened more than 80 stakeholders from across Brazil's packaging and waste management value chain, including policymakers, waste picker organisations, businesses, academia, NGOs, IGOs, financial institutions, and philanthropies. Their input gives this paper both its analytical grounding and its practical ambition. The findings draw on extensive data research and in-depth engagement across Brazil, including interviews, workshops, and site visits across different regions.

ABOUT THE ORGANISATIONS



The Ellen MacArthur Foundation is a global leader in accelerating the transition to a circular economy, working with businesses, governments, and cities to eliminate waste and pollution, circulate products and materials, and regenerate nature.

CLEAN RIVERS

Clean Rivers, a United Arab Emirates-backed foundation and affiliate of Erth Zayed Philanthropies, works at the nexus of waste and water globally — bridging two traditionally siloed sectors to drive systems change, reduce waste leakage into waterways, and support the communities and ecosystems that depend on healthy rivers.

Together, the two organisations bring complementary expertise to a shared goal: demonstrating what city-scale waste management system transformation can look like in practice, to inform national scale-up and beyond.

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IN SUPPORT

ENDORISING ORGANISATIONS

ABIHPEC - Associação Brasileira da Indústria de Higiene Pessoal, Perfumaria e Cosméticos

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Arcor

Autarquia de Manutenção e Limpeza Urbana do Recife

BlackForest Solutions GmbH

CEMPRE (Compromisso Empresarial para a Reciclagem)

Circulate Capital

Coopervivabem

Fundación Avina

Grupo L'Occitane

Grupo Raíces

Helice UFRGS

IAWP International Alliance of Waste Pickers

ICLEI América do Sul

Indorama Ventures

Instituto ABIA de Meio Ambiente

LAMIPAK

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Leroy Merlin

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MNCR

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WIEGO

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Endorsers support the overall vision and recommendations of this publication. The paper reflects areas of broad alignment, but does not necessarily represent the detailed views of every endorsing organisation on all aspects of the analysis or conclusions, and does not reflect any agreement by any endorsing organisations to take any individual or collaborative actions.

“In contributing to the review of this document, we reaffirm the value of this publication as an important milestone for guiding the transformation of urban waste management systems in Brazil, connecting strategic vision, multi-stakeholder collaboration, and concrete impact in the implementation of the circular economy for smart cities.”

**Istefani Carísio de Paula, Professor and researcher
FEDERAL UNIVERSITY OF RIO GRANDE
DO SUL (UFRGS)**

“Transforming waste management systems is a fundamental condition for cities to advance towards more sustainable, resilient, and inclusive urban development. By placing municipalities at the heart of this transformation, the whitepaper reinforces the strategic role of local governments in promoting the circular economy, recognising the work of waste pickers, and expanding the infrastructure needed to address the environmental and social challenges associated with waste. ICLEI South America supports initiatives that strengthen multi-stakeholder collaboration and accelerate the transition towards more circular and sustainable cities.”

**Armelle Cibaka, Brazil Director
ICLEI SOUTH AMERICA**

“Having effective waste management systems requires solutions across the entire value chain — from building the collection and sorting infrastructure through to growing the demand from manufacturers for recycled content. Working across the value chain represents a powerful opportunity to create jobs, build economic resilience, and deliver cleaner cities for Brazilians. The World Bank Group looks forward to working with the Ellen MacArthur Foundation to deploy its full value chain, multi-stakeholder approach to unlock the public and private capital needed to deliver system-level change.”

**Lisa Da Silva, Global Lead for Circular Economy
and Pollution
WORLD BANK GROUP**

“Transforming waste management in Brazil requires a systemic approach capable of combining infrastructure, municipal governance, logistical efficiency, consumer education, innovation, recycling, and environmentally sound disposal. Structuring reverse logistics schemes, as demonstrated by Mãos Pro Futuro, are a meaningful lever in this process, but they only achieve scale when integrated with engaged municipalities, well-informed consumers, and a shared responsibility that is genuinely exercised by all actors in the system.”

**Fábio Brasiliano, Executive and Sustainable
Development Director
ABIHPEC / MÃOS PRO FUTURO**

“The transition from the current waste pollution scenario to one of environmental protection and social development depends on cross-cutting action that connects the various links in the chain through a coordinated effort focused on tangible results, which I understand to be the ambition of this project. Turning this vision into practice is the challenge we face every day. We hope to contribute with our perspective and experience.”

**Erich Burger, Co-founder
INSTITUTO RECICLEIROS**

“At Mars, we believe meaningful progress on plastic waste can only be achieved through collaboration. Supporting projects like this reinforces our commitment to helping build a more circular future while partnering with cities that are leading the way.”

**Katia Souza, Corporate Affairs Director
MARS PET NUTRITION BRASIL**

“We at Nestlé Brazil are proud to endorse the Ellen MacArthur Foundation’s city program in Brazil as a meaningful step toward accelerating circular economy solutions through local action and cross-sector collaboration. Brazil has a unique opportunity to strengthen inclusive recycling systems, support innovation in packaging circularity, and scale practical models that keep materials in use and reduce waste. We look forward to working with partners across cities, business, government, civil society, and recycling cooperatives to help turn shared ambition into lasting impact.”

**Ionah Kochen, Head of Marketing, Communication and ESG
NESTLÉ BRAZIL**

“Advancing plastic collection and recycling is one of the priorities of Nestlé and we are glad to work together with the Ellen MacArthur Foundation to develop a common baseline and shared vision for system transformation in Brazil. It offers a valuable opportunity to test and learn from a local model that could inform packaging circularity approaches in other geographies. We see strong value in working alongside industry peers and broader stakeholders to build shared learning, demonstrate scalable solutions, and support systemic change.”

Jean-Luc Negrier, Head of Packaging Sustainability
NESTLÉ

“Each stakeholder across the value chain has a role to play to help bring about the systemic transformation required to improve recycling infrastructure and reduce waste. We support efforts that bring together business, civil society, and governments to advance practical, scalable recycling solutions.”

David Allen, Vice President Sustainable Packaging,
Global Sustainability Office
PEPSICO

“Turning system transformation from an ambition into a practical reality in waste management requires the convergence between global perspectives and local understanding. In Brazil, this means moving beyond isolated solutions to build the operating models, partnerships, and evidence needed to deliver durable change across the waste management system. Delterra celebrates all efforts to foster a coordinated approach among all relevant stakeholders and is committed to bringing together city governments, companies, recyclers, waste workers, communities, and funders around implementation programs that can be tested, adapted, and scaled in the real world.”

Mike Stockman, Director of Programs and Latin America
DELTERRA

EXECUTIVE SUMMARY

The circular economy offers a fundamentally different vision for how we produce, use, and manage materials — one in which waste is designed out of the system, rather than managed after the fact. For plastics, that means rethinking products and packaging from the ground up, scaling circular business models like reuse systems, and eliminating unnecessary plastic entirely. These upstream solutions are where the greatest opportunity lies, and where the transition must go.

Collection and recycling systems are one key part of the picture — a necessary feature of any circular economy, keeping materials in use and out of the environment. Right now, in too many places around the world, those systems don't exist at the scale required — and the consequences are playing out in the environment, with millions of tonnes of plastic leaking into land, freshwater and marine ecosystems every year.

Brazil is one of the most instructive places in the world to examine this challenge. Among the five largest generators of municipal solid waste globally, and home to the world's largest freshwater reservoir at 12% of the world's total, the stakes of

inadequate waste management are uniquely high. Although municipal collection covers approximately 92% of the population in Brazil, mismanaged waste remains a major challenge — both from the uncollected fraction, and the fact that around 26% of the waste sent for disposal is mismanaged.¹ While 36% of municipal solid waste is made up of recyclable materials, such as metal, plastic, glass or paper,² less than 2% of solid waste collected by municipalities is sent for recycling,³ and this reaches only 9% when waste collected by the informal sector is included.⁴ Mismanaged plastic waste alone is estimated at 3.5 million tonnes annually, with approximately 1.3 million tonnes entering drainage systems, accumulating in rivers, and ultimately threatening the terrestrial, freshwater and marine ecosystems and communities that depend on them.⁵

The consequences extend well beyond visible pollution. In 2020, it was estimated that waste mismanagement caused around BRL 97 billion^A in indirect economic damages — environmental contamination, public health impacts, climate costs from landfill methane emissions, and the loss of recoverable materials.⁶ At the same time, the shortcomings of the current system



A USD 18.7 billion. All BRL figures are converted to USD using an indicative average exchange rate of BRL 5.19 = USD 1 for January-June 2026. USD equivalents are rounded and provided for reference only.



are reflected in the lives of nearly a million waste pickers, who provide a significant share of the country's recycling services but whose work remains largely informal and under-recognised.

Brazil is not starting from scratch. The country has built a comprehensive national policy framework over more than a decade. The National Solid Waste Policy (PNRS, 2010) introduced a shared responsibility concept across the value chain, EPR-like reverse logistics systems and a waste hierarchy prioritising non-generation, reduction, reuse, and recycling over disposal. The National Solid Waste Plan (PLANARES, 2022) translated this into national targets and a long-term implementation roadmap through to 2040. This framework has been progressively supplemented through additional, targeted regulation, such as the National Circular Economy Strategy (2024) and a new Plastic Packaging Decree (2025) which establishes the reverse logistics system for plastic packaging. Alongside one of the world's most prominent waste picker cooperative movements, a growing recycling industry, and genuine political momentum, the foundations for transformation are increasingly in place.

The opportunity is significant — economic, social, and environmental.

Stronger waste management systems could help recover up to an estimated BRL 14 billion^B in recyclable materials currently lost to landfill every year, create employment and improve livelihoods for the hundreds of thousands of waste pickers who already underpin the country's recycling system, and prevent millions of tonnes of plastic from entering Brazil's rivers and coastal ecosystems. Preventing river pollution would reduce diseases, increase productivity, and strengthen sectors like tourism, agriculture, and sustainable fisheries.

Realising that opportunity requires addressing structural gaps across the system — in policy enforcement, funding model, social inclusion, behaviour change, and physical infrastructure.

This paper, developed in collaboration with more than 80 organisations from across Brazil's collection and recycling value chain, establishes a baseline of where Brazil's cities stand today, sets out that shared vision for 2040, and provides an initial framework for the actions needed to get there. It closes with a call to action for policymakers, municipalities, businesses, waste picker organisations, philanthropies, and financial institutions to play their part and join future multistakeholder initiatives to make the wider transformation happen.

01

BASELINE



1.1

CURRENT LEVELS OF MUNICIPAL SOLID WASTE MANAGEMENT AND RECYCLING

The headline picture is one of partial progress. Brazil serves approximately 92% of the population with regular household solid waste collection services and collected around 88 million tons of urban solid waste in 2024⁷ — a strong foundation by global standards. But collection and adequate management are not the same thing. Of the collected waste ultimately sent for disposal, approximately 74% was sent to sanitary landfills, while approximately 26% was mismanaged in open dumps (16%) and controlled landfills (10%).⁸ Total mismanaged waste is estimated at around 40% when waste not captured by municipal collection services, as well as waste that is littered, dumped, or openly burned, is included.⁹ Studies indicate that approximately 36% of Brazilian urban waste is potentially recyclable,¹⁰ but less than 2% of solid waste collected by municipalities is sent for recycling.¹¹ When waste collected by the informal sector is included, only about 9% effectively returns to the recycling chain.¹²

It is important to note that waste management data, at national- or subnational-level, varies across sources and methodologies — figures should be treated as indicative rather than definitive (see appendix 1 for detail).

Plastic packaging is the largest recyclable fraction by weight — and the hardest to recover effectively. Brazil is one of the few middle- or high-income countries in the world that generates a larger share of plastics in municipal solid waste, by weight, than paper and cardboard (see Figure 1). It generates approximately 4 million tonnes of plastic packaging waste annually,¹³ but overall plastic packaging recycling stands at around 24%.¹⁴ However, that average conceals a sharp divide: PET reaches around 46%, HDPE near 29%, PP around 17%, and LDPE and LLDPE less than 10%.¹⁵ Other materials perform better where market incentives are stronger — paper and cardboard at approximately 60%,¹⁶ aluminium at 97%,¹⁷ and steel at 47%.¹⁸ Glass packaging recycling is estimated at around 25%.¹⁹

Industry-reported recycling rates bring different information.

Figures vary significantly across methodologies: plastic packaging recycling is reported at around 24% by PICplast,²⁰ while other estimates suggest around 10% (Packaging Data Hub)²¹ and as low as 4.5% in academic studies.²² The true scale of unrecovered recyclable materials is likely larger than headline figures suggest (see appendix 1).



