Panorama

OF SOLID WASTE IN BRAZIL

2025

ABREMA

ASSOCIAÇÃO BRASILEIRA DE RESÍDUOS E MEIO AMBIENTE

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PANORAMA OF **SOLID WASTE** IN BRAZIL 2025

ENVIRONMENTAL PRESERVATION AND HEALTH PROTECTION

OUR MAIN COMMITMENT

ENVIRONMENTALLY SOUND WASTE MANAGEMENT

OUR MISSION

PREFACE

It is with great satisfaction and a sense of accomplished mission that we present the latest edition of our **Panorama of Solid Waste in Brazil**.

This established publication, which has served for years as the primary benchmark and technical reference for waste management in Brazil, takes a historic and strategic step: for the first time, it is being published in full in an English version.

This decision goes far beyond a simple translation. It represents the opening of a vital channel of knowledge, aligned with the globalization of environmental challenges and solutions. The data meticulously compiled, analyzed, and presented in this report transcends geographical borders. It contains valuable insights into consumption patterns, the effectiveness of public policies, infrastructure challenges, and innovation opportunities in one of the world's largest economies.

By making the **Panorama** available in English, we fulfill a dual objective:

> To provide our members and their international shareholders with clear, standardized information, facilitating comparative analysis, due diligence, and transparent communication of the sector's performance and impact on global platforms.
>
> To place this rich dataset within reach of the international community – including multilateral organizations, research institutions, foreign universities, ESG investors, and policymakers worldwide. We believe the lessons learned in the Brazilian context, with its vast scale and regional diversity, can significantly contribute to the global debate on the circular economy, climate change, and sustainable urban development.

This bilingual edition is, therefore, a tool for collaboration and an invitation to action. May this data serve not only to diagnose realities but also to inspire partnerships, guide responsible investment, and accelerate the global transition towards smarter and more regenerative resource management.

We invite everyone to explore, analyze, and utilize the information contained in this **Panorama**. Knowledge, when shared, becomes the most solid foundation for building a future with less waste and more value.

Enjoy the reading!

Pedro Maranhão
Chief Executive Officer of ABREMA

LIST OF ACRONYMS

ABRECON	Brazilian Association for Recycling Construction and Demolition Waste
ABREE	Brazilian Association for Recycling Electronic and Electrical Equipment
ABREMA	Brazilian Association of Waste and Environment
ANA	National Water and Sanitation Agency
ANP	Brazilian National Agency for Petroleum, Natural Gas and Biofuels
Anvisa	Brazilian Health Regulatory Agency
RDF	Refuse-Derived Fuel
CONAMA	National Environment Council
GAP	Performance Monitoring Group
IBER	Brazilian Institute of Recyclable Energy
IBGE	Brazilian Institute of Geography and Statistics
inpEV	National Institute for Processing Empty Packaging
MMA	Ministry of the Environment and Climate Change
MME	Ministry of Mines and Energy
UCLO	Used or Contaminated Lubricant Oil
VDP	Voluntary Drop-off Point
PNRS	National Solid Waste Policy
CW	Construction Waste
CDW	Construction and Demolition Waste
WEEE	Waste from Electrical and Electronic Equipment
HCW	Healthcare Waste
MSW	Municipal Solid Waste
SINISA	Brazilian National System of Basic Sanitation Information

SUMMARY


01

INTRODUCTION

INTRODUCTION

The Panorama of Solid Waste in Brazil 2025 consolidates a trajectory of complex and urgent challenges, which demand an accelerated transition from traditional paradigms. According to the most current data, the generation of municipal solid waste (MSW) in the country remains significant, exceeding 81 million tons annually, a direct reflection of consumption and economic dynamism. However, the indicators reveal that environmentally sound final disposal is still a critical challenge, with approximately 34% of the waste generated in 2024 destined to open dumps or controlled landfills, practices that represent an environmental and social liability for present and future generations.

This document, anchored in an extensive database and technical analyses, aims to go beyond the simple quantification of the problem. It seeks to elucidate the systemic interconnections between generation, collection, treatment, and final disposal, offering a diagnosis to support the formulation of public policies, infrastructure investments, and the promotion of the circular economy. The objective analysis contained in this Panorama 2025 is, therefore, a fundamental instrument for indicating the most effective paths and contributing to the definition of actions that will bring the greatest socio-environmental and economic impact to waste management in Brazil.

The Panorama 2025 is structured in eight chapters, with the first being this Introduction. Chapter 2 presents a note on the methodology used in the publication, highlighting the reference year of the data presented. Unlike the last two editions, the Panorama 2025 has its methodology published separately, in digital format.

The most recent projections regarding MSW management in Brazil are included in Chapter 3. The results, presented at national and regional levels, cover the generation, collection, and final disposal of MSW, as well as intermediate processes such as composting, sorting of dry recyclables, and preparation of refuse-derived fuel (RDF). The plurality of MSW management in the country is illustrated, for the second consecutive year, in a national MSW flow. The third chapter also addresses municipal expenses for managing street cleaning services and MSW handling, and the quantity and distribution of jobs in the sector. For this edition of the Panorama, there was a change in the methodology for estimating these indicators, including, in addition to the analyses of public data already used previously, statistical techniques for handling missing data and out-of-standard values.

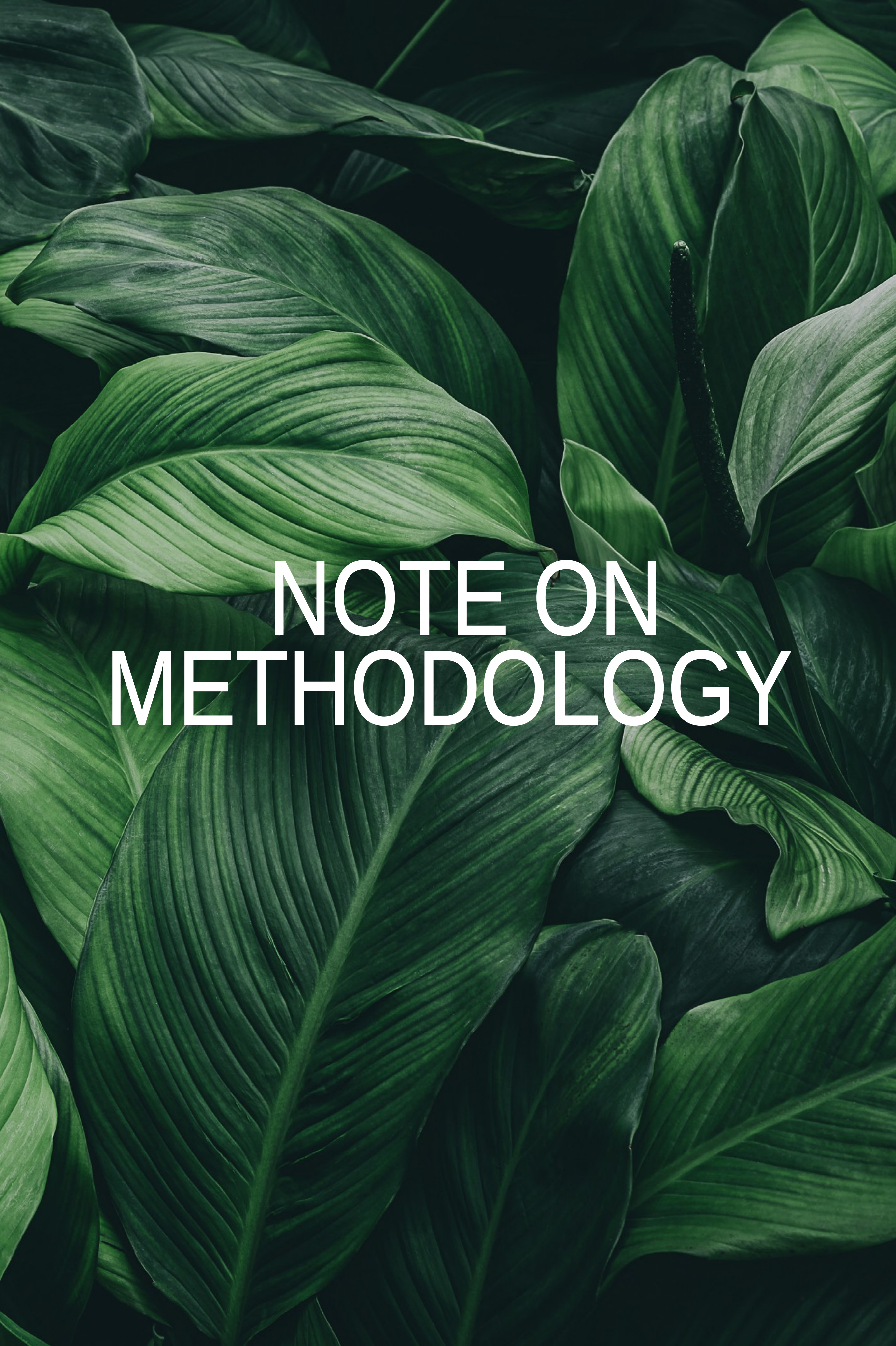
Expanded analyses of the generation of construction and demolition waste (CDW) and healthcare waste (HCW) are presented in Chapters 4 and 5, respectively. These materials have specific characteristics, going from inert to hazardous, and require special attention in their collection, treatment, and final disposal. For this edition, Panorama deepened its analysis regarding generation of CDW and HCW, presenting more comprehensive information at both national and regional levels.

Chapter 6 is a compilation of data from reverse logistics systems officially established in Brazil. This chapter brings together information from managing organizations and institutions responsible for monitoring the reverse logistics of various materials, as well as from the Ministry of the Environment and Climate Change (MMA), enabling the observation of the evolution of these systems in the country.