FIGURE 1 Composition of municipal solid waste in Brazil, 2020²³

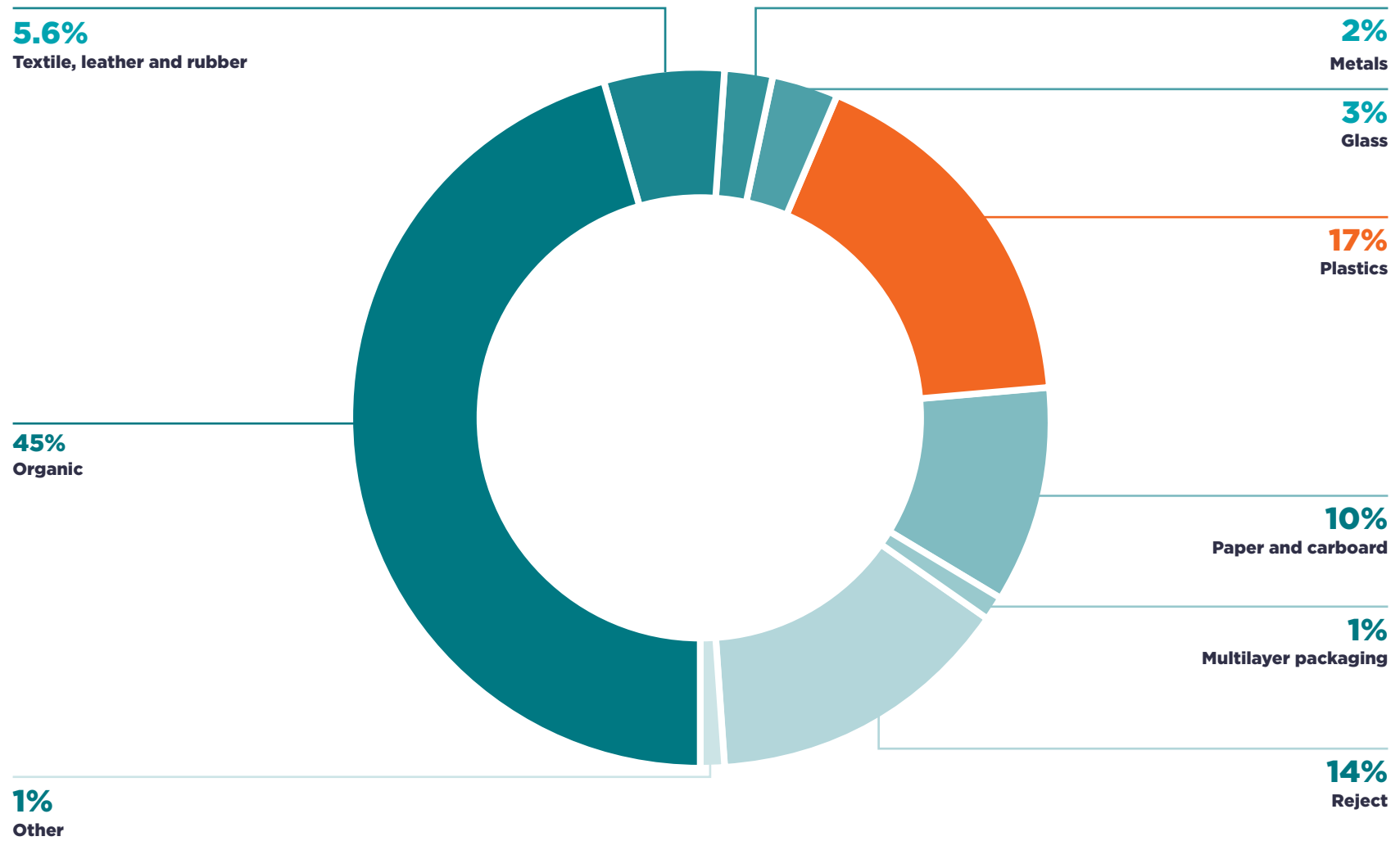






FIGURE 2 Waste management statistics by region^{24,25}



Regional inequality runs through all of this. Moving from south to north, waste management maturity falls, recycling capacity diminishes, and the chance of leakage into critical freshwater ecosystems increases. Municipalities in the South spend on average around 40% more per tonne of waste than those in the North.^{26,27} Mismanagement rates fall

from 61% in the North down to 29% in the Southeast,²⁸ and separate collection coverage reaches 66% of households in the South but just 6% in the Northeast.²⁹ But even in better-performing regions, gaps remain significant — Southern cities continue to face challenges including mismanaged waste in less urbanised areas and incomplete

selective collection coverage. Still, the regions with the least capacity to manage waste well are also those where the Amazon, the Pantanal, and other globally significant ecosystems bear the greatest environmental impacts^{30,31} (see Figure 2).

-  % of municipalities with formalised engagement with cooperatives
-  % households with segregated waste (recyclables) collection
-  Municipal spending on MSW per ton generated [€]
-  % of MSW that is mismanaged



This baseline reveals a system with foundations but significant structural gaps across the value chain. High mixed waste collection coverage and an established informal waste sector means meaningful volumes of higher-value materials are already recovered. But closing the gap requires more than operational capacity — it demands policy enforcement, selective collection along with behaviour change, socioeconomic inclusion of waste pickers, demand-side mechanisms, and effective waste management strategies working in concert. Those structural and systems coordination gaps are most acutely felt in the performance of lower-value materials, underserved regions, and the plastics most at risk of leaking into Brazil's rivers and freshwater ecosystems — the subject of the next section.

1.2

FRESHWATER ECOSYSTEMS AND POLLUTION PRESSURES



Brazil holds approximately 12% of the world's freshwater resources — the largest share of renewable freshwater of any country globally. Those

ecosystems underpin extraordinary biodiversity, support the livelihoods of millions, play a critical role in the country's climate resilience, and underpin a significant proportion of economic activities. They are also under growing pressure from agricultural runoff, mining, industrial discharge, sewage, and municipal

solid waste — pressures that climate change is compounding through more frequent extreme rainfall and flooding events that disrupt waste collection, damage infrastructure and carry pollutants into rivers and waterways.

Of those pollution sources, municipal solid waste presents a particular opportunity for improvement — even as the scale of the challenge remains significant. Unlike diffuse agricultural runoff or complex industrial discharge,

solid waste pollution follows predictable pathways, concentrates in identifiable hotspots, and responds to targeted action.

SOURCES AND SCALE

Mismanaged municipal solid waste enters freshwater ecosystems through three main pathways:³² uncollected waste entering waterways directly; leakage from waste disposed of through non-sanitary routes; and

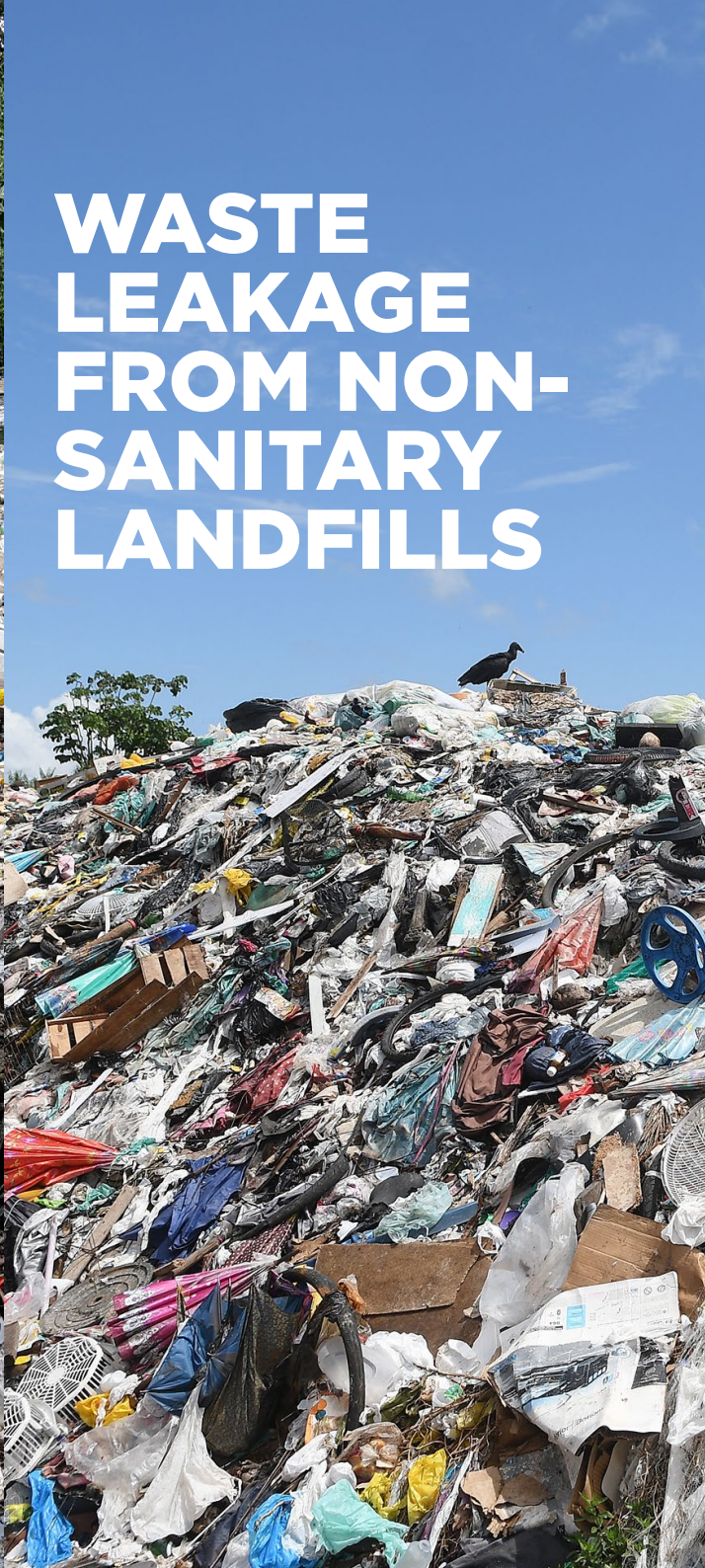
leachate from non-sanitary disposal sites. Plastics consistently dominate inorganic aquatic pollution where compositional data are available.³³ Total mismanaged plastic waste in Brazil is estimated at around 3.5 million tonnes annually — the highest of any country in the Western Hemisphere — with an estimated 1.3 million tonnes reaching the ocean, which is equivalent to 8% of total global ocean plastic leakage.³⁴

MAIN FRESHWATER PATHWAYS

**UNCOLLECTED
WASTE**



**WASTE
LEAKAGE
FROM NON-
SANITARY
LANDFILLS**



**LEACHATE
FROM NON-
SANITARY
LANDFILLS**





HOW POLLUTION MOVES

Plastic pollution in rivers does not distribute evenly. Globally, studies estimate that 80% of river plastic reaching the ocean flows through just 1,000 rivers (representing 1% of all rivers studied) — a concentration that reveals the outsized improvement possible through targeted action.³⁵ As one of the most heavily dammed countries in the world, Brazil accumulates significant volumes of waste upstream of dams rather than reaching the ocean directly, building up in sediment and surface waters along river lengths.³⁶ Climate change is amplifying these dynamics: intensified flood events increase leakage volumes and accelerate microplastic contamination, particularly in urban areas where loosely bagged waste can flow into drainage systems.³⁷ The relationship is self-reinforcing — mismanaged waste blocks drainage infrastructure, placing additional pressure on flood management systems.³⁸

IMPACTS

The impacts of waste entering freshwater ecosystems extend well beyond visible pollution. Leaked municipal solid waste disrupts river carbon cycling by increasing organic material loads, driving elevated methane production — a dynamic that rising temperatures further intensify. Leachate from mismanaged landfill sites carries heavy metals, chemical contaminants, and pathogens into both surface and groundwater, with contamination and associated impacts on ecosystem health persisting long after a dumpsite closes.³⁹ At the same time, plastic waste present in these environments undergoes progressive fragmentation, forming microplastics that persist in aquatic ecosystems and increase the risks of exposure for wildlife and human populations.

Some emerging research suggests possible human health consequences warrant further investigation. Widespread microplastic presence has been documented in the Paraná and Amazon rivers, with microplastics detected in the gut of 98% of fish sampled in the Amazon — including species actively consumed by riverine communities.⁴⁰ While scientific consensus has not been established, some emerging studies have reported the detection of microplastics in a range of human tissues and organs.^{41,42} The implications of consuming fish in which microplastics have been detected remain unsettled, alongside other areas of ongoing inquiry including the open burning of plastics and the behaviour of chemical additives associated with plastic materials.⁴³

PROBLEM HOTSPOTS

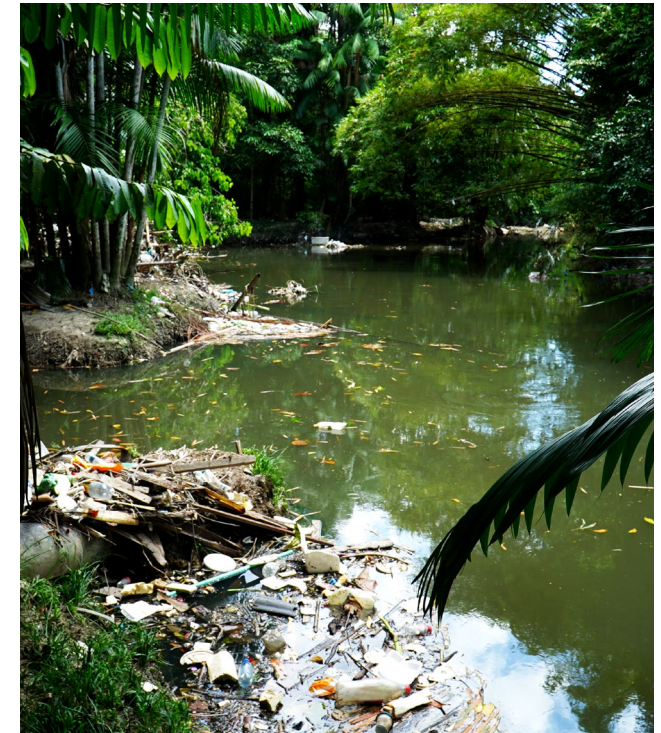
Leakage is not evenly distributed across Brazil.

The highest-risk corridors are identifiable: the Rio de la Plata system, the Amazon basin, the São Francisco basin, and Guanabara Bay account for a disproportionate share of total waste transport,⁴⁴ driven by inland cities including São Paulo, Belo Horizonte, and Manaus, and coastal cities including Belém, Salvador, and Rio de Janeiro. Some analysis suggests that certain lightweight, low-value plastics — films, fragments, and fibres — are disproportionately represented in leakage streams. Their low recycling value and buoyancy may make them more likely to escape collection and enter river systems.^{45,46,47}



The concentration of the problem may also present opportunities for targeted action.

A relatively small number of cities, river basins, and material types account for a disproportionate share of Brazil's plastic leakage. Targeted action in those corridors — strengthening collection, closing dumpsites, improving the incentives for collecting and recycling low-value plastics — could deliver outsized environmental and economic impact.



Manaus illustrates these dynamics clearly.

Located on the Rio Negro near its confluence with the Amazon, an estimated 3,500 tonnes of plastic enter surrounding water systems annually,⁴⁸ driven by low-value packaging and single-use plastic items. This underscores how inland urban centres directly influence downstream marine outcomes through riverine transport pathways.

1.3

STAKEHOLDER ROLES AND PERFORMANCE IN MUNICIPAL SOLID WASTE MANAGEMENT



Waste management outcomes are shaped by five core stakeholder groups: policymakers and regulators; municipalities and concessionaries; households and large waste generators; the waste picker ecosystem; and recyclers, producers⁴⁹ and end markets. Each plays a distinct role — and each faces its own barriers to performing that role more effectively.

A POLICYMAKERS AND REGULATORS

Brazil's policy framework for municipal solid waste provides a strong foundation — comprehensive, ambitious, and increasingly focused on plastics and circularity.

The National Solid Waste Policy (PNRS, 2010) established a broad legal framework and shared responsibilities for waste management, including reverse logistics obligations. Brazilian reverse logistics is the legally required system through which producers, importers, distributors, and retailers are held accountable for enabling the collection and return of post-consumer products and packaging for reuse in their cycle or in other production cycles, or other environmentally sound final destination, with public authorities overseeing and supporting the system. The National Solid Waste Plan (PLANARES, 2022) translated these requirements into national targets and a long-term implementation roadmap through to 2040. Decrees 10.936/22 and 11.413/23 further operationalised these obligations by strengthening implementation rules, traceability requirements, and monitoring mechanisms for reverse logistics systems, including the use

of Waste Transportation Manifests (MTRs), invoices, and results verification systems conducted by accredited verifiers. More recently, the National Circular Economy Strategy (ENEC, 2024) and the National Strategy for a Plastic-Free Ocean (ENOP, 2025) broadened the scope to include circularity and plastic-specific objectives. Subsequent federal measures have further reinforced implementation — including the Recycling Incentive Law (2024) and the expansion of reverse logistics under additional decrees, notably the Plastic Packaging Decree (2025), strengthening incentives for material recovery and investment in the waste sector (see Appendix 2).

State-level legislation plays a bridging role — translating federal mandates into enforceable regional requirements. Many states have introduced additional waste and reverse logistics rules, which can strengthen implementation but also create fragmentation, particularly for packaging where requirements vary across jurisdictions.

The gap between policy intent and implementation, however, is real. The clearest illustration is the drive to eliminate open dumps:

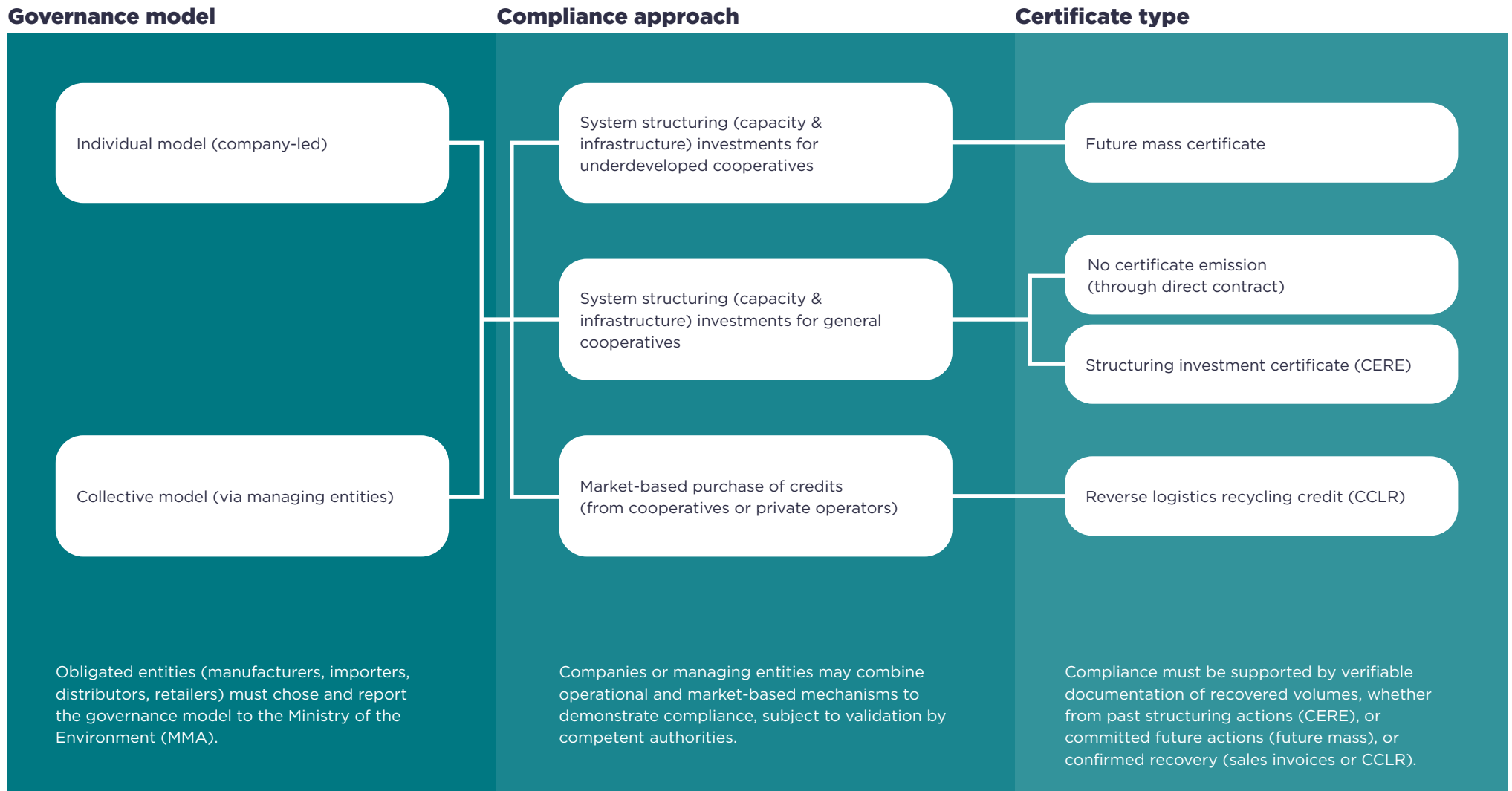
originally mandated by 2014, the deadline was extended to 2024, yet a substantial number of municipalities still rely on inadequate disposal sites.⁵⁰ Shared responsibilities across levels of government, uneven monitoring and enforcement capacity, and varying levels of financial and technical support for municipalities all contribute to this gap. The governance of reverse logistics systems for packaging has advanced significantly, but strengthening supervision and enforcement — alongside a more consistent understanding of roles and responsibilities across the different actors involved — remains an important opportunity to enhance the effectiveness of the system.

The design of Brazil's reverse logistics system for general packaging creates further structural challenges. Producers can meet their recovery obligations through multiple compliance routes — through direct infrastructure investment or the purchase of recycling certificates (see Figure 3). That flexibility broadens participation, but disperses funding across parallel mechanisms without strategic coordination across collection, sorting, and processing, as well as cities and

materials. Indicative estimates from secondary sources suggest that the prices of reverse logistic credits paid to waste picker organisations and operators— currently BRL 50–350 per tonne,^c varying widely by geography, operational model and material stream — remain far below the actual cost of collection and sorting, estimated at BRL 1,100–1,800 per tonne,^{d,51} limiting their ability to finance the system adequately or compensate waste pickers fairly. Differences in the methodologies, risks, and costs across credit types — combined with limited oversight — can lead to compliance being met through lower-cost, suboptimal end-of-life pathways or non-packaging materials. These variations should be addressed to avoid disproportionate competition or cost asymmetry. Furthermore, the presence of multiple, often for-profit PRO-like managing entities can exacerbate the fragmentation of the system. A more centralised model — aligned with internationally recognised EPR best practices^{52,53,54,55,56,57} and similar to successful reverse logistics systems in Brazil, such as that for agrochemical packaging or lubricating oil plastic packaging (see Table 2 in appendix) — could enable a more integrated and strategic deployment of the additional reverse logistics funding expected from the new material-specific decrees.

C USD 10-67
D USD 212-347

FIGURE 3 Main compliance routes for reverse logistics obligations in Brazil



1: Brazilian legislation does not provide a fully prescriptive definition of these compliance pathways or a strict differentiation between instruments (e.g., CCLR and CERE). The figure reflects the main arrangements observed in practice; other configurations may be accepted by competent authorities.

In practice, lower-value materials, particularly flexible plastic, receive less reverse logistics funding than their fair share. This is because obligations can be met through material offsets using higher-value, easier-to-recover materials. Infrastructure investment is typically recognised at the capital expenditure stage, while operating costs are less consistently covered, meaning assets can be in place but sit idle or broken with capability-building and maintenance overlooked.

There is also a structural gap in how costs are shared between reverse logistics systems, municipalities, and waste pickers. Municipalities currently fund collection (including separate collection) and disposal of municipal solid waste — including materials covered by reverse logistics obligations — with no operational mechanism to recover those costs from producers, importers, distributors and retailers, as envisaged in the PNRS framework, but not yet consistently operationalised in practice.⁵⁸ This reduces financing predictability and makes long-term investment harder to coordinate.

On freshwater specifically, the governance challenge on waste leakage is compounded by a fundamental jurisdictional mismatch.

River governance in Brazil operates at state and federal level, while waste management is municipality-led — but rivers cross municipal, state and national boundaries, and the entities responsible for collecting waste have no authority over the waterways they affect further downstream. River Basin Committees exist to enable cross-boundary coordination, but municipal participation is voluntary and their mandate rarely extends to implementation. Waste and water policies are developed nationally but not joined up locally, with rare exceptions.



B MUNICIPALITIES AND CONCESSIONARIES

Municipalities are the operational heart of Brazil's waste management system — and budget constraints are the central challenge they face. In

most urban centres, municipal waste collection coverage exceeds 90%, and the foundations of a functional system are in place. But local governments are systematically pushed toward the cheapest option by limited budgets, competing political priorities, and the absence of consistent compensation by producers when municipal selective collection systems support the implementation of reverse logistics — and the cheapest option is rarely the one that recovers the most material. Expert interviews reveal that — on a per-tonne basis — separate collection and sorting of recyclables can cost several times more than mixed waste collection and landfill disposal today. This dynamic reinforces the need to channel additional funding towards selective collection, favouring material recovery over lower-cost disposal options.

Cost recovery mechanisms are weak, and contract structures can reinforce the wrong incentives. On average, large cities cover only around half of their waste management costs through taxes and fees⁵⁹ and rely on government aid

to cover the remainder, with just 8% of municipalities charging a specific waste management fee.⁶⁰ Volume-based collection contracts reward operators based on the amount of waste landfilled rather than diverted, leaving little structural motivation to invest in recycling over disposal — and reducing the bankability of projects that might otherwise attract external financing.

The fiscal expenditure picture varies sharply by region, and the gap in outcomes is visible across every metric. Municipalities in the South

spend on average around 40% more per tonne of waste than those in the North. In some cases, municipalities in the South and Southeast can spend up to three times more per tonne than those in lower-spending regions.⁶¹ Open dumping is reported by 73.8% of municipalities in the North and 51.6% in the Northeast, compared with 5.7% in the South.⁶² Among large cities, the Southern city of Porto Alegre reports full coverage for separate collection of recyclables, while Recife in the Northeast stands at just 1%.⁶³

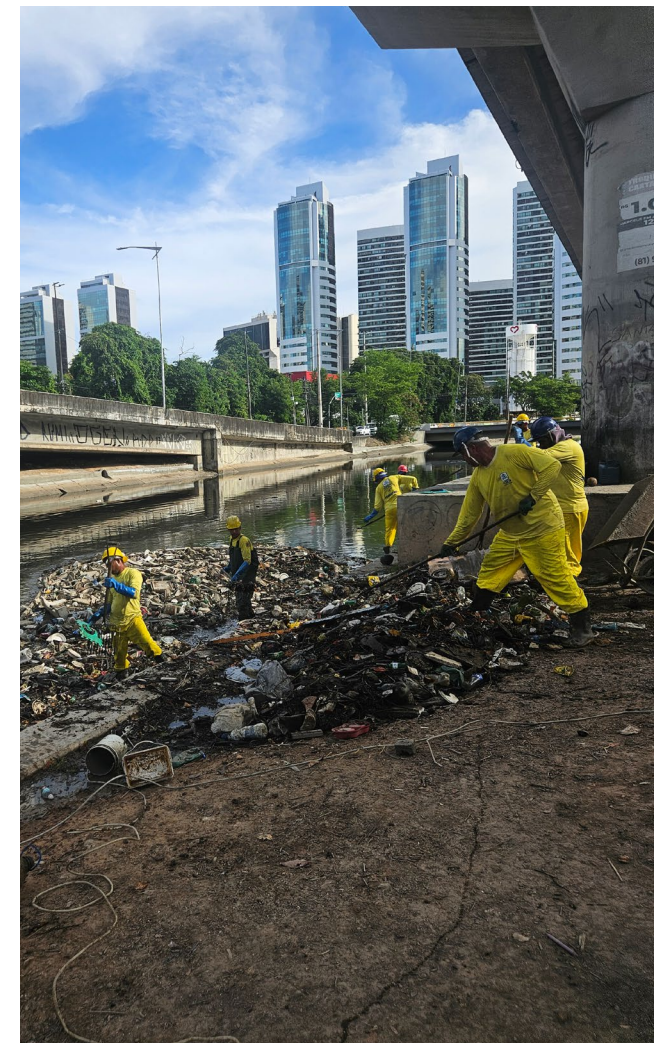
Within cities, the pattern repeats.

Informal settlements and peri-urban communities consistently receive less reliable services and face the highest leakage risks, and have the least political leverage to demand better.

Underserved, flood prone, and river adjacent communities are often the main interface through which land-based waste enters freshwater systems.

Municipalities also face a fundamental governance gap on water. Waste collection, sanitation, and urban drainage all converge on water quality — and municipalities control all three. But they have no accountability for the rivers and waterways that carry the consequences of failures in each, and without coordination and joint investments between neighbouring municipalities along a river's length, even well-performing local systems cannot address pollution at the watershed scale.

Brazil's high collection coverage is an asset — but translating it into a system that circulates materials effectively, reduces leakage, reaches underserved communities, and fairly integrates informal workers, will require stronger fiscal foundations, greater institutional integration, and multi-level management and shared ambitions across stakeholders.





C HOUSEHOLDS AND LARGE GENERATORS

Households and large waste generators constitute the main sources of waste generation in the Brazilian urban system, although they present distinct dynamics, responsibilities, and challenges related to the segregation, collection, and management of the materials generated.

Households are a key entry point to the waste management system — but the incentives and behavioural conditions needed to support better waste practices are largely absent. Only around 8% of municipalities currently charge a specific waste management fee,⁶⁴ and where fees exist they are typically flat charges bearing no relation to the quantity of waste generated. At the same time, other behavioural mechanisms

that have driven participation rates in other countries — including social norm messaging, feedback loops, convenience measures, and pay-as-you-throw systems supported by traceability mechanisms — remain the exception rather than the rule.

The consequences are visible in source separation performance. Even where selective collection is available, roughly one-third of residents with access do not routinely separate recyclables.⁶⁵ And when households do participate, they tend to focus on higher-value items — aluminium cans, PET bottles — rather than lower-value materials like flexible plastics and paper that make up the majority of recyclable waste they produce. Academic studies and research conducted by public agencies and civil society organisations indicate that the

population frequently has doubts about how to correctly separate waste, which packaging and materials are recyclable, and how selective collection works in their region, including information about the existence of the service in the neighbourhood and the collection days.^{66,67,68} Expanding participation and improving separation quality will require sustained public engagement and better behavioural incentives, not just more collection infrastructure.

Where formal collection is limited or irregular, the risk of environmental leakage rises sharply. Waste disposed of in nearby waterways, vacant land, or open dumpsites contributes directly to freshwater pollution — and lightweight, low-value plastics are disproportionately represented in those leakage streams.⁶⁹

Large generators represent an underleveraged opportunity.