Among the new features of this edition, bio-energetic recycling stands out, detailed in Chapter 7. This chapter covers the conversion of waste into energy, fuels, and other inputs and products, expanding recycling beyond the mechanical separation of dry waste, in alignment with the National Solid Waste Policy (PNRS). This approach reinforces the alignment of waste management with the principles of the circular economy, signaling additional paths for Brazil to accelerate its transition towards more sustainable production and consumption models.

To conclude, final considerations are made in Chapter 8, along with a brief analysis by ABREMA on the results presented and the association's perspectives for the sector.


02



NOTE ON METHODOLOGY

NOTE ON METHODOLOGY

The information presented in the Panorama of Solid Waste in Brazil is the result of a survey of data published by public institutions and organizations linked to the street cleaning and solid waste management sector in the country. This data is analyzed considering economic and social indicators of the corresponding period and, when necessary, is subjected to statistical analyses and projections of historical trends, so that it represents the reality of solid waste in Brazil in the best possible way.

The data presented in the Panorama 2025 correspond to the reference year 2024. The Brazilian population used as a reference for the calculations, of 212,583,750 inhabitants, is an estimate for July 2024 released by the Brazilian Institute of Geography and Statistics (IBGE). The socioeconomic indicators used as a reference correspond to the annual values for 2024, released in the first half of 2025. The reverse logistics information, also referring to the year 2024, was made available throughout 2025.

For this edition of the Panorama, in order to make the data presentation more objective and the reading more fluid, the methodology of the work, which includes the sources of information consulted, as well as variables and indicators involved in the data analysis, will only be released in digital version. The access to the methodology file is free, as is the access to Panorama, and both area available in the ABREMA website (www.abrema.org.br).


03

MUNICIPAL SOLID WASTE

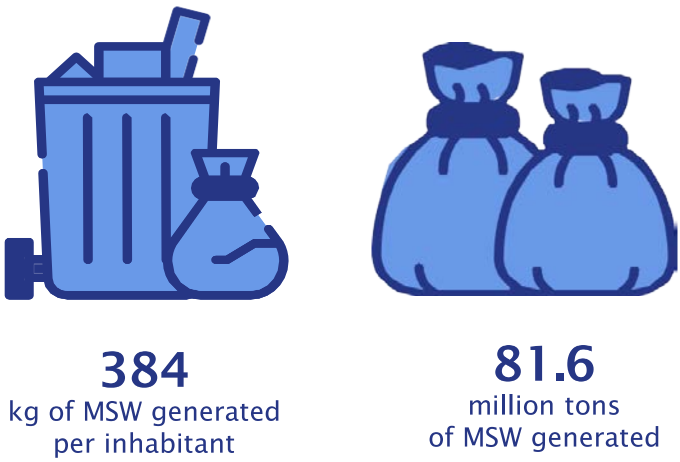
This chapter cover items used and discarded in Brazilian households during daily activities. These items include newspapers, paper, bottles and plastic packaging, glass containers, clothing, food scraps, pruning and gardening waste, among others, which do have no hazardous characteristics. The proper management of this material involves collection, transportation, treatment and final disposal and, according to the National Solid Waste Policy (PNRS), is responsibility of the municipality where such waste is generated.

This chapter presents data on the generation of MSW in Brazil, as well as a flow of this waste in the country, including collection, recycling and other treatments, and final disposal. Data on the number of jobs in the sector and the amount spent on MSW management services in Brazilian municipalities are also provided.

3.1. MSW Generation

Reduction in the unemployment rate in Brazil in 2024 suggests an increase in the population's purchasing power and, consequently, greater generation of MSW. However, the average *per capita* MSW generation in Brazil remained almost constant, with each inhabitant generating, on average, 1.051 kg of MSW per day (an increase of less than half percentage point). Applying this value to the population for Brazil, an estimated annual generation of more than 81.6 million tons of MSW is obtained, which is equivalent to more than 223,000 tons of waste generated every day, or about 384 kg of MSW per inhabitant during the year. These values indicate that, although there has been an increase in the total amount of MSW generated in the year, this was mainly due to the increase in population.

Figure 3.1. MSW generation in Brazil in 2024



Regionally, the Southeast continues to be the largest generator of MSW in Brazil, both in *per capita* and total values. For the year under analysis, the average annual generation was 453 kg of MSW per inhabitant, or 1.241 kg per inhabitant per day (kg/inhab/day). Considering total values, there was a generation of more than 40 million tons of MSW in 2024, or 110,000 tons per day, which represents about 50% of the national generation.

The region with the lowest *per capita* MSW generation is the South, with an annual generation of 285 kg of MSW per inhabitant, or 0.781 kg/inhab/day. In terms of total annual generation, the region that contributes the least to the national total is the North, responsible for generating approximately 16,700 tons of MSW daily, or 6.1 million tons annually, which is equivalent to 7.5% of the MSW generated in the country (0.894 kg/inhab/day).

Figure 3.2. Regional participation in Brazilian MSW generation in 2024

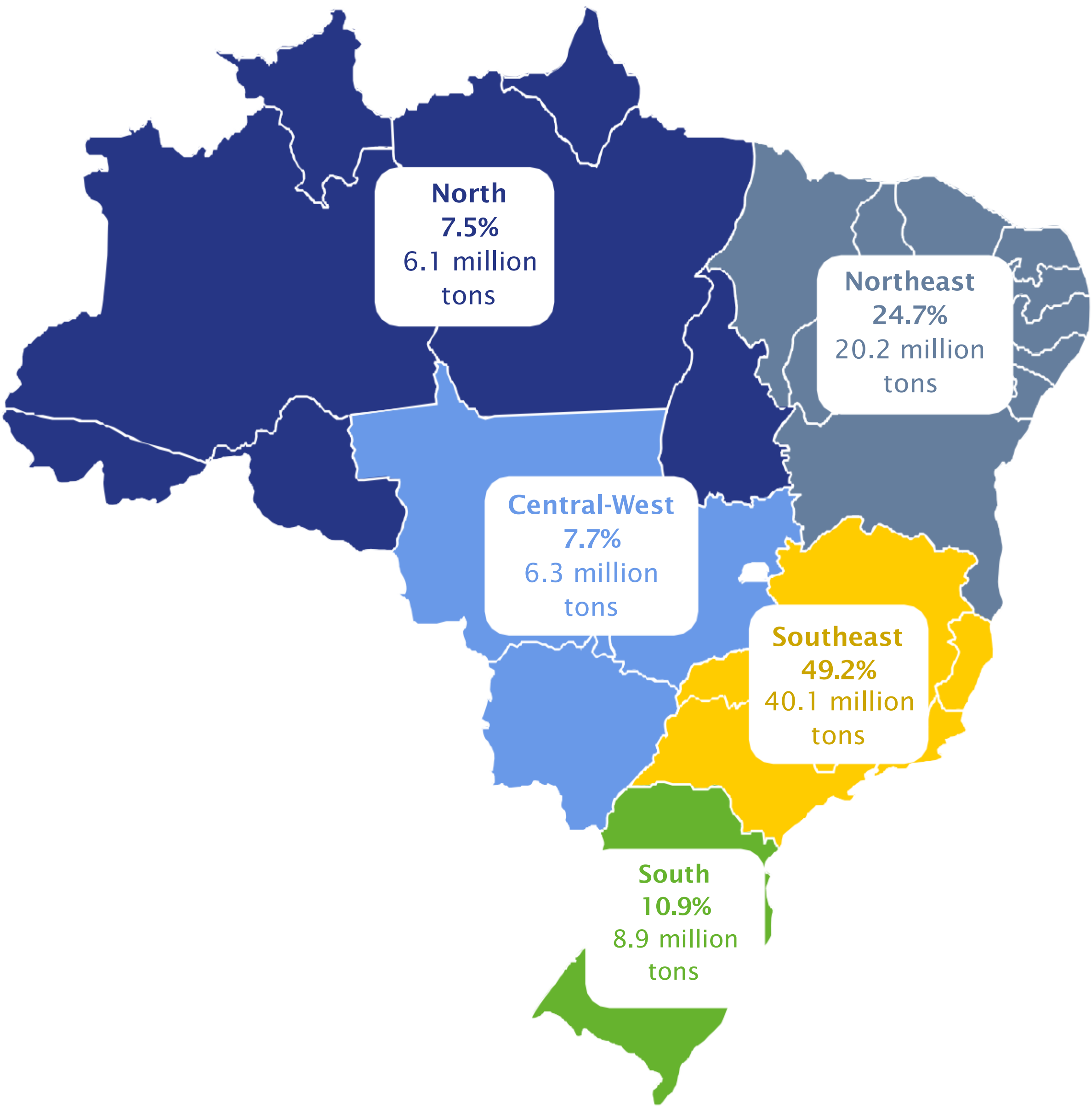
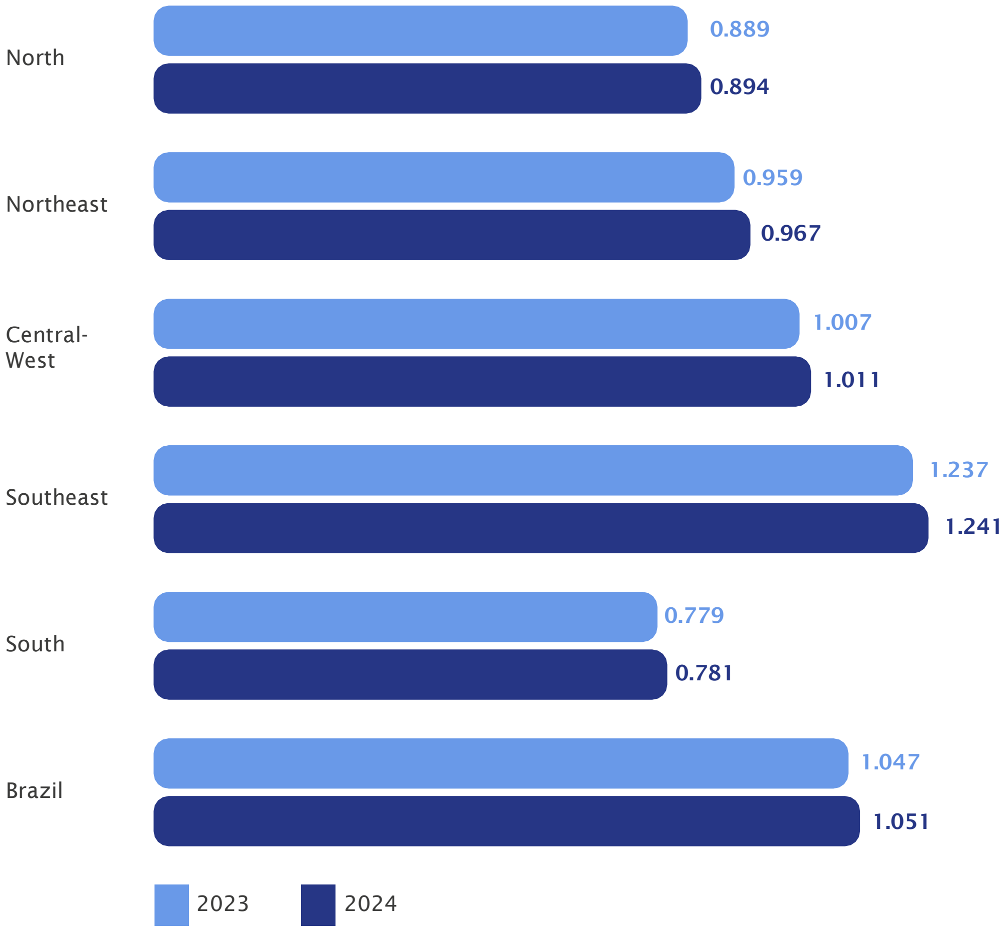