Commercial establishments and institutions are required under Brazil's National Solid Waste Policy to organise and finance the management of their own waste. In principle this creates scope to divert substantial volumes of relatively homogeneous waste streams — cardboard, packaging, food waste — at scale. In practice, monitoring and enforcement are inconsistently applied, and the potential of this part of the system remains largely unrealised. At the present moment, municipalities are responsible for regulating large waste generators, although a national framework — currently under discussion through a proposed CONAMA resolution — aims to harmonise these rules across jurisdictions.

D THE WASTE PICKER (CATADORES) ECOSYSTEM

Brazil's waste pickers are the backbone of the country's recycling system — and represent a strategic opportunity to expand material recovery. Around 800,000 autonomous waste pickers collectively recover an estimated 65-90% of Brazil's recyclable materials,^{70,71} alongside roughly 40,000 workers operating across approximately 2,200 cooperatives.⁷² Without waste pickers, the recycling system as it currently exists would not function.

Their contribution comes at a significant human cost. Working conditions are generally poor — physically demanding, often hazardous, and largely outside the protections that formal employment provides. Income is low and unstable. Research documents waste pickers' preference for autonomy and immediate payment over cooperative structures, but that preference reflects the practical logic of economic precarity and limited alternatives, rather than unconstrained choice.

Waste picker cooperatives offer a more structured model, but face their own pressures. Cooperative members typically benefit from better working conditions and can earn significantly more than autonomous pickers — income comparisons in São Paulo and Belém suggest more than double the income⁷³ — and cooperatives are more institutionally integrated, in some cases contracted directly by municipalities and sometimes by large generators. But many operate with limited infrastructure and equipment, and payments for the service they provide are rarely embedded in municipal contracts.

Collection rates may vary based on the market. In general, materials with established resale value are more likely to be collected and recycled; lower-value materials — particularly flexible plastics, films, and sachets — are less likely to be recovered. Without compensation or reliable offtake for these materials, there may be less financial incentive to collect or sort them. These may also be the materials most likely to leak into drainage systems and freshwater environments.





Private sector partnerships are helping reshape that dynamic. Reverse logistic programmes channel producer funding into waste picker networks, supporting collection and sorting while enabling producers to meet regulatory recovery targets. These arrangements provide waste pickers with equipment, safety improvements, and operational training, while giving brands operational insight into material flows and real-world recyclability.

Waste pickers play a central role in Brazil's recycling system — but still require greater recognition, support, and structural integration. National legislation increasingly recognises waste pickers as key contributors to environmental and climate action, and efforts to strengthen cooperative structures, improve working conditions, and expand municipal integration are moving in the right direction. But the pace needs to accelerate — on terms set by what works for waste pickers: better working conditions, fairer remuneration for the service they provide, and access to public social benefits and economic stability.

E RECYCLERS, PRODUCERS AND END-MARKET BUYERS

Recycling market economics in Brazil create a two-tier system that mirrors the pollution problem.

Materials with established resale value — aluminium, PET, HDPE, cardboard — are supported by relatively mature recovery markets. Lower-value materials face structural barriers — lower margins, higher contamination rates, limited demand, and competition from cheap virgin materials — that no amount of collection effort can overcome without changes to the underlying market incentives.

Demand signals are beginning to shift, but the gap remains large.

The 2025 Plastic Packaging Decree, which introduces a recyclability index, recycled content requirements (except for specific food-contact applications) and recovery targets for producers with reverse logistics obligations, is beginning to shift those signals. Additionally, growing corporate demand for recycled inputs is gradually strengthening the investment case for expanded capacity, and in some cases this is already translating into multi-year offtake agreements, particularly for

materials like PET.⁷⁴ But lower-value materials, such as post-consumer multimaterial packaging and flexible plastics, cannot easily be processed into mechanically recycled feedstock of sufficient quality — and are typically recycled into lower-grade applications where willingness-to-pay is low relative to virgin resin prices. Meanwhile, producers have high performance requirements for packaging, including strength, transparency, colour, and lack of odour, and therefore often rely on feedstock from post-industrial waste, which is less contaminated and more homogenised but is typically already recycled. As a result, this can shift material flows without significantly expanding the recovery of post-consumer waste. New recycling technologies are able to create high quality feedstock suitable for packaging applications, but they remain costly and present broader challenges to deployment, and have yet to be proven at scale in Brazil.

Recycling markets may be further constrained by structural supply-demand challenges. While weak and unreliable demand can keep prices low and undermine investment in capacity, insufficient volumes of quality feedstock prevent recyclers from securing stable offtake agreements. As a result, significant installed capacity —

particularly in segments such as PET — remains underutilised.⁷⁵ Meanwhile, a lack of capacity to recycle lower-value plastics, such as LDPE, prevents the sector from achieving the economies of scale needed to compete with virgin resin prices. At the same time, with the Selic rate — the economy's benchmark interest rate — above 14% as of April 2026, the cost of capital remains high, making investment in recycling operations less attractive. Breaking this cycle will require decisive action on both the supply and demand sides of the recycling market, alongside de-risking mechanisms to enable financing.

Geography compounds the structural challenge. Recycling capacity is heavily concentrated in the South and Southeast. In regions with more limited processing infrastructure, materials must travel long distances to reach recycling hubs, with prices for plastics, paper, and aluminium in the North running approximately 20–35% below national averages. The regions where leakage risk is highest are also where the economics of local sorting are weakest.

As recycling capacity expands, managing the sector's own environmental impacts becomes increasingly important. Like any other industrial activity, recycling operations can release a range of pollutants if not properly regulated and enforced. Strengthening facility-level controls, wastewater treatment, and regulatory oversight — alongside capacity expansion — will be essential to ensure that increased material recovery does not introduce new pollution pathways.



LOOKING AHEAD

THE FOUNDATION FOR TRANSFORMATION

The baseline tells a clear story: Brazil has the foundations, but not yet a well-enforced and orchestrated system that works for higher and lower-value plastics, waste pickers, underserved communities, or the rivers and other ecosystems that bear the cost of the gaps.

But those gaps are closing. Plastics recycling in the Northeast grew by 17% in 2024, against a national average of 8%⁷⁶ — evidence that progress is accelerating in the regions that have historically lagged furthest behind. The question now is whether that momentum can be turned into a more durable system where infrastructure reaches the

materials and places currently left behind, and market conditions make it economically viable. The following chapter sets out what the opportunity looks like if those gaps are closed.

02

VISION AND OPPORTUNITIES



2.1

VISION FOR BRAZILIAN CITIES BY 2040

Addressing Brazil's waste management challenge requires more than incremental improvement — it requires a shared vision to guide stakeholders' long-term decision-making. Without a shared vision, actions risk becoming fragmented or reactive, limiting their ability to deliver lasting systemic change. The vision set out here is not a fixed model but a set of principles — ambitious but achievable across different local contexts, and designed to be reached through multiple pathways.

Through an initial collaborative effort, the Ellen MacArthur Foundation, Clean Rivers, and more than 80 organisations co-created a shared vision of what Brazilian cities' waste management and recycling systems could look like by 2040. The transition to a circular economy is an ongoing process, and 2040 represents an ambitious but achievable milestone — a significant step in the right direction rather than a finish line.

This vision builds on the principles and objectives established by the National Solid Waste Policy (PNRS), building on its foundation to articulate a forward-looking perspective for urban waste management systems in Brazil. Achieving it will require collaborative efforts across stakeholders — from policymakers and municipalities to obligated parties under reverse logistics, waste picker organisations, recyclers, and financial institutions. The next section explores the economic, social and environmental benefits of this transformation — and why the opportunity is too significant to leave on the table.

We envision waste management and recycling systems for Brazilian cities that capitalise on existing momentum, support national policy objectives, and pave the way toward a truly circular economy, by following six key objectives by 2040:

1

Waste volumes are minimised and material circularity is maximised across the economy. Accessible recycling systems capture and reprocess most materials, supported by the elimination of unnecessary materials, design for circularity, and circular practices throughout the chain.

2

Waste pickers are compensated for the service they provide and have safe and healthy working conditions. Cooperatives, associations, and autonomous waste pickers are fully integrated into municipal waste management systems, being properly rewarded and supported in their fundamental role, and new jobs are created in the chain.

3

Inadequate waste disposal is prevented by effective management and monitoring systems. Non-sanitary disposal sites and open burning are eliminated, and reliable collection and treatment systems prevent waste from leaking into the environment, protecting rivers, lakes, and other freshwater ecosystems.

4

Environmental emissions and health impacts are minimised. Adequate treatment and processing of waste significantly reduces greenhouse gas emissions, as well as other pollutants, reducing social and environmental impacts, while creating opportunities for climate mitigation, adaptation, and resilience.

5

Households and large waste generators are enabled and actively participate in the waste management system. Households and large waste generators are enabled to effectively participate through adequate systems, information and environmental education that support the correct disposal and proper separation of materials. Households and large waste generators recognise they play an essential role in the adequate management of waste, and act accordingly.

6

The waste management and reverse logistics systems are well-governed, transparent, and economically sustainable. Roles and responsibilities throughout the waste management and reverse logistics chain are clear, they are in line with internationally recognised best practices for effective EPR, there is effective oversight and collaboration to support circular economy outcomes, and the performance of the system is monitored and transparent.

2.2

THE OPPORTUNITY: ECONOMIC, SOCIAL, AND ENVIRONMENTAL RETURNS

The gaps identified in chapter 1 represent opportunity as much as challenge. The materials being lost, the costs being incurred, the livelihoods being left unsupported, and the pollution being generated are not inevitable features of Brazil's waste system — they are the consequence of a system that has not yet been built to perform at the level required. Closing that gap delivers returns across economic, social, and environmental dimensions.

A better-performing system could save BRL 98 billion per year.^E

In 2020, waste mismanagement caused an estimated BRL 97 billion^F in indirect economic damages — environmental contamination, public health impacts, climate costs from landfill methane emissions, and the loss of recoverable materials⁷⁷ — alongside approximately BRL 30.5 billion in direct system costs.⁷⁸ Without improvement, these combined costs are projected to rise to approximately BRL 168 billion^G annually by 2050.⁷⁹ Better waste management aligned with national targets, including the closure of dumpsites, expansion of recycling, recovery of organic waste, and improved landfill management, could reduce these costs by approximately BRL 98 billion per year by 2040.⁸⁰

Beyond cost reduction, a better-performing system recovers value that is currently being thrown away.

Each year, recyclable materials worth approximately BRL 14 billion^H are disposed of in Brazilian landfills rather than recovered.⁸¹ Improving waste management systems could redirect that value back into the economy while reducing pressure on virgin material production.

Stronger waste management systems create employment as well as economic value.

Each 1% increase in recycling rates is estimated to create approximately 9,300 jobs across collection, sorting, and materials processing.⁸² The development of plastics recycling value chains specifically could generate approximately 64,000 jobs by 2030.⁸³

As well as new jobs, there is an opportunity to improve conditions for the hundreds of thousands of people already doing this work.

An estimated 800,000 waste pickers operate across Brazil,⁸⁴ approximately 87% of them informally.⁸⁵ Voluntary participation in organised systems, including waste picker cooperatives and formal partnerships with municipalities and recycling companies can make a material difference to their earnings and working conditions. Cooperative members can earn more than double

the income of autonomous waste pickers,⁸⁶ and scaling that integration on terms that work for waste pickers is one of the most direct social returns available.

There is also an important gender dimension in this context.

Women have a significant presence in Brazil's recycling chain and frequently hold leadership positions in cooperatives and associations of waste pickers. In many cases, they are also the main providers of household income, which amplifies the social and economic impacts of policies aimed at valuing, formalising, and strengthening the sector.

Stronger waste management infrastructure directly reduces the volume of plastic entering Brazil's rivers and coastal ecosystems.

Mismanaged plastic waste is estimated at around 3.5 million tonnes annually, with an estimated 1.3 million tonnes reaching the ocean.⁸⁷ Improved collection, recycling, safe disposal, and treatment systems reduce the volume of plastics directly entering Brazil's rivers, while lowering risks of landfill leachate contamination, in turn protecting the country's unique biodiversity, water quality and climate resilience.



PHOTO CREDIT: LINA MINTZ FOR WIEGO

E USD 18.89 billion
F USD 18.70 billion

G USD 32.45 billion
H USD 2.79 billion



Improved waste management also reduces greenhouse gas emissions. Substituting virgin material production with recycled content, and improving organic waste and landfill gas management, are also significant levers for reducing greenhouse gas emissions. Phasing out selected single-use applications could reduce disposable plastic waste generation by approximately 8.2 million tonnes between 2025 and 2040, avoiding around 18 million tonnes of CO₂e emissions over the same period,⁸⁸ while development of plastics circularity value chains is estimated to reduce emissions from the plastics sector by approximately 7%.⁸⁹

Public health benefits reinforce the case further. Studies of waste pickers and communities near disposal sites show elevated incidence of infectious diseases linked to exposure to mismanaged waste.⁹⁰ Improved waste collection and selective collection coverage are associated with lower disease incidence through reduced vector breeding and lower exposure to contaminated water and air — translating into lower healthcare costs and improved labour productivity.^{91,92}

Taken together, these returns make a compelling case for prioritising investment in Brazil's waste management systems — economic, social, and environmental, and mutually reinforcing rather than in tension with one another.

2.3

CITIES AT THE FRONTLINE



Brazil's large cities represent a concentrated opportunity and sit at the primary interface between land-based waste generation and freshwater ecosystems. The 48 municipalities with populations above 500,000 are home to around 66 million people⁹³ and generate approximately 27 million tonnes of municipal solid waste annually — around 33% of Brazil's total.⁹⁴ That concentration of waste volumes under a limited number of local authorities amplifies both the risks of environmental leakage and the potential leverage of collaborative, system-level action.

Smaller municipalities present a different challenge. More than 5,500 municipalities with populations below 500,000 collectively generate around 48 million tonnes of waste annually,⁹⁵ but those volumes are dispersed across thousands of local systems averaging around 9,000 tonnes per municipality per year.⁹⁶ More than 70% of municipalities have fewer than 20,000 inhabitants,⁹⁷ limiting economies of scale and reducing the attractiveness of investment. Prioritising large urban centres initially allows for the capture of significant waste volumes, reduce leakage at scale, and develop replicable models that can be progressively adapted for smaller municipalities over time.

Even among large cities, starting points vary significantly. Waste management maturity, recycling performance, and leakage risk differ substantially across Brazil's urban centres, reflecting the regional inequalities established in the baseline. A one-size-fits-all approach will not work — and the following city archetype framework developed through this process is designed to navigate that diversity.