Figure 3.3. *Per capita* MSW generation by region
comparison 2023 and 2024 (kg/inhab/day)



Despite continuing to have the largest share in national MSW generation, the Southeast region showed the smallest increase in MSW generation: it generated 0.5% more household waste than in 2023. The Central-West region, due to a combination of decreased unemployment and regional population growth, increased its annual MSW generation by 1.7%. When analyzing generation *per capita*, the South was the region that showed the smallest increase in waste generation: its 0.3% growth in *per capita* generation was below the 0.8% growth shown by the Northeast region, which showed the largest increase in *per capita* generation in 2024.

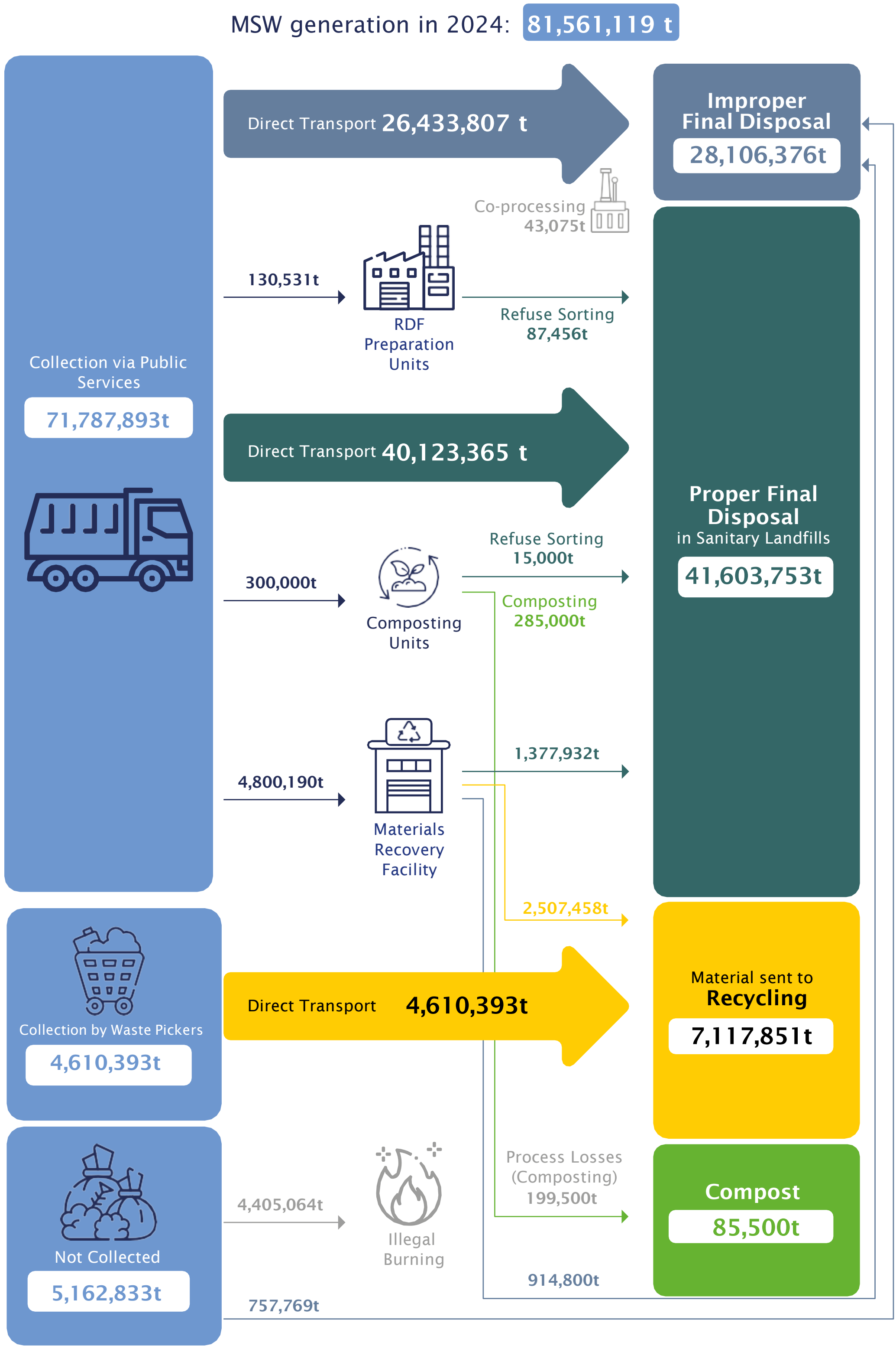
3.2. MSW Flow

Proper MSW management must respect a hierarchy: non-generation, reduction, reuse, recycling, treatment, and environmentally sound final disposal. This order of priority, established in the PNRS (National Solid Waste Policy), prioritizes processes with less environmental impact and that promote the development of a circular economy.

In order to illustrate the complexity and diversity of processes in MSW management in the country, the Panorama 2025 presents, for the second year, the flow of MSW in Brazil. This flow allows us to understand waste management beyond the undifferentiated stages of generation, collection, and final disposal. Additionally, the analysis of this flow over the years will allow us to observe the transition to a more sustainable and circular model. Today, the country already has initiatives for recycling dry and organic waste, which are being progressively intensified. The production of refuse-derived fuel (RDF), although still representing a small fraction in MSW treatment, presents itself as an alternative for the disposal of materials not used in the mechanical recycling of dry waste. Finally, there is a significant presence of disposal in sanitary landfills, which allow for energy recovery and the production of biomethane from MSW, contributing to better operation and sustainability of the process and reducing gas emissions into the atmosphere – consequently, the sector's contribution to climate change.

Several data sources were consulted to obtain the information presented here. For data not yet quantified in the country, in addition to gathering information that allowed projections and estimates, the results obtained were discussed with stakeholders in the sector, so that the flow presented here would represent the Brazilian reality as best as possible. Although there are other technologies available for the treatment of MSW, the Panorama focuses on those that operate on a commercial scale in the country. The flow of MSW in Brazil in 2024 is presented as follows, and the processes in this diagram are discussed in the subsequent items.