Based on waste management maturity and recycling performance, Brazil's large cities can be grouped into four archetypes (see Figure 4). These measures are assessed relative to Brazil's own national context and standards, rather than against international benchmarks:



Archetype 1

Cities have higher recycling levels but lower waste management maturity, and carry higher leakage risk as a result. Primarily in the Southeast, these cities — typified by Belo Horizonte — benefit from proximity to established recycling infrastructure but face collection gaps that contribute to environmental leakage despite relatively strong recycling performance.

Archetype 2

Cities have both higher waste management maturity and higher recycling levels, and generally present lower leakage risk. Mostly in the Southeast and South, these cities have the most developed systems — Florianópolis is an example — but even here, seasonal population surges and service gaps in lower-income areas continue to pose challenges.

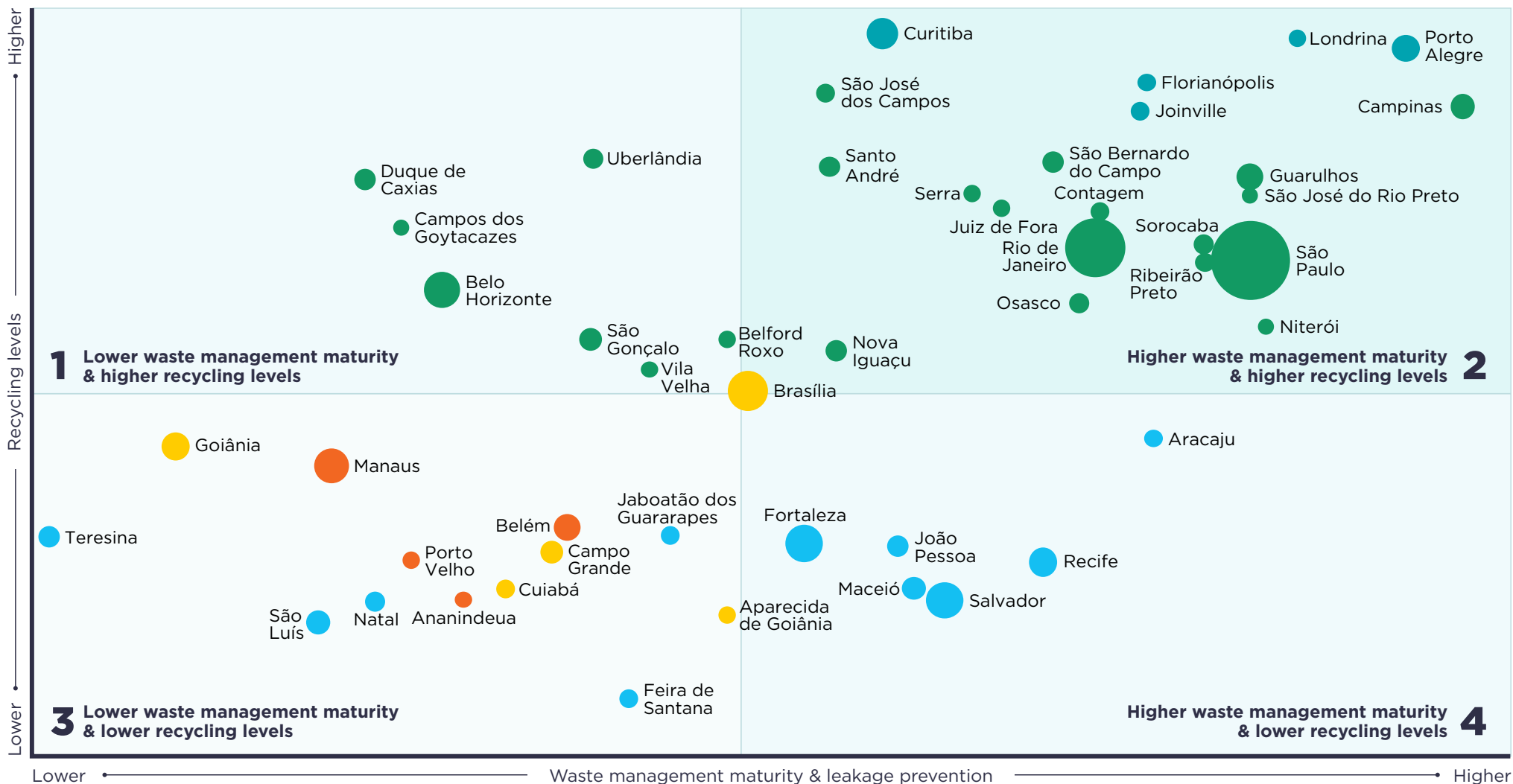
Archetype 3

Cities have lower waste management maturity and lower recycling levels, placing them at higher leakage risk. Predominantly in the North, Northeast, and Centre-West, these cities — illustrated by Belém and Manaus — have weaker overall waste management systems, limited proximity to recycling infrastructure, and higher levels of plastic leakage into rivers.

Archetype 4

Cities have higher waste management maturity, meaning lower leakage, but lower recycling levels. Mainly in the Northeast, these cities — typified by Recife — have relatively mature collection and disposal systems but still limited recycling infrastructure, despite recent progress. The priority here is expanding recovery, rather than fixing fundamentals.

FIGURE 4 Archetypes of large Brazilian cities (see appendix 3 for methodology and data sources).



- North
- Northeast
- Centre-west
- Southeast
- South
- Circle size represents population size

This classification matters because it determines where to focus and what to prioritise. Chapter 3 sets out how the framework for system transformation maps onto each archetype – and why the emphasis and sequencing of action needs to differ across them.

03

PATHWAY TO SYSTEM TRANSFORMATION

3.1

FRAMEWORK FOR SYSTEM TRANSFORMATION IN BRAZILIAN CITIES

Closing the structural gaps in Brazil's waste management system requires collaborative efforts across all stakeholders — from collection through to recycling, conversion and end-markets. The framework set out in Figure 5 organises this action into nine modules that collectively address the downstream value chain, and identifies the critical stakeholders that need to be engaged. This integrated structure offers a starting point for designing waste management and recycling systems transformation in Brazilian cities. Importantly, the modules are mutually reinforcing: no single module is sufficient on its own, and selective implementation will limit the overall impact of the system. A complementary Module 0 sits upstream of this framework — focusing on eliminating unnecessary packaging, enabling reuse, and redesigning packaging for circularity⁹⁸ — but as these actions relate to production and consumption rather than waste management systems, they are intentionally out of scope here.

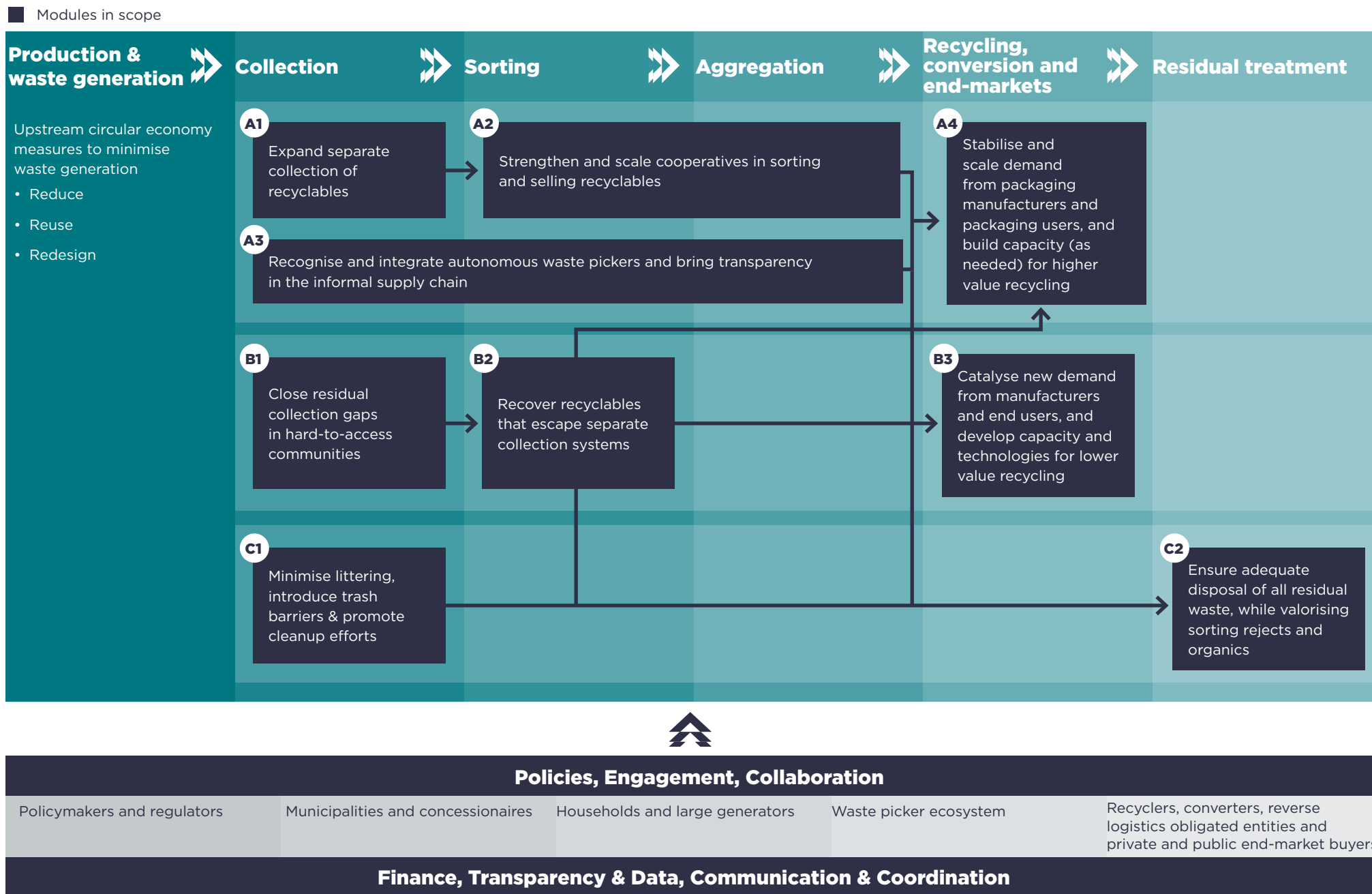
The framework presented in this section is a working hypothesis rather than a definitive model for transforming urban waste systems. It reflects the current shared understanding of the stakeholders involved, and it is expected to evolve as the approach is tested at city level, generating new evidence, practical experience, and continued stakeholder engagement. What is most important is not necessarily the precise configuration of the framework at this stage, but the underlying logic it embodies — collaborative, system-wide efforts to advance a circular economy.

Case studies exist that can illustrate how elements of the framework are already being implemented in Brazil and help ground the analysis in real-world experience. However, no city in Brazil has yet achieved strong performance across all nine modules simultaneously, highlighting both the partial nature of existing successes and the scale of the transformation required.¹

Implementation is not one-size-fits-all. The relative emphasis and sequencing of modules will vary depending on each city's starting point — the archetypes introduced in chapter 2 provide the map for that. The process and learnings from developing and testing this framework in practice offer real value for other geographies facing similar challenges. The framework itself, however, is grounded in the Brazilian context. Outside of Brazil, it should be treated as a reference point rather than a blueprint, with its applicability assessed against local realities. Similar collaborative processes elsewhere may reasonably arrive at different frameworks better suited to their circumstances.

¹ Note that case studies are illustrative and based on information provided by implementing organisations; inclusion does not constitute endorsement or verification by the authors.

FIGURE 5 City-level framework for system transformation.



THE NINE MODULES

Modules A unlock the full system shift — simultaneously improving waste picker recognition, strengthening collection and recycling systems, and preventing pollution.

A1. Expand separate collection of recyclables. Separate collection — organised in close collaboration with local authorities, waste pickers, waste management operators, and reverse logistics systems — is the primary route through which plastics and other recyclable materials are captured and directed toward recovery. Strengthening access to environmental education about, and participation in, source-separated collection are all essential to making this module work at scale.

A2. Strengthen and scale cooperatives in sorting and selling recyclables. Waste picker cooperatives play a central role in sorting, aggregation, and commercialisation of recyclable materials, and recent legislation has emphasised their prioritisation. Supporting their role as core service providers within municipal systems — alongside expanded infrastructure, technology, capacity strengthening, equipment, and formal service arrangements — enables higher recycling rates, more consistent material flows, and improved livelihoods.



MODULE A1 CASE STUDY: Guaxupé

The 50,000-strong municipality of Guaxupé carried out a city-wide behaviour change initiative developed by Instituto Recicleiros and Delterra, with support from the Alliance to End Plastic Waste, designed to strengthen source-separated collection. Building on an existing selective collection system operating since 2021, the programme used community research and human-centred design to develop targeted engagement campaigns reaching households, schools, businesses, and public institutions through door-to-door visits, radio, social media, school activations, and partnerships with health agents and local business associations. Over 85% of households in the city were reached through direct “bottom-up” engagement, alongside broader city-wide communication efforts. In the pilot area, weekly recyclables collected increased by 139%, participation rates rose from 11% to 18%, and disposal points with separated recyclables increased by 64%. Across the full city rollout, average recyclables collected per effective collection day increased by more than 10% between July 2024 and April 2025.

PHOTO CREDIT: GUAXUPÉ



MODULE A2 CASE STUDY: Mãos pro Futuro

Mãos pro Futuro is one of the leading initiatives supporting and strengthening waste picker cooperatives in Brazil, alongside the Reciclar pelo Brasil programme (co-led by ANCAT, among others) and the federal government’s Cataforte programme. Mãos pro Futuro is a national industry-led reverse logistics initiative coordinated by ABIHPEC and partner associations, operating across all 27 states of Brazil. The programme connects over 220 participating companies with a network of waste picker cooperatives, providing infrastructure investment, equipment, technical assistance, training and management support. Cooperatives are integrated into reverse logistics systems through formal contracts and traceable material flows, supported by digital platforms and independent verification to ensure data transparency. The programme supports approximately 200 cooperatives and 5,500 waste pickers across 170 municipalities, recovering around 200,000 tonnes of post-consumer packaging in 2024. The programme has led to increased income stability and productivity among cooperatives, with measurable improvements in operational performance.

PHOTO CREDIT: MÃOS PRO FUTURO

A3. Recognise and integrate autonomous waste pickers and bring transparency in the informal supply chain.

A significant share of recyclable materials is recovered through autonomous waste pickers operating outside formal systems. Compensating them fairly for services rendered — not solely based on material value — facilitating access to social protection and social security, and creating transparency in informal supply chains improves visibility of material flows, pricing, and end destinations, supporting more stable incomes and greater recognition of autonomous waste pickers within the broader system.