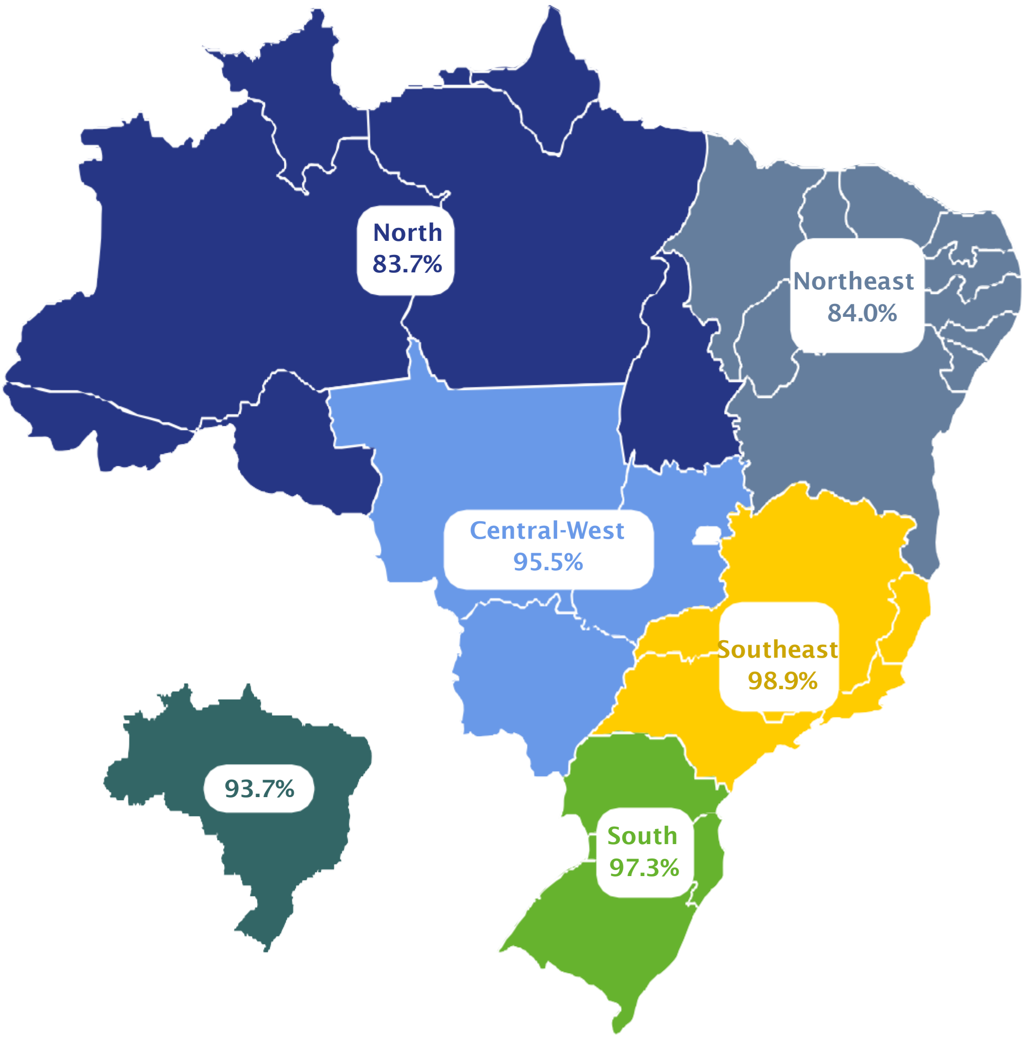
Figure 3.4. Flow of MSW in Brazil in 2024



3.2.1. Collection of MSW

It is estimated that 76.4 million tons of MSW were collected in Brazil in 2024 – an average of more than 209,000 tons collected daily. This amount corresponds to 93.7% of the MSW generated in the country, which increases national collection by approximately 0.3% compared to the 93.4% of the previous year. The averages by region are above the national average in the South, Southeast, and Central-West, with collections of 97.3%, 98.9%, and 95.5% of the MSW generated, respectively. Despite the improvement in their rates, the North and Northeast regions continue to have averages below the national average, having collected 83.7% and 84.0% of the MSW generated.

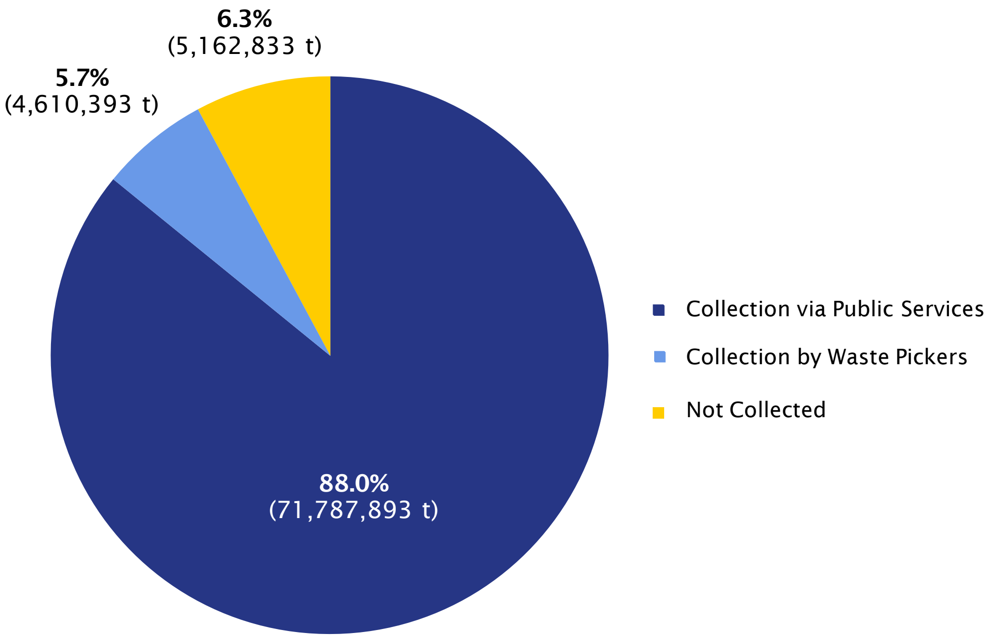
Figure 3.5. MSW collection by major region in 2024



The collection of MSW in Brazil is divided into two types: collection via public services and collection by waste pickers. Collection via public services includes curbside collection (selective and undifferentiated), collection via voluntary drop-off points, collection in partnership with waste picker associations and cooperatives, etc. This modality was responsible for 94% of solid waste collection in Brazil, which corresponds to 71.8 million tons of waste, or 88% of the total solid waste generated in the country that year.

It is estimated that 6% of solid waste collection in Brazil was carried out by waste pickers. These 4.6 million tons of recyclable material, or 5.7% of the solid waste generated in the country, were collected by more than 700,000 independent waste pickers, who have no employment relationship with associations or cooperatives. Estimating the mass of MSW collected by independent waste pickers is a challenging task, as it involves quantifying work that is not formally registered, making it difficult to monitor and measure it. However, since this is a common activity in Brazil, its quantification is important not only in the environmental and MSW management spheres, but also in the social and economic spheres. Because the data used in this analysis lacked regional precision, the collection was not quantified by region.

Figure 3.6. Amount of MSW collected in Brazil in 2024 by type of collection

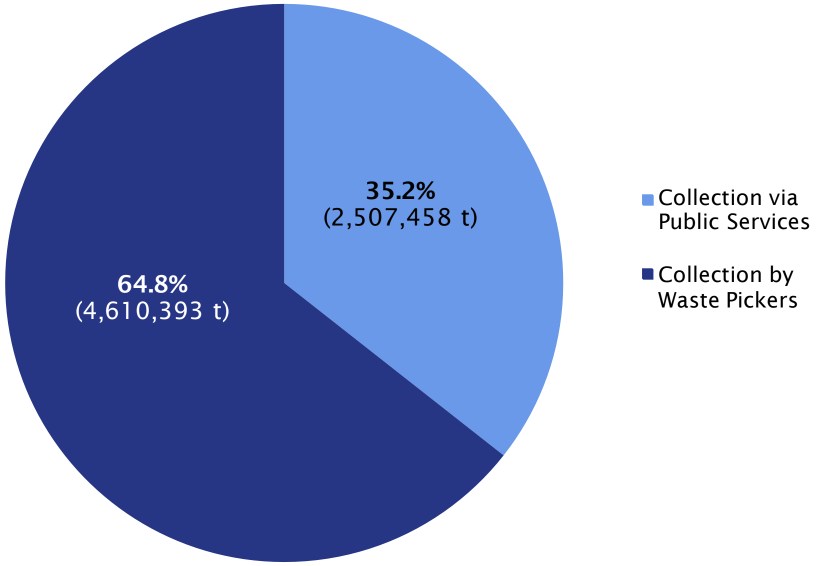


3.2.2. Mechanical Recycling of Dry Waste

It is estimated that approximately 7.1 million tons of dry waste were sent for recycling in Brazil, which is equivalent to 8.7% of the MSW generated in the country in the same year. The waste sent for recycling has two main origins: collection via public services and collection by waste pickers. About 6.7% of the total MSW collected via public services, or 4.8 million tons, was sent to materials recovery facilities. Approximately 52% of this material, or 2.5 million tons, was recovered, and the remainder, considered refuse, was sent for final disposal. Collection by waste pickers, carried out by independent waste pickers, was responsible for collecting about 4.6 million tons of MSW. Since independent waste pickers only collect materials with value for the recycling chain, it is assumed that 100% of the material collected by these workers was recovered.

The 5% increase in the amount of waste sent for recycling, compared to the previous year, reflects an increase in both collection via public services, which has been expanding its coverage, and collection by waste pickers. This increase was also observed in the quantities of materials collected and properly disposed of via reverse logistics programs.

Figure 3.7. Amount of dry MSW sent for recycling in Brazil in 2024 by type of collection.



Compared to previous year, there was an increase in the share of collection via public services in Brazil. However, almost two-thirds of MSW sent for recycling is still collected by independent waste pickers. This highlights the extent of informal labor participation in the Brazilian recycling chain and the importance of including these workers in discussions about the topic.

3.2.3. Composting

Composting is a method of treating the organic fraction of MSW which consists of the controlled decomposition of organic waste by microorganisms under aerobic conditions, generating carbon dioxide (CO_2), water (released as steam or generating leachate), and compost. Compost is a dark material rich in nutrients, used as fertilizer and to improve soil properties. Because it results in a product with physical and chemical characteristics different from the initial material, composting is considered organic or bio-energetic recycling[1].

Data collection and interviews conducted with composting facilities and associations linked to this activity indicate that the amount of domestic organic waste composted in 2024 did not vary significantly compared to the previous year. Thus, it is estimated that approximately 300,000 tons of material were received in composting facilities in Brazil, which is equivalent to approximately 0.4% of the MSW generated in the country.

It is estimated that around 5% of the material received in these units, approximately 15,000 tons, is non-compostable material, such as Styrofoam, plastic bags, and other packaging, which is sorted prior to composting and sent to landfills. The remaining organic material is subjected to composting. Considering that the decomposition process consumes an average of 70% of the mass of organic matter (generating water and CO_2), approximately 85,500 tons of compost were produced in Brazil as a result of MSW composting.

3.2.4. Fuel Derived from Municipal Waste

The production of refuse-derived fuel (RDF) is an alternative for utilizing MSW that, after sorting, is no longer viable for reuse or mechanical recycling. The preparation of RDF consists of a waste sorting process, in which materials with the highest calorific value are selected, followed by shredding and drying, so that the physical characteristics of the material become suitable for its use as fuel. The final product has a high calorific value and is used as a substitute for fossil fuels in the production of thermal energy in industrial furnaces.

Currently, the main consumer of RDF in Brazil is the cement industry, which uses this fuel as a substitute for coke and incorporates the ashes resulting from combustion into clinker, the main component in cement manufacturing. This dual utilization process (production of thermal energy and use as raw material) is called co-processing.

It is estimated that approximately 130,500 tons of MSW were sent to RDF processing units in Brazil, representing less than 0.2% of the total MSW generated in the country. Given that every ton of MSW received at processing units results on an average of 330 kg of RDF (a utilization rate of 33%), it is estimated that the country produced around 43,000 tons of RDF last year.

Due to the nature of the RDF production process, it is estimated that the 87,500 tons rejected by the sorting process were sent to landfills.

[1] Concept presented in Chapter 7.

3.2.5. Illegal Burning

Approximately 4.4 million tons of MSW were burned on the property where they were generated or in nearby locations in 2024. This is equivalent to 5.4% of the MSW generated in Brazil that year. The practice of burning waste on the property is observed more frequently in households in rural areas or far from large urban centers, which are not served by collection services. However, unauthorized burning or improper disposal of MSW on the ground, even in small quantities, is illegal and can negatively impact the environment and the health of the local population. Air pollution caused by uncontrolled burning can cause respiratory difficulties and other health problems for the surrounding population. Additionally, in some regions of Brazil, uncontrolled burning of waste is one of the main causes of wildfires, which exacerbate climate change, severely impact air quality and human health, and cause economic losses and irreparable damage to ecosystems and biodiversity.

3.2.6. Final Disposal

Final disposal must consider a series of technical criteria in order to avoid damage or risks to public health and safety, and to minimize adverse environmental impacts. The final disposal unit that fits this definition is the sanitary landfill, a complex engineering work that, according to Reference Standard No. 7/2024 of the National Water and Sanitation Agency (ANA), must have an impermeable base liner and drainage and collection systems for leachate, gases and stormwater, in addition to other operational requirements. Dumps, controlled landfills and similar units, including the burial of small quantities of MSW on the property of generation, do not have these protection structures and are considered environmentally improper for the final disposal of waste.

In Brazil, approximately 69.7 million tons of MSW were sent for final disposal in 2024 (proper and improper), which corresponds to 85.5% of the MSW generated in the year. Projections for the Panorama 2025 indicate that 59.7% of this amount was disposed of in sanitary landfills (environmentally proper final disposal).

The Southeast and South regions performed best, with sanitary landfills being the destination for more than 69% of the waste sent for final disposal. The other regions performed below the national average, with sanitary landfills in the North region being the destination of nearly 39% of the waste sent for final disposal. Improper final disposal areas are present in all regions of Brazil and received more than 28 million tons of waste in 2024 – about 40.3% of the total sent for final disposal in the country. Of this total, about 154,000 tons of MSW were buried on the generator's property.

When comparing the projected data for 2024 with the data from 2023, it is noted that the amount of waste sent for final disposal – proper or improper – remained practically the same: 85.6% in 2023 and 85.5% in 2024. The amount of waste sent for improper final disposal decreased from 41.5% of final disposal in 2023 to 40.3% in 2024. The reduction in the percentage of MSW sent for improper final disposal points to a greater participation of sanitary landfills in the final disposal of waste, which suggests a greater concern and commitment from municipal bodies to the environment and public health. However, this small variation reinforces the urgency of increasing the speed of improvement in MSW management in the country, so that concrete results from public policies can be observed.

Figure 3.8. Proper vs. Improper Final Disposal of MSW in Brazil in 2024

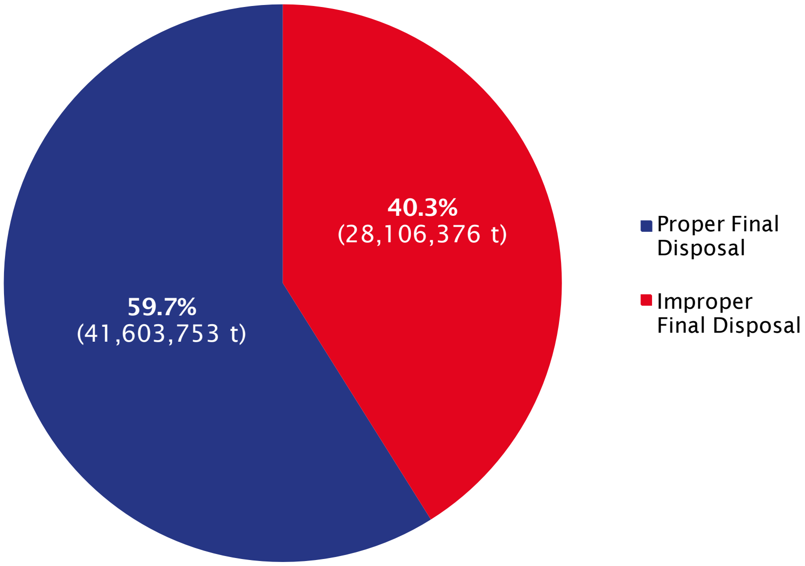
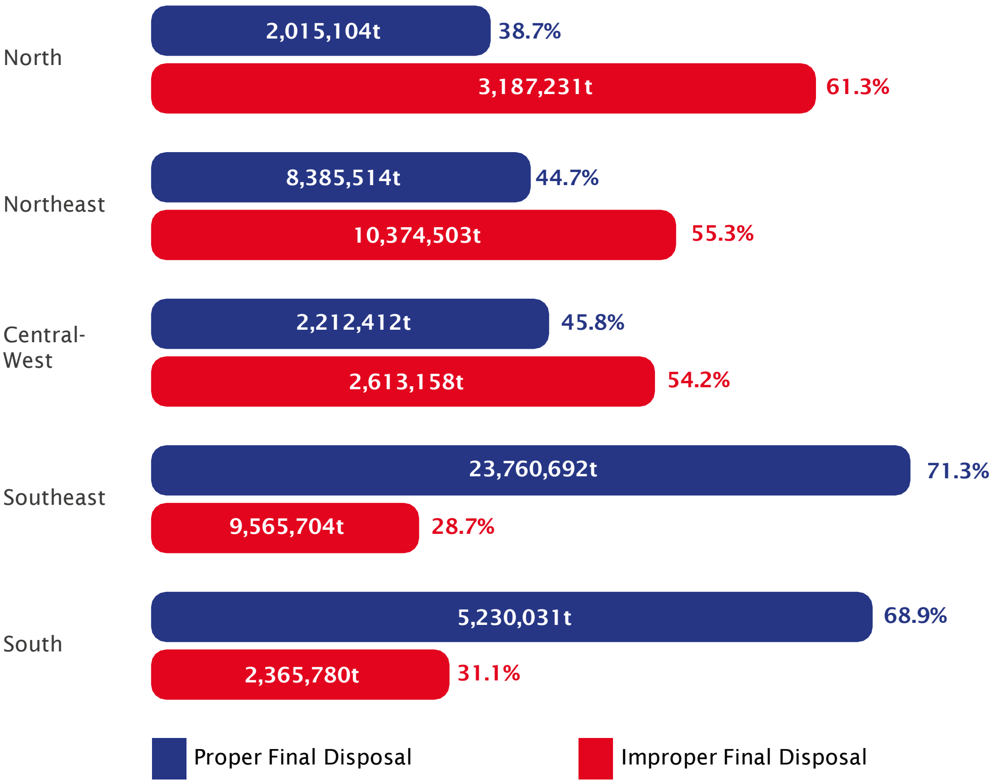


Figure 3.9. Final disposal of MSW by region in 2024

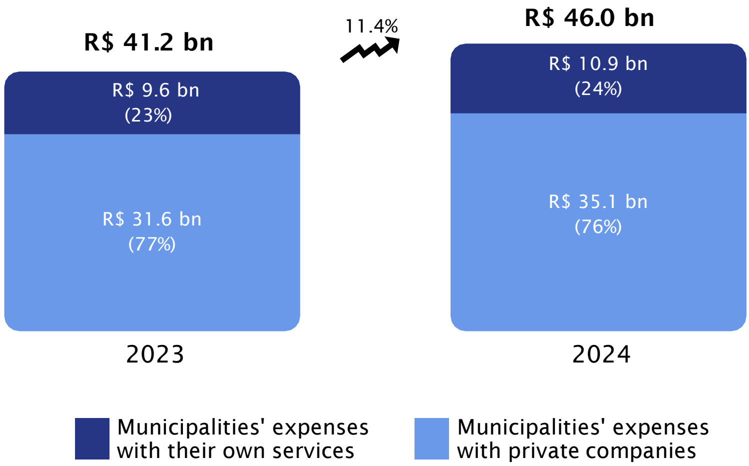


3.3. Expenses related to MSW Management

This section presents indicators of municipal expenditures with MSW management, which cover street cleaning and solid waste management services, the execution of which is the responsibility of the municipalities, even if they outsource it to private companies.