A4. Stabilise and scale demand from packaging manufacturers and packaging users, and build capacity (as needed) for higher value recycling.

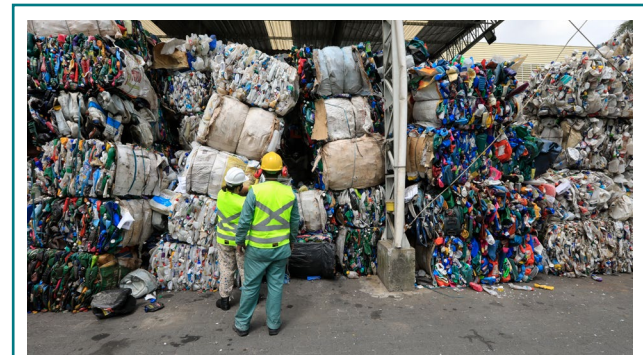
For materials with established recycling markets (like PET, HDPE, paper, cardboard, and aluminium), the priority is to stabilise and scale intermediate and final demand (such as packaging manufacturers and their public and private clients). This must be coupled with creating logistical efficiencies (like pre-treatment and hub-and-spoke catchment expansion) and improving quality standards and traceability to increase the use of recycled content in manufacturing, including for contact-sensitive applications.



MODULE A3 CASE STUDY: Preço de Fábrica

Preço de Fábrica is a reverse logistics initiative developed by Green Mining in partnership with companies and public actors, with support from the Recycling Incentive Law and coordinated by the Ministry of the Environment, designed to connect waste pickers and end recyclers — bypassing the intermediaries that typically reduce income. The initiative operates a network of collection hubs that purchase recyclable materials directly from waste pickers and the public at prices equivalent to those offered by recycling industries, with digital registration, weighing, and tracking of all transactions through an app and direct payment via Pix (a Brazilian instant payment system). To date, 10 stations have been deployed across five states, collecting over 7,100 tonnes of recyclable materials through more than 140,000 transactions, with approximately BRL 6.9 million^J distributed to around 6,500 participants — an estimated additional income uplift of around BRL 800^K per participant. The initiative is still in expansion phase and geographically concentrated, but has demonstrated a scalable model.

PHOTO CREDIT: PREÇO DE FÁBRICA



MODULE A4 CASE STUDY: Wise Plásticos S.A.

Wise is an industrial-scale recycling company focused on producing high-quality post-consumer recycled resins from plastics including HDPE and PP, for demanding applications including contact-sensitive packaging. The company operates facilities capable of processing more than 30,000 tonnes of plastic annually, combining recycling technologies with certified quality control and traceable sourcing systems, including partnerships with formal and informal collection networks and waste picker cooperatives. Through these operations, Wise supplies consistent industrial-grade recycled resin to major consumer goods and packaging companies in Brazil, contributing to strengthening demand for post-consumer recycled plastics in the domestic market, while demonstrating the importance of traceability, certification, and quality standards.

PHOTO CREDIT: WISE PLÁSTICOS S.A.

J USD 1.33 million

K USD 154

Modules B further reinforce collection and recycling systems and strengthen pollution prevention.

B1. Close residual waste collection gaps in hard-to-access communities. Where collection remains incomplete — particularly in informal settlements, peri-urban communities, and geographically remote areas — waste leaks directly into the environment before any recovery is possible. Closing those gaps and strengthening operational practices where collection exists but is unreliable is essential to reduce pollution at source.

B2. Recover recyclables that escape separate collection systems. In addition to the expansion of source-separate collection — outlined in Module A1 as the primary route for capturing plastics and other recyclables — there is a need for complementary pathways to recover recyclable materials, particularly low value formats, that persistently escape separate collection systems before they are disposed in landfills. While solutions will be context-dependent, they should ultimately aim to recover those materials so that they can be directed to the highest value applications possible in other plastics products or packaging.



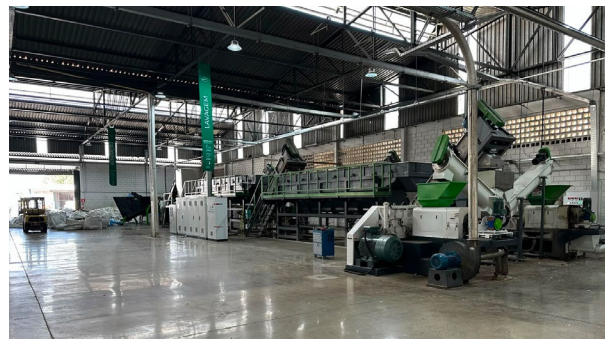
MODULE B1 CASE STUDY: SOLOS

SOLOS is a Salvador-based startup that develops community-adapted waste recovery solutions for underserved territories where conventional collection systems are incomplete or unreliable, such as informal settlements, peri-urban areas, remote communities, and tourism-intensive territories. The

company combines localised collection logistics, environmental education, reverse logistics, and partnerships with municipalities, cooperatives, and private companies, with initiatives spanning coastal destinations such as Caraíva and Atins as well as urban programmes including Re-ciclo Fortaleza — a door-to-door selective collection programme using electric tricycles and digital scheduling tools developed with the municipality of Fortaleza, iFood, and local waste picker associations. Across its operations, SOLOS reports having correctly directed more than 2,300 tonnes of recyclable materials, generated over BRL 10 million in income for waste pickers and cooperatives, and mobilised more than 2 million people through education and engagement activities, demonstrating the role that decentralised and community-adapted collection models can play in reducing waste leakage in underserved communities.

PHOTO CREDIT: SOLOS

B3. Catalyse new demand from manufacturers and end users, and develop capacity and technologies for lower value recycling. Lower-value plastics — films, flexible packaging, multilayer formats, contaminated materials — make up the majority of plastics in municipal solid waste and are the hardest to recover economically and the most likely to leak into the environment. While the long-term solution to this challenge lies primarily in upstream strategies such as eliminating unnecessary packaging, expanding reuse, and redesigning packaging for circularity (the focus of Module 0), more immediate measures are also needed to increase material recovery and reduce the volume of these materials sent to landfill. In this context, unlocking recycling pathways starts with end-market development, alongside targeted expansion of processing capacity, supported by aggregation models and selective financial support. While technological improvement will also be a key enabler, large-scale mechanical recycling can already produce feedstock sufficiently cost-competitive with virgin resin for applications that do not require high material performance.



MODULE B3 CASE STUDY: Resiban

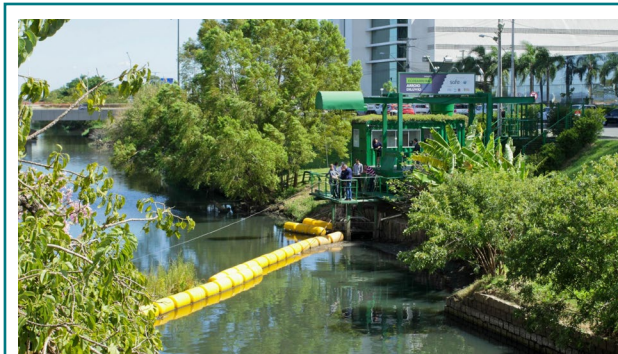
Resiban is a mechanical recycling operation focused on low-density polyethylene (LDPE) — particularly films and flexible packaging — one of the most widely used but least economically viable plastic streams to recycle in Brazil. The company operates at industrial scale across two production lines, with approximately 800 tonnes per month of installed output capacity, combining washing, extrusion, and high-performance filtration systems with laboratory-based quality control to produce recycled LDPE resin for demanding industrial applications including packaging and consumer goods. Sourcing draws on a diversified supply chain spanning cooperatives, aggregators, scrap dealers, and commercial generators. The initiative has expanded end-market pathways for lower-quality plastics through programmes such as FlexTech, and has contributed to strengthening upstream collection by generating structured demand. However, Resiban's experience also illustrates the limits of technology and scale alone — the viability of recycling LDPE at scale remains constrained by weak demand for recycled resin relative to virgin alternatives, and the company has been actively engaged in policy discussions around mandatory recycled content requirements as a necessary demand-side lever.

PHOTO CREDIT: RESIBAN

Modules C complete the suite of pollution prevention measures.

C1. Minimise littering, introduce trash barriers, and promote cleanup efforts. A portion of waste enters the environment through littering, illegal dumping, and leakage from public spaces. Reducing these flows requires improved infrastructure — trash barriers in canals and sewage systems — alongside behaviour change campaigns and targeted cleanup initiatives in high-risk areas. These actions complement upstream improvements in collection and recovery.

C2. Ensure adequate disposal of all residual waste, while valorising sorting rejects and organics. Closing and remediating dumpsites, while developing sufficient sanitary landfill capacity in parallel, eliminates legacy pollution and reduces one of the most direct sources of contamination of freshwater systems, particularly inhibiting leachate and uncontrolled waste leakage from entering surrounding soil, drainage networks, and waterways. Scaling the valorisation of sorting rejects and organic waste can deliver benefits in terms of landfill diversion and reduced climate impacts, while generating a potential source of income that can reduce total system costs. However, it falls outside the direct scope of a strategy focused on packaging waste.



**MODULE C1 CASE STUDY:
Ecobarrier, Porto Alegre**

The Ecobarrier is a floating barrier system installed in 2016 on the Arroio Dilúvio, a heavily polluted urban waterway that carries litter and debris into Guaíba River in Rio Grande do Sul. Developed by Instituto Safeweb in partnership with the municipality and local agencies, the system intercepts solid waste using floating barriers, with daily removal carried out by municipal cleaning teams. Operation and maintenance are coordinated between the NGO (Safeweb) and municipal departments, with proper downstream handling and disposal of collected materials. Over ten years, the barrier has prevented over 1,366 tonnes of waste from reaching Guaíba River — equivalent to around 44 truckloads. The initiative also incorporates environmental education efforts and has raised public visibility of waste leakage issues, reinforcing behaviour change, alongside cleanup efforts. This has demonstrated the viability of a replicable solution for intercepting waste already in the environment.

PHOTO CREDIT: ECOBARRIER

APPLYING THE FRAMEWORK ACROSS CITY ARCHETYPES

The relative emphasis of modules varies significantly across Brazil's cities depending on each city's starting point. In some cases, additional factors influence prioritisation — particularly where the impacts of waste leakage on freshwater systems are more immediate.

Cities in Archetype 1 have comparatively strong separate collection and recycling for key materials. The emphasis falls on modules A1, B1, B2, C1, and C2: closing collection gaps, reducing leakage, strengthening safe disposal and remediation, and improving residual management.

Cities in Archetype 2 have the most developed systems. The focus shifts to optimisation and expansion — accelerating recycling rates, enabling recycling of additional material streams, and improving overall system efficiency and value recovery, particularly through modules A1-A4, B2, B3 and C2.

Cities in Archetype 3 require a comprehensive end-to-end approach. Both foundational collection systems and recycling performance need substantial strengthening, and all nine modules are relevant.

Cities in Archetype 4 have relatively advanced collection and disposal systems. The priority is modules A1-A4, B2, B3, C1 and C2: expanding separate collection, sorting capacity, recycling markets, and valorisation pathways.



3.2

CALL TO ACTION

The structural gaps — which undervalue the work of waste pickers, allow millions of tonnes of plastic to leak into Brazil's rivers, and lose at least comparable volumes of valuable materials to landfills every year — are not the result of a single failure by a single actor, but are found across the entire system. Closing those gaps requires collaborative efforts across stakeholders — and every part of the system moving together.



POLICYMAKERS AND REGULATORS

Brazil's existing policy framework is a valuable asset in this transition — and policymakers have the unique ability to set the rules of the game for every other actor in the system.

A key priority going forward is effective implementation: providing clear, enforceable, and aligned regulation supported by strong governance, effective economic incentives, and accountability across the value chain.

Federal and state-level policymakers and regulators are well placed to:

- Align economic and regulatory incentives to reward recycling over disposal, correcting distortions that favour landfill and suboptimal end-of-life pathways, and to foster investment in sortation and recycling capacity (modules A1, A4, B2, B3, C1, C2)
- Enforce the closure and remediation of dumpsites to eliminate legacy pollution and prevent continued environmental leakage (module C2)
- Create enabling regulatory frameworks that support safe valorisation pathways and strengthen overall system performance (modules B3, C2)

- Establish clear standards for traceability, reporting, and transparency to ensure accountability and credible recovery verification (all modules)
- Address jurisdictional misalignment between municipal waste management and basin-scale freshwater governance by strengthening institutional linkages across municipalities, states, and River Basin Committees, ensuring that upstream waste management actions are aligned with downstream river system impacts and implementation responsibilities (modules C1, C2).

Strengthening the governance and financing of reverse logistics systems, in line with internationally recognised EPR best practices, is central to making operational improvements stick. Three areas of reform are critical:

- Policymakers can **enhance reverse logistics governance** by strengthening the strategic planning role of managing entities to enable a more centralised oversight and consistency of industry-led initiatives with national recycling and recovery goals (modules A2, A3, A4, B2, B3).