Municipal expenditures with MSW management in 2024 totaled approximately R$ 46 billion, representing an increase of 11.4% compared to 2023. The increase in expenditures did not significantly alter the composition of spending between services provided in-house and those performed by private companies, as illustrated in Figure 3.10. Services provided by private companies continue to account for over 75% of total expenditures, remaining the main model adopted by municipal administrations[2].

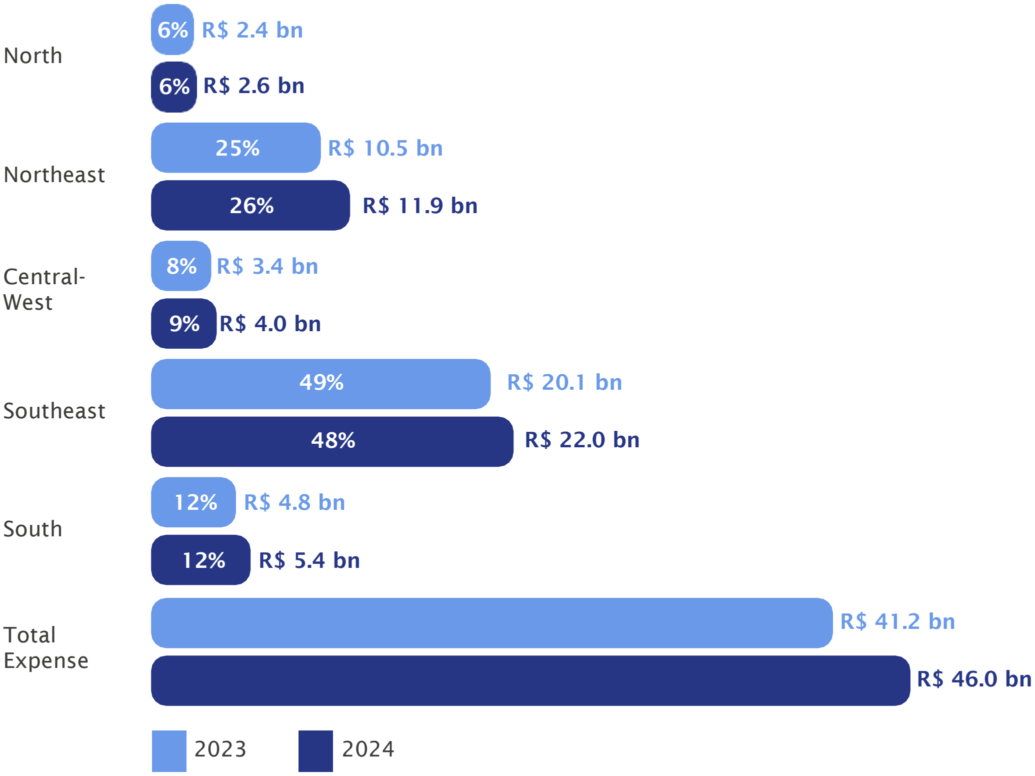
Figure 3.10. Evolution of municipal spending with MSW management in Brazil



Between 2023 and 2024, it is estimated that expenses with MSW management increased in all regions of the country, especially in the Southeast, which concentrated around 48% of the total national projection for 2024, as shown in Figure 3.11.

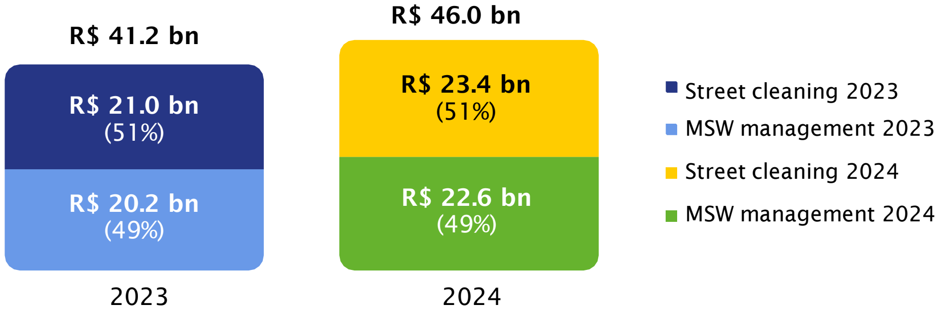
[2] The division between expenses with in-house services and private companies follows the division of the Brazilian National System of Basic Sanitation Information (SINISA), which aggregates around the categories not only the expenses with labor, but also expenses with vehicles, machinery and equipment contracted.

Figure 3.11. Evolution of municipal spending with MSW management by major region



The analysis of the distribution of municipal expenses between MSW management[3] and street cleaning[4] reveals that, on average, spending is distributed in a balanced way between the two categories, with approximately 50% allocated to each type of service, as shown in Figure 3.12.

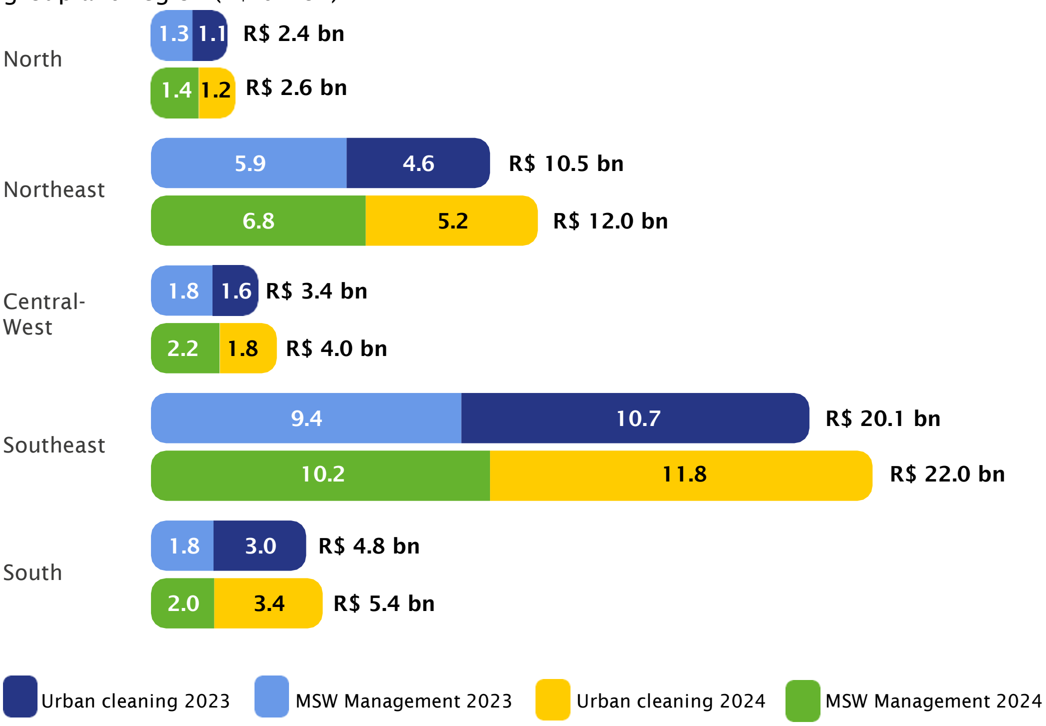
Figure 3.12. Evolution of total municipal expenses for MSW management by expense group



[3] Management includes collection, transportation, treatment, and final disposal.
[4] Street cleaning includes sweeping, cleaning streets and public spaces, unclogging drains, etc.

However, there are relevant regional variations, as illustrated in Figure 3.13. The Northeast and North regions presented stronger participation of MSW management than the national average in 2024, with approximately 57% and 55% of expenses directed towards these activities, respectively. On the other hand, the South region registered the lowest relative participation of management in 2024, with only 38% of expenses allocated to this category.

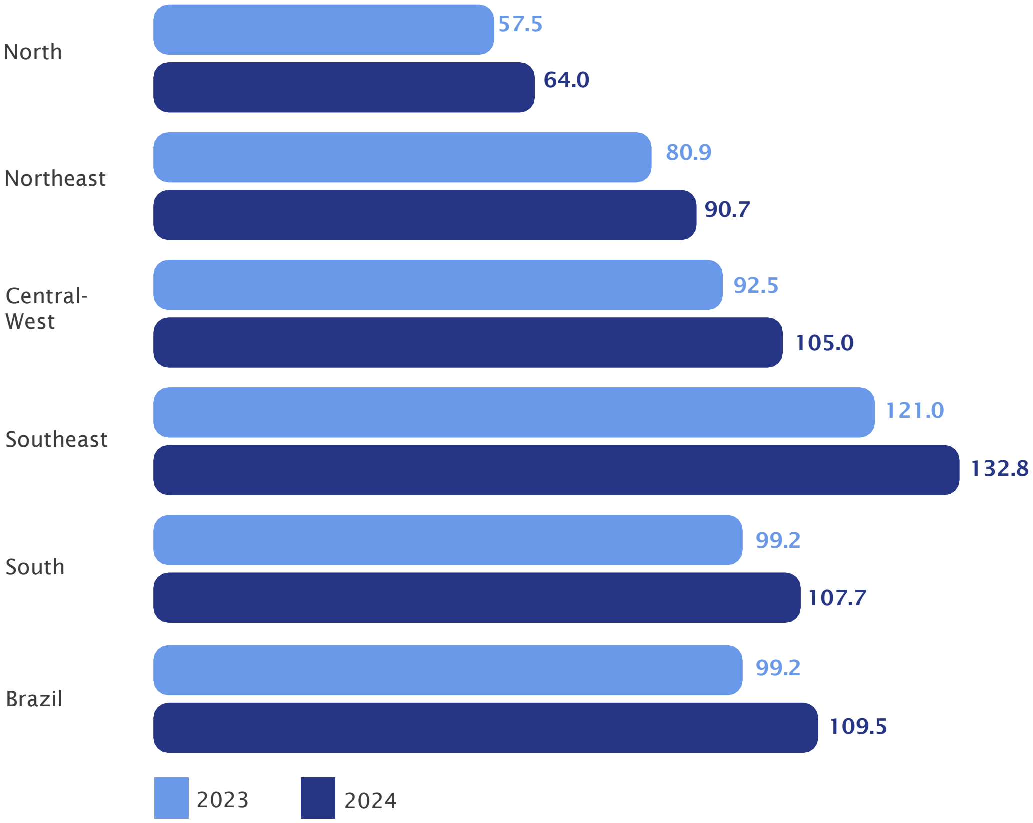
Figure 3.13. Evolution of municipal expenses with MSW management by expense group and region (R$ billion)



The Southeast region presented the highest *per capita* expenditure with municipal solid waste management services, reaching approximately R$ 133 per inhabitant per year, as shown in Figure 3.14. At the other end, the North region presented the lowest annual *per capita* expenditure, with about R$ 64 per inhabitant, a value approximately 41% below the national average. Nationally, *per capita* expenditure with MSW management grew by 10.3% between 2023 and 2024, increasing from R$ 99 to over R$ 109 per inhabitant per year.

Figure 3.14. Evolution of annual *per capita* expenditure of municipalities on MSW management

(R$ per inhabitant per year)

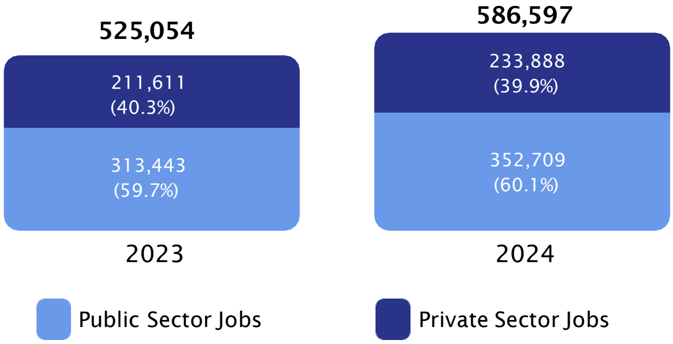


3.4. Jobs in MSW Management

This section presents employment indicators for the sector, which may be directly linked to municipalities or private companies that provide services to municipalities.

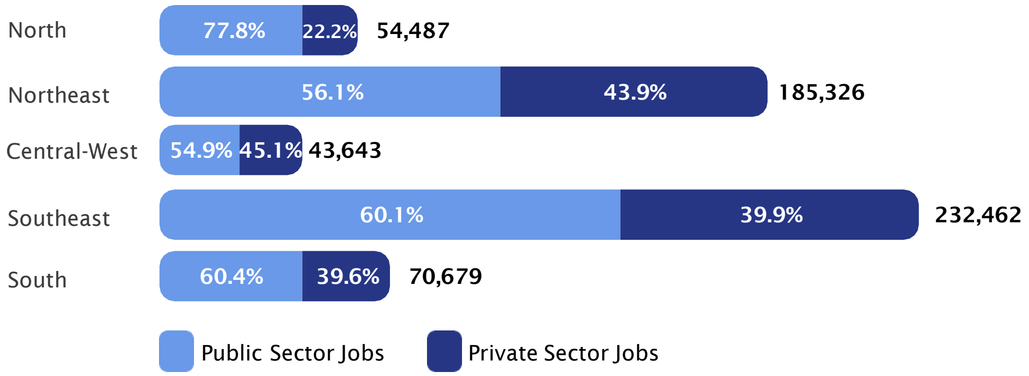
Between 2023 and 2024, there was an 11.7% growth in the total number of jobs linked to the MSW management sector. This increase was slightly more pronounced in the public sector, which showed a variation of 12.5%, compared to 10.5% in the private sector, as shown in Figure 3.15. In 2024, it is estimated that Brazil had approximately 587 thousand jobs in the MSW management sector, with approximately 40% (234 thousand) being private jobs under contracts with municipalities. Jobs directly linked to municipalities totaled 353 thousand, or about 60%.

Figure 3.15. Public and private sector jobs in MSW management (number of employment relationships)



Private sector jobs accounted for approximately 40% of total jobs in the sector for four Brazilian regions, with exception of the North, which recorded a significantly lower percentage, of 22.2%, as shown in Figure 3.16.

Figure 3.16. Public and private sector jobs in MSW management (number of employment relationships)



04

CONSTRUCTION AND DEMOLITION WASTE

Construction and demolition waste (CDW), also known as civil construction waste (CCW), is waste originated from the construction, renovation, repair, and demolition of civil construction works, and waste resulting from land preparation or excavation, commonly called construction debris or rubble (National Environment Council (CONAMA) Resolution No. 307/2002). Such waste can be separated into four classes, according to its recyclability:

Class A: reusable or recyclable materials that can be added to new civil construction processes, such as bricks, concrete, and tiles;

Class B: recyclable materials that can be used for other purposes not related to civil construction, such as plastic and paper;

Class C: waste that cannot be recycled or recovered due to lack of technology or economic unfeasibility;

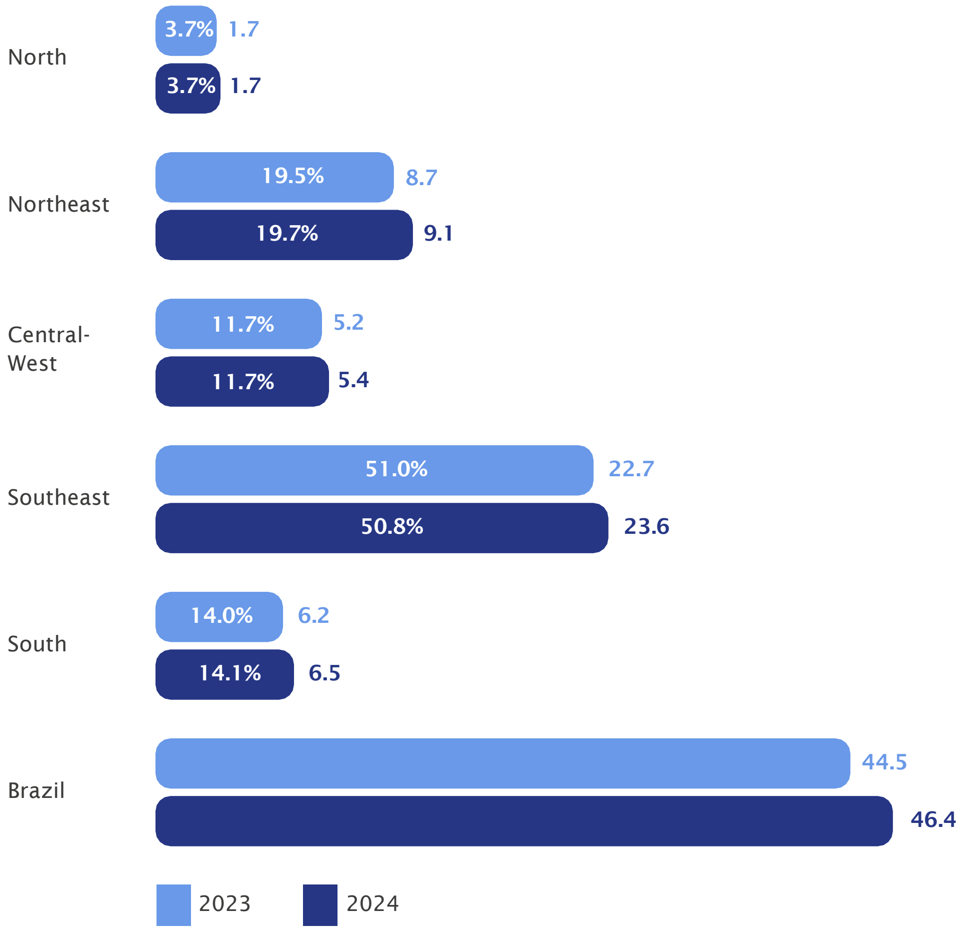
Class D: hazardous waste, such as paints, solvents, or other materials that may contain components harmful to health.

According to the National Solid Waste Policy (PNRS), as with other types of waste, the main parties responsible for the proper management of CDW are the generators themselves, but this responsibility can be extended to transporters and those responsible for public urban cleaning and solid waste management services.

Until the previous edition of the Panorama, the estimate of CDW generated was mainly limited to individuals – commonly generating CDW in small construction projects and home renovations – and demolition companies. For the reference year of 2024, it is estimated that this generation increased by approximately 4.3%, totaling approximately 46.4 million tons of CDW. This growth follows the variation in the GDP of the construction sector and represents the first annual growth after two consecutive years of reduction in CDW generation from these generators.

The increase in CDW generation by individuals and demolition companies was observed in the five major Brazilian regions, with the Northeast region standing out, showing a growth of 5.3% compared to its generation in 2023. The Southeast continued to be the region with the largest contribution to the total CDW generated in the country, with 50.8% of the total. The North region had the smallest contribution, being responsible for only 3.7% of the CDW generated by individuals and demolition companies.