- Policymakers can **strengthen reverse logistics impact** through optimised rules and enforcement (modules A2, A3, A4, B2, B3), including:
 - Clarifying compliance rules for reverse logistics credits, including eligibility criteria, standardised methodologies for calculating recovery volumes, and limits on suboptimal end-of-life pathways
 - Strengthening requirements for circular product and packaging design to minimise waste generation at source
 - Progressively strengthening recycled content requirements to broaden market demand beyond high-value materials, while allowing time for industry adjustment and infrastructure scaling (especially module B3)
 - Ensuring regional distribution of reverse logistics targets — particularly for plastic packaging — so that recovery efforts extend beyond the most economically attractive regions
 - Strengthening monitoring and enforcement, clarifying institutional responsibilities, and improving verification systems for reported recovery volumes

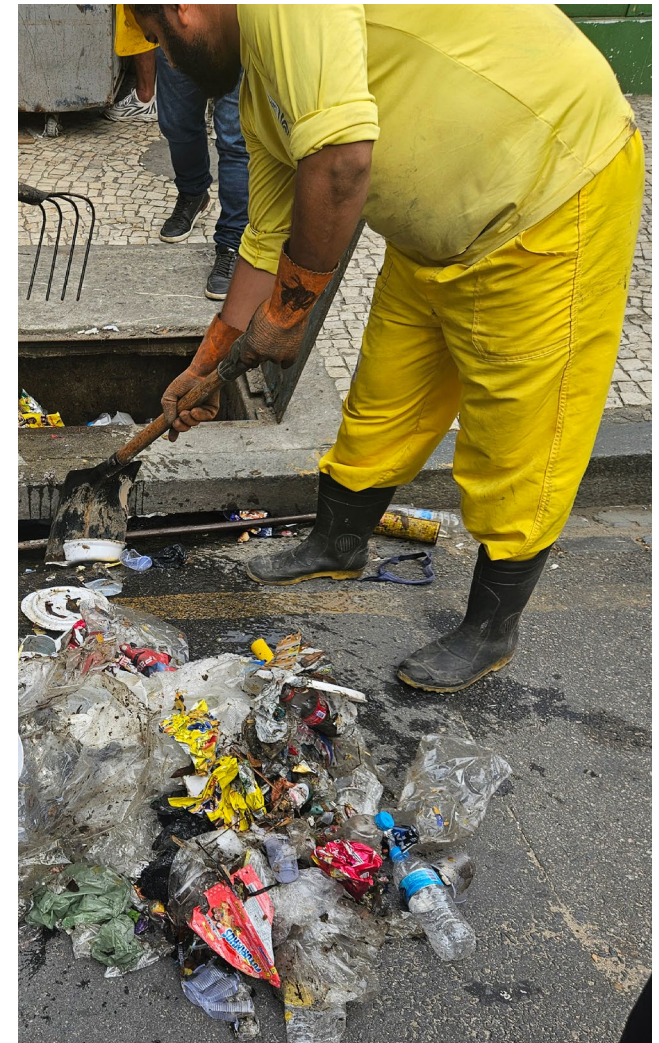
- Policymakers can **operationally and financially integrate municipalities and waste pickers** into packaging reverse logistics systems to ensure transparency, accountability, effective material recovery, and fair remuneration (modules A2, A3, A4, B3), including:
 - Integrating reverse logistics with municipal waste management systems, linking producer-financed recovery mechanisms with local infrastructure
 - Ensuring stable financing for packaging waste management at the municipal level, including through the facilitation of mechanisms whereby reverse logistics systems reimburse municipalities for the collection and handling of packaging waste, as envisaged by the PNRS, but not yet consistently operationalised in practice.
 - Supporting the fair integration and remuneration of waste pickers, promoting standardised models for cooperative integration, fair payment for collection and sorting services, and pathways for autonomous workers to participate in formal systems on their own terms

MUNICIPALITIES AND CONCESSIONARIES

Municipalities and their contracted operators are the system integrators — translating policy into operational reality on the ground. Their decisions about service design, contract structures, and infrastructure investment determine what actually happens in Brazil's cities. The opportunity is to design and operate waste management systems that are financially sustainable, fair to waste pickers, and performance-driven.

Municipalities and concessionaries are well placed to:

- Implement appropriate waste collection fees — as already required by law — to ensure financial sustainability of municipal waste systems where lacking (modules A1, B1)
- Introduce and strengthen measures to prevent environmental leakage, including those that reduce waste entering freshwater ecosystems (module C1)
- Improve concession and service contracts by shifting from disposal-focused models toward performance-based contracts with clear goals that encourage collection, sorting, and recycling over landfill (modules A1, A2, A3, B1, B2)
- Formally recognise and hire/compensate waste pickers for the services they provide in selective collection, sorting and environmental education — both autonomous and cooperative — and integrate them into municipal service delivery (module A2)
- Support autonomous waste pickers through structured integration pathways and improved health and safety conditions (module A3)
- Leverage public procurement to encourage the use of recycled content, creating stable local markets for recovered materials (modules A4, B3)
- Close remaining dumpsites and remediate legacy disposal sites to address ongoing pollution and strengthen sanitary residual waste management. Invest in technologies to valorise residual rejects and organics at landfills (module C2)
- Build inter-municipal consortia where scale is lacking to improve efficiency, strengthen performance, and attract investment (all modules)
- Deliver continuous public information and education to ensure proper use of waste management infrastructure and the reduction of waste leakage into waterways (modules A1, B1, C1)



HOUSEHOLDS AND LARGE GENERATORS

Individual behaviour is not a substitute for systemic change — but it is an essential complement to it. Disposing of waste correctly, separating at source, and contributing financially to a transparent and accountable waste management system are the foundations on which much of the system depends.

Households and large generators can:

- Reduce littering and improve disposal practices to reduce environmental leakage and strengthen the effectiveness of collection systems (module C1)
- Contribute financially — through waste fees for households — to support the sustainability of municipal waste systems (modules A1, B1)
- Increase consistent participation in separate collection by improving source separation and reducing contamination of recyclables, in compliance with disposal rules (module A1)



THE WASTE PICKER (CATADORES) ECOSYSTEM

Waste pickers are at the heart of Brazil's recycling system — and the vision for this system is one in which they operate as professionalised environmental service providers, integrated into municipal systems on fair terms. Safe working conditions, fair remuneration, and access to stable service contracts that reflect the public value of the work they do are the foundation of that vision.

The waste picker ecosystem, with the right enabling environment, can:

- Increase operational capacity and technical capability, including participation in semi-mechanised and more advanced sorting environments (modules A2, A3, B2)
- Continue strengthening cooperative governance, professionalism, and integration into formal municipal and reverse logistics systems (module A2)
- Support pathways for autonomous waste pickers to be integrated, or transition, into structured networks, improving income stability and working conditions (module A3)
- Aggregate volumes of sorted materials to cater to industrial demand, for example through cooperative networks or second-level cooperatives



RECYCLERS, PRODUCERS, AND END-MARKET BUYERS

Recyclers, obligated parties under reverse logistics, and end-market buyers have a central role to play in investing in domestic recycling capacity, ensuring material traceability and quality, internalising end-of-life costs, and creating the stable demand for recycled feedstock that makes the economics of collection and sorting work.

Recyclers can:

- Scale and modernise domestic recycling capacity and improve its regional distribution to keep materials in productive use (modules A4, B3)
- Implement supplier development practices, promoting continuous improvement in the quality of their processes, especially in the case of cooperatives.
- Ensure high material quality and robust traceability standards to strengthen market confidence, enable reliable recycling outputs, and support stable end markets (modules A4, B3)
- Invest in new technologies to support viable recycling pathways for materials that are currently difficult or uneconomic to recover, expanding overall system circularity (module B3)

Obligated parties under reverse logistics (producers, importers, distributors and retailers) can:

- Strengthen circular product and packaging design to minimise waste generation at source through more efficient material use and improved design-for-recycling (modules A4, B3)
- Take proportional financial responsibility for end-of-life management, ensuring compliance with reverse logistics obligations and, where possible, going beyond minimum requirements to provide stable funding for collection and sorting systems (modules A1-A3)
- Provide long-term demand certainty and financing commitments to de-risk recycling investments and enable expansion of domestic processing capacity (modules A4, B3)

End-market buyers can:

- Commit to and progressively increase the use of recycled materials in products and packaging to create sustained demand for secondary materials, provided there is enough supply of recycled feedstock of sufficient quality to maintain products' performance (module B3)
- Provide long-term offtake agreements and demand signals to de-risk investment in recycling infrastructure and support market development (modules A4, B3)
- Adapt product specifications and procurement standards to enable the use of recycled materials (modules A4, B3)

SYSTEM ENABLERS

Capital, data, and coordination are the enablers that unlock everything else — and they are currently in short supply in the parts of the system that need them most.

An appropriate governance framework established across all levels of government is critical to enabling action. Within this framework, financial institutions, philanthropies, research bodies, industry associations, and innovation actors all have a role to play in providing the financing mechanisms, data systems, and coordination platforms that enable system-wide scaling.

The finance sector and philanthropy can:

- Provide grant funding for behaviour change and public awareness programmes to reduce littering and increase participation in source separation (modules A1, C1)
- Provide grant funding to support waste picker cooperative upgrading and formalisation, including equipment, capacity building, governance strengthening, and safer working conditions (module A2)
- Deploy catalytic and blended finance to de-risk investments and lower the cost of capital in sorting, recycling, and valorisation infrastructure and unlock scalable private capital (modules A4, B2, B3)
- Fund innovation, technology, and pilot projects to enable recycling pathways and new circular business models where markets are not yet fully viable (module B3)
- Fund cleanup and remediation of legacy pollution where responsibilities are fragmented and investment is insufficient (modules C1, C2)
- Provide commercial and project development capital for valorisation infrastructure where business cases are viable (module B2, C2)

Other system enablers can:

- Improve data quality, transparency, and system intelligence through stronger waste flow tracking, recovery monitoring, and performance benchmarking (all modules)
- Facilitate coordination across sectoral stakeholders by convening public, private, and civil society actors, aligning incentives, and resolving system bottlenecks (all modules)
- Build municipal and cooperative capacity through technical assistance, training, and institutional strengthening (modules A1-A3, B1, B2)
- Strengthen the ability of municipalities and system actors to plan, coordinate, and deliver long-term system improvements, aligning infrastructure, financing, and roles across stakeholders (all modules)
- Support the testing, evaluation, and scaling of new technologies and operational models to ensure successful approaches are translated into broader adoption (all modules)

THE MOMENT TO ACT

The case has been made — and the opportunity is too significant to leave on the table.

Brazil holds more freshwater than any other country in the world and is home to some of the most biodiverse river systems on Earth. Yet the regions with the weakest waste management systems are often those that contain the most biologically rich freshwater ecosystems. Behind the data are nearly a million waste pickers whose livelihoods depend on a system that still undervalues them, and communities whose rivers bear the cost of a gap that can be closed — one worth nearly BRL 100 billion¹ a year in savings, and thousands of jobs. Transforming waste management systems is one part of a larger transition toward a circular economy that eliminates waste, circulates materials, and regenerates nature. But it is an essential part, and Brazil has the foundations, the momentum, and now the shared understanding of what that transformation requires. The next step is to put that understanding into practice — through collaborative, city-level action that brings policymakers, municipalities, businesses, waste pickers, communities, financial institutions, and philanthropies together around a common goal.

GLOSSARY OF KEY TERMS

Definitions are based on OECD, ISWA, UNEP, and Brazilian National Solid Waste Policy (PNRS) terminology, harmonised for consistency.

| | | | | | |
|---------------------------------|---|---|---|-----------------------------|--|
| Adequately managed waste | Waste that is collected and directed to reuse, recycling, composting, or other environmentally sound treatment and disposal methods, as well as residual waste directed to environmentally sound final disposal, in accordance with the Brazilian National Solid Waste Policy (PNRS). | Concessionaries | Private or mixed-capital companies operating under a formal concession agreement with a public authority, granting them the right to provide specified public services — such as waste collection, treatment, or disposal — under defined regulatory, contractual, and performance conditions. | Freshwater ecosystem | A system of inland waters, including rivers, lakes, wetlands, and aquifers, and the biological and physical processes they support. Freshwater ecosystems provide essential services such as drinking water supply, biodiversity maintenance, and hydrological regulation. Brazil contains extensive freshwater networks, including the Amazon Basin, which accounts for a significant share of global freshwater resources. |
| Agricultural runoff | The flow of water from agricultural land that carries excess nutrients (such as nitrogen and phosphorus), pesticides, sediments, and other contaminants from fertilisers, soil, and farm operations into nearby surface water bodies, including rivers, lakes, and wetlands. Agricultural runoff is a major contributor to water pollution and ecosystem degradation, particularly in areas with intensive farming or insufficient soil and water management practices. | Controlled landfill | A waste disposal site with basic operational and environmental controls — such as restricted access, waste compaction, and periodic soil cover — but lacking the full engineering systems, environmental safeguards, and regulatory compliance required of a sanitary landfill. Controlled landfills continue to pose risks of soil, groundwater, air, and public health impacts due to inadequate leachate, gas, and environmental management systems. | Large generators | A commercial, industrial, institutional, or service-sector entity that generates waste in quantities exceeding thresholds established by applicable state or municipal regulations, and which is therefore typically required to arrange and finance the collection, transport, treatment, and environmentally sound destination of its waste independently of standard municipal collection services. |
| Circularity | The design and management of products so that materials remain in circulation after use, for example in the case of packaging through reuse, refill, and recycling, thereby reducing waste generation and the use of virgin resources. | Extended Producer Responsibility (EPR) | A policy approach under which producers are assigned responsibility — financial and/or operational — for the collection, sorting, reuse, recycling, composting or environmentally sound disposal of their products and packaging after use. | Leachate | A contaminated liquid generated when water percolates through waste — for example, accumulated at a disposal site — and extracts dissolved, suspended, or soluble substances, potentially causing pollution of soil, surface water, and groundwater. |

| | | | | | |
|------------------------------------|--|---------------------|---|---|---|
| Mismanaged waste | Waste that is not formally collected or adequately managed after collection and is therefore at risk of leakage into terrestrial, freshwater, or marine environments. This includes waste disposed of in open dumps, controlled landfills and other non-sanitary disposal sites, through open burning, or directly into the environment. | Open burning | The combustion of waste in open air without engineered containment, emissions control systems, or adequate operational oversight, resulting in the release of particulate matter, greenhouse gases, and potentially hazardous pollutants harmful to human health and the environment. | Recycling | Any reprocessing of waste materials into products, materials, or substances whether for the original (closed-loop recycling) or other purposes (open-loop recycling), excluding energy recovery and reprocessing into materials that are to be used as fuels. |
| Mixed collection | A waste collection system in which recyclable and non-recyclable materials are collected together without source separation, typically reducing material quality and recovery potential while increasing contamination of recyclable materials. | Open dump | An uncontrolled waste disposal site where waste is indiscriminately deposited without adequate planning, engineering measures, environmental protection systems, or operational controls. Open dumps commonly result in leachate contamination, methane emissions, uncontrolled fires, air pollution, disease vectors, and waste leakage into surrounding ecosystems. | Residual waste | Waste materials remaining after feasible reuse, recycling, or composting activities have been undertaken, and which therefore require final treatment or disposal. |
| Municipal solid waste (MSW) | Waste generated from households, commercial establishments, institutions, and municipal services, excluding industrial process waste, hazardous waste, and construction waste unless otherwise specified. | Recovery | Under Brazil's National Solid Waste Policy (PNRS), the diversion of waste from final disposal through processes such as reuse, recycling, composting, or other environmentally sound forms of treatment and destination. | Reverse logistics (and obligated parties) | Under Brazil's National Solid Waste Policy (PNRS), a set of actions, procedures, and means intended to enable the collection and return of post-consumer products and packaging to the business sector for reuse, recycling, or reintegration into productive cycles, or, where these are not feasible, other environmentally sound final destinations. For general packaging, obligated parties include producers, importers, distributors, and retailers of packaged goods. |
| Non-sanitary disposal site | A waste disposal site that does not meet the engineering, operational, and environmental standards of a sanitary landfill, including open dumps and controlled landfills, and that typically generates uncontrolled emissions, leachate, fires, and environmental and health risks. | | | | |

Sanitary landfill

An engineered waste disposal facility designed, constructed, and operated to minimise environmental and public health impacts through measures such as waste compaction, daily cover, liner systems, leachate collection and treatment, landfill gas management, environmental monitoring, and controlled operation.

Selective collection

The separate collection of recyclable or recoverable materials at source — for example, through kerbside collection or drop-off points — preventing their mixing with residual waste and facilitating higher-quality recycling and material recovery.

Waste picker (catador)

A person who works in the collection, sorting, processing, commercialization, and environmentally sound destination of recyclable materials, either independently or through cooperatives and associations. In Brazil, waste pickers are recognised as environmental and recycling agents who play a fundamental role in waste management and reverse logistics systems.

Waste management system

The combined policies, infrastructure, institutions, financing mechanisms, and operational activities involved in the collection, transport, sorting, recovery, reuse, recycling, composting and disposal of waste.

Waste valorisation

The process of recovering value from waste materials by returning them to productive use through reuse, recycling, composting, or other material recovery processes.

APPENDIX 1

Variability and Methodological Differences in Waste Management Data in Brazil

Waste flow data and recycling rates in Brazil vary across sources (see Table 1), due to differences in definitions, system boundaries, methodologies, and measurement points along the waste flow. As a result, reported municipal solid waste (MSW) recycling rates differ widely, and material-specific recycling rates do not necessarily add up to the total estimated MSW recycling rate. This paper relies on the most up-to-date waste flow data from SINISA and ABREMA, and complements this with material-specific recycling data from relevant industry associations (e.g., ABIPLAST/PICPlast for plastics).

TABLE 1 Examples of different recycling rates reported.

| Material | Source | Reference year | Recycling rate |
|-----------------------|-----------------------------|----------------|------------------------|
| Municipal solid waste | IPEA | 2017 | 13% |
| | ABRELPE | 2020 | <4% |
| | SINISA | 2024 | 2% |
| | ABREMA, Dom Cabral | 2024 | 9% (Sent to recycling) |
| Plastics | Pincelli et al. (packaging) | 2021 | 4.5% |
| | Plasteax (packaging) | 2022 | 10% |
| | PICplast (packaging) | 2024 | 24% |
| | PICplast (all plastics) | 2024 | 21% |
| PET bottles | Plasteax | 2022 | 25% |
| | PICplast | 2024 | 46% |

Several factors contribute to the lack of alignment in the waste flow and recycling rates:

- **Differences in calculation methodologies:** Some recycling rates are calculated based on production-to-estimated-consumption ratios; others consider the full product lifecycle, deducting the share of materials that are expected to still be in use and adjusting for export/import data, etc. Others consider the material flow within cooperatives and/or arriving at landfills, and include all waste, not only MSW. Different sources also measure data at different moments of the waste flow, e.g. sent for recycling vs. effectively recycled.
- **Waste flow mix:** MSW flows often intersect with other waste streams, such as industrial waste and commercial waste from large generators, which may go into cooperatives for triage. Similarly, waste characterisation and triage conducted at landfills may consider all waste rather than clearly isolating MSW from other sources.
- **Different categorisation of materials:** Inconsistent reporting complicates data matching: metals are often grouped together in waste characterisation studies, while recycling rates are specified separately for iron and steel. Similarly, some plastic data aggregates broad categories (e.g. all flexible packaging), while others specify polymer types such as LDPE and PP, but do not break these down further by rigidity.
- **Self-declaration & multiple data sources:** Most municipal data relies on self-declaration by municipalities, making it vulnerable to differences in the level of knowledge and diligence of the employees responsible for completing the reports.
- **Traceability limitations:** Although traceability remains an issue, there have been recent advances, such as the use of invoices and Manifestos de Transporte de Residuo, that aim to track materials throughout the waste flow. However, traceability of materials across the value chain remains limited at scale, which can lead to issues such as double counting.
- **High levels of informality throughout the value chain:** Informality limits material tracking throughout the value chain. Most materials reaching sorting centres are collected informally by waste pickers, who typically sell to informal aggregators before the material reaches recyclers.

APPENDIX 2

Brazil's waste management policy landscape

Brazil's waste management policy framework is comprehensive and multi-layered, reflecting a growing national focus on improving the sector. Responsibilities are distributed across three levels of government: the federal level sets overarching legal frameworks, national targets and regulatory guidelines; states develop complementary plans and support regional coordination; and municipalities hold primary responsibility for service delivery, including collection, treatment, disposal and separate collection systems.

While this appendix focuses on the federal framework, outcomes depend on state coordination and municipal implementation capacity, which can vary by region. The sections below summarise the main national policy instruments shaping Brazil's waste management landscape.

National Solid Waste Policy (PNRS), 2010.

Brazil's National Solid Waste Policy (PNRS), enacted in 2010, established the country's primary legal framework for modern waste management. The law mandates the elimination of open dumps and requires environmentally appropriate disposal in licensed sanitary landfills. To guide this transition, the legislation set population-based deadlines for closing dumpsites: state capitals and metropolitan regions by 2021; municipalities with more than 100,000 inhabitants by 2022; municipalities with 50,001-100,000 inhabitants by August 2023; and municipalities with fewer than 50,000 inhabitants by August 2024.

The PNRS also formalises the principle of shared responsibility across public authorities, producers, importers, distributors, retailers and consumers. A central instrument of the policy is reverse logistics, which requires designated priority products and packaging to be collected and managed after use through producer-financed systems.

In addition, the policy requires states and municipalities to develop solid waste management plans as a condition for accessing federal funding and technical support. While implementation and updating of these plans varies across municipalities, the requirement has led many municipalities across the country to develop formal waste management plans over the past decade.

National Waste Plan (PLANARES), 2022.

In April 2022, Brazil formalised the National Solid Waste Plan (PLANARES), establishing a 20-year federal plan to strengthen waste management systems and operationalise the objectives of the National Solid Waste Policy (PNRS). The Plan outlines a range of actions aimed at improving waste management performance across the country.

Key priorities include reaffirming the elimination of open dumps and environmentally inadequate disposal sites, reinforcing and expanding Brazil's reverse logistics framework, and embedding social inclusion as a structural pillar of the waste management system. Within the reverse logistics framework, producers, importers, distributors and retailers

of designated priority products and packaging are legally required to structure and finance systems for post-consumer collection and appropriate end-of-life management. Companies may comply individually or collectively through sectoral agreements, reverse logistics systems or accredited management entities.

PLANARES also formally recognises waste picker cooperatives as key actors in material recovery and highlights organic waste management as a priority growth area, encouraging composting, anaerobic digestion and other biological treatment technologies to reduce landfill dependence and methane emissions.

In addition, the Plan establishes binding national recovery targets that require the continued improvement of Brazil's waste management system between 2024 and 2040. Total effective waste recovery — including recycling, composting, biodigestion and energy recovery — is targeted to increase from approximately 14% in 2024 to 48% by 2040. Effective recycling of the dry fraction is targeted to increase from approximately 6% in 2024 to 20% over the same period.

Implementation is supported by federal monitoring and reporting mechanisms, primarily through the National Information System on Solid Waste (SINIR). The Plan is designed for review every four years, enabling periodic recalibration of targets and policy measures.

Reverse Logistics:

Brazil's National Solid Waste Policy (PNRS) formalised reverse logistics as a national policy instrument, expanding producer responsibility across multiple priority waste streams and establishing standardised compliance mechanisms. Under PNRS, producers, importers, distributors and retailers are legally required to structure and finance systems for post-consumer collection and environmentally appropriate final destination of designated products and packaging.

Implementation occurs through sectoral agreements, commitment terms and federal decrees, with most sectors operating through collective management entities that coordinate national take-back networks and report results to federal authorities, including IBAMA, through the National Information System on Solid Waste (SINIR).

Reverse logistics systems have historically demonstrated stronger and more consistent implementation for materials outside municipal solid waste (MSW), particularly hazardous or high-risk streams such as agrochemical packaging, oils and batteries, which are regulated under stringent CONAMA resolutions and subject to federal oversight. For MSW-related materials, especially general packaging, compliance and recovery performance are more closely influenced by market dynamics. Higher-value materials such as aluminium are more consistently collected and recycled, while lower-value materials remain more dependent on separate collection coverage and commodity pricing.

Plastic Reverse Logistics Packaging Decree, 2025.

The 2025 federal decree establishes a plastics-specific reverse logistics framework for plastic packaging, expanding the scope of Brazil's packaging reverse logistics regulation to explicitly cover primary, secondary and tertiary packaging, as well as equivalent plastic products placed on the market. The decree defines supply-chain responsibilities, compliance pathways and verification standards for producers, importers, distributors and retailers, while also explicitly promoting the integration and remuneration of waste picker cooperatives within reverse logistics systems.

The regulation introduces national recovery targets for plastic packaging, requiring the share of plastic packaging placed on the market that is recovered through reuse or recycling to increase from 32% by 2026 to 50% by 2040. In parallel, it establishes post-consumer recycled (PCR) resin incorporation targets for plastic packaging, with the national average required to rise from 22% by 2026 to 40% by 2040.

Compliance requires documented traceability of recycled content, supplier documentation, reporting through the National Information System on Solid Waste (SINIR), and periodic verification.

National Ocean Without Plastics Strategy (ENOP), 2025.

In 2025, Brazil introduced the National Ocean Without Plastics Strategy (ENOP), establishing a federal framework to prevent and reduce plastic pollution in marine and coastal environments for the 2025–2030 period. The strategy formally links ocean protection with land-based waste management policy, recognising that marine plastic leakage originates primarily from gaps in terrestrial collection and disposal systems. The integration of waste picker cooperatives as key actors in preventing environmental leakage is also emphasised.

National Circular Economic Strategy (ENEC), 2024.

Brazil's National Circular Economy Strategy (ENEC), instituted in June 2024, establishes a national framework to promote circular production and consumption. The strategy provides cross-sectoral direction encouraging eco-design, increased use of secondary raw materials, sustainable public procurement and innovation in circular business models. It also integrates circular economy principles with existing environmental policies, including the PNRS and PLANARES, and establishes cross-ministerial governance mechanisms to coordinate federal programmes, regulatory initiatives and financing instruments.

Overall, Brazil has developed a comprehensive set of policies aimed at strengthening waste management systems and advancing circular material flows, creating important opportunities for further progress in the sector.

TABLE 2 List of materials covered by reverse logistics systems

| Nº | Material | Institution / Managing Entity | Implementation Instrument | Year of Instrument | Part of MSW |
|----|---|---|--|--------------------|-------------|
| 1 | Agrochemicals, their residues and packaging | inpEV | Decree nº 4.074 | 2002 | X |
| 2 | Lead-acid batteries | IBER | Sectoral Agreement | 2009 | X |
| 3 | Electrical and electronic equipment and their household components | Abree / Green Eletron | Decree nº 10.240 | 2019 | ✓ |
| 4 | Steel packaging | PROLATA | Commitment Term | 2018 | ✓ |
| 5 | Glass packaging | Circula Vidro | Decree nº 11.300 | 2022 | ✓ |
| 6 | General packaging (including plastics) | Various Entities (e.g. PRAGMA, Ambipar, Instituto Giro, Coalizão Embalagens, Instituto ABIA, Mãos Pro Futuro) | (Sectoral Agreement) Decree nº 11.413 New: Decree nº 11.413 | (2015) 2023 | ✓ |
| 7 | Lubricant oil packaging | Instituto Jogue Limpo | Sectoral Agreement | 2012 | X |
| 8 | Used or contaminated lubricant oils (OLUC) | ANP / Instituto Jogue Limpo | CONAMA Resolution nº 362 | 2005 | X |
| 9 | Fluorescent lamps, sodium vapor lamps, mercury lamps, and mixed light | Reciclus | Sectoral Agreement | 2014 | ✓ |
| 10 | Aluminum beverage cans | Recicla Latas | Commitment Term | 2020 | ✓ |
| 11 | Medicines, their residues and packaging | LogMed | Decree nº 10.388 | 2020 | ✓ |
| 12 | Batteries and cells | Green Eletron | CONAMA Resolution nº 401 | 2020 | ✓ |
| 13 | End-of-life tires | Reciclanip | CONAMA Resolution nº 416 | 2008 | X |

APPENDIX 3 Methodological Framework for City Archetype Classification

To reflect structural differences between cities, archetypes combine indicators of MSW management maturity & leakage risk and recycling levels. These dimensions group a set of quantitative and qualitative criteria (see Table 4) and provide a non-exclusive framework to compare cities' relative starting points.

To position cities within the matrix, each city was ranked against the others for every assessment criterion. An average rank was then calculated per dimension, resulting in one composite score for MSW management maturity & leakage risk (x-Axis) and recycling levels (y-Axis). Cities were plotted accordingly on a two-axis matrix, with quadrants reflecting relative positioning within the sample rather than absolute performance thresholds.

TABLE 3 Archetype classification - Dimensions, assessment criteria and data sources

| Dimension | Assessment criteria (measurement) | Data source |
|--|--|-----------------------------------|
| MSW management maturity & leakage prevention (x-Axis) | MSW collection rate (% of population covered) | SINISA 2024 (Reference year 2023) |
| | Sanitary landfill available (yes, no) | SINISA 2024 (Reference year 2023) |
| | Risk of mismanaged waste (% of mass disposed in sanitary landfills vs open dumps and unsanitary landfills in respective state) | SINISA 2024 (Reference year 2023) |
| | MSW self-sufficiency index (% revenue collected from MSW management fees and charges as share of total MSW costs) | SINISA 2023 (Reference year 2022) |
| | Existence and recency of municipal or state MSW management legislation (high, medium, low) | Ciclosoft 2023 |
| Recycling levels (y-Axis) | Separate collection coverage (% of population covered) | SINISA 2024 (Reference year 2023) |
| | Material recovery rate (% recovered of total waste generated) | SINISA 2024 (Reference year 2023) |
| | Social inclusion (Cooperative participants / 100k inhabitants) | SINISA 2023 (Reference year 2022) |
| | Density of plastic recycling industry in region (# of companies in the plastics recycling industry per km ² of region area) | ABIPLAST (2025) |
| | Density of paper recycling industry in region (# of companies in the paper recycling industry per km ² of region area) | ENF Paper (2025) |
| | Density of glass recycling industry in region (# of companies in the glass recycling industry per km ² of region area) | ENF Glass (2025) |
| | Density of metal recycling industry in region (# of companies in the can recycling industry per km ² of region area) | ReciclaLatas (2024) |

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ENDNOTES

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