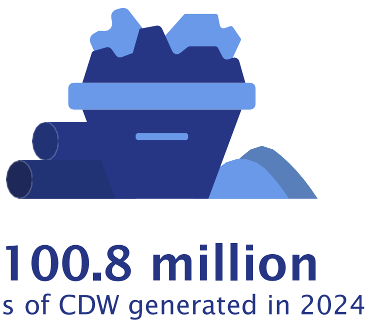
Figure 4.1. CDW generated by individuals and demolition companies in Brazil
Comparison 2023 and 2024 (millions of tons)



According to the Brazilian Association for Recycling Construction and Demolition Waste (ABRECON)[5], CDW generated by individuals and demolition companies represents about 46% of the CDW generated in the country. The other main generators are construction companies, responsible for 30% of CDW generation in Brazil, and public bodies and paving companies, each group responsible for 12% of the waste generated. Respecting this proportion, the total CDW generated in the country was estimated considering its main generators. Thus, it is estimated that Brazil generated a total of approximately 101 million tons of CDW in the reference year.

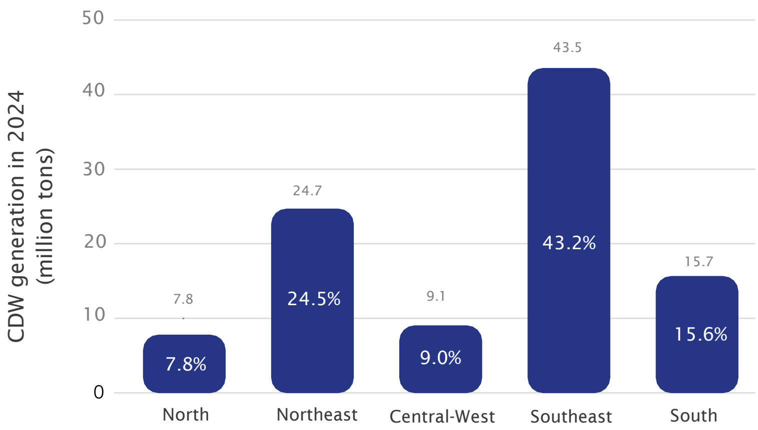
[5] ABRECON (2025). "ABRECON Sectoral Research Report 2024".

Figure 4.2. Construction and demolition waste generation in Brazil in 2024



Regionally, the Southeast region accounts for the largest share of CDW generation in Brazil, responsible for 43.2% of the total generated. The smallest contribution is from the North region, with generation corresponding to 7.8% of the national total.

Figure 4.3. Participation of each major region in Brazilian CDW generation in 2024



Construction and demolition waste constitutes a silent but massive challenge in Brazilian urban centers. Although rarely mentioned in public discourse, the mass of CDW is greater than the mass of MSW generated. The complexity of CDW management lies in the diversity of its four classes – ranging from noble materials such as concrete and ceramics (Class A) to potentially hazardous products such as paints and solvents (Class D) – often mixed indiscriminately on construction sites. This inadequate separation, coupled with the difficulty of monitoring it and the lack of incentives for the use of recycled aggregates, means that much of this economic potential is converted into an environmental liability, wasting opportunities to reintegrate these materials into new production cycles, to the detriment of both the economy and the environment.

Figure 4.4. Comparative table of national MSW and CDW generation in 2024

Brazil's population in 2024		212,583,750	
		MSW	**CDW**
Total generation	[million tons]	81.6	100.8
Generation *per capita*	[kg/inhab/day]	1.051	1.300
	[kg/inhab/month]	32.0	39.5
	[kg/inhab/year]	384	474


05

HEALTHCARE WASTE

Healthcare waste (HCW) is all waste resulting from activities related to human or animal healthcare (Collegiate Board Resolution (RDC) No. 222/2018, of the Brazilian Health Regulatory Agency - Anvisa). Such waste is divided into five different groups:

Group A: waste containing biological agents and which may pose infection risks;

Group B: waste containing chemical products which may pose a risk to public health or the environment;

Group C: radioactive waste;

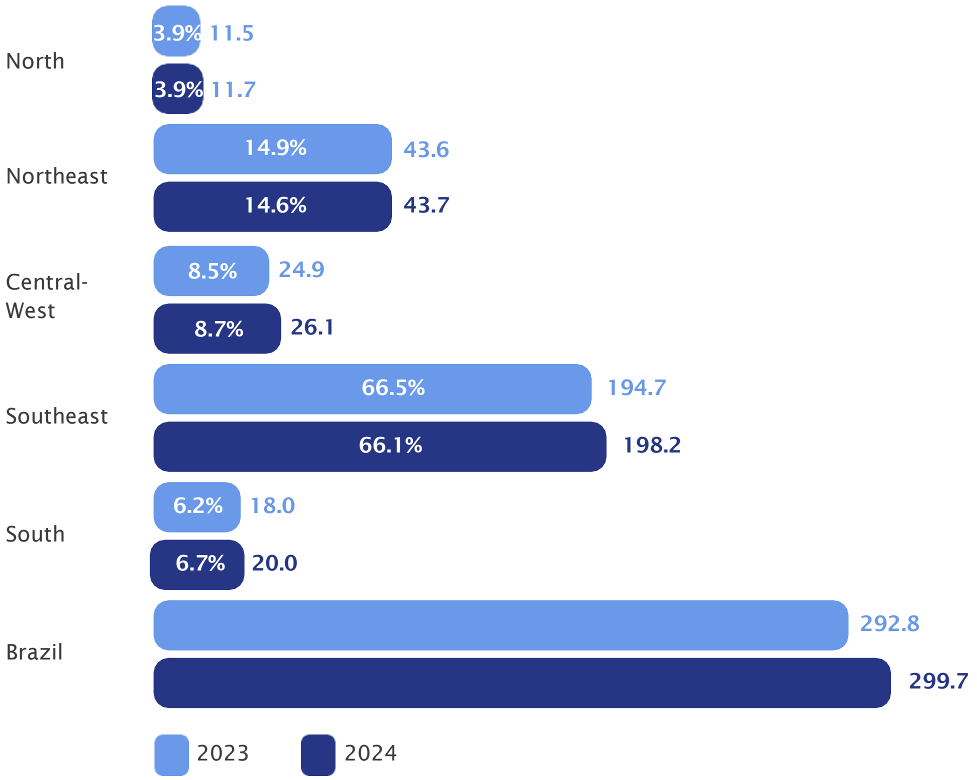
Group D: waste that does not present the risks mentioned in the previous groups and can be equated to household waste; and

Group E: sharps waste.

Until the previous edition of the Panorama, the HCW generation data presented reflected the amount of waste from hospitalizations and surgical procedures. For the reference year of 2024, an increase of 2.4% was estimated in the national generation of this waste, totaling approximately 300,000 tons of HCW. The Southeast region continues to be the largest generator of this type of waste in the country, accounting for 66.1% of the total generated, while the North region, at the other extreme, accounts for 3.9% of this total. All five regions showed an increase in the generation of HCW in 2024.

Figure 5.1. HCW from surgical procedures in Brazil

Comparison 2023 and 2024 (thousand tons)

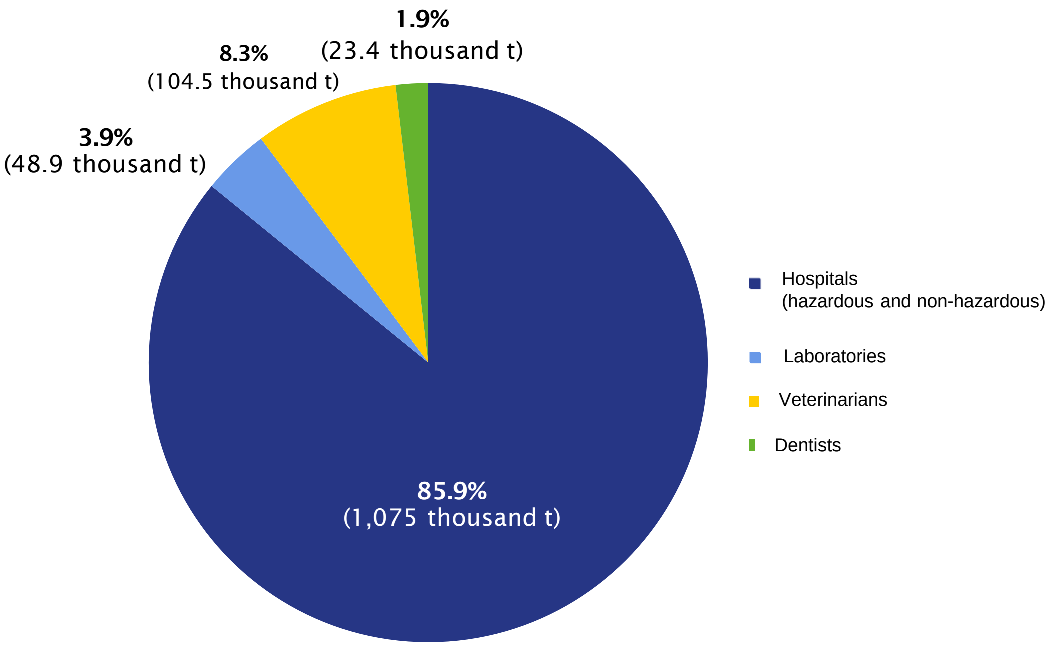


Beyond this source of waste, it is estimated that approximately 1.3 million tons of HCW were generated in Brazil in 2024. In addition to waste from surgical procedures, Panorama 2025 expanded the analysis of hospital waste to include waste from wards, hospitalizations not related to surgical procedures, and non-hazardous waste. It is estimated that these materials represents approximately 86% of the HCW generated in Brazil in 2024. Also included in the analysis was waste generated in clinical examination and analysis laboratories, responsible for 3.9% of the HCW generation in the country. Dental offices and clinics generated less than 2% of the total.

Finally, the generation of HCW in veterinary establishments, such as hospitals, clinics, and pet shops, was analyzed. It is estimated that these animal health care establishments are responsible for 8.3% of the total HCW generated in the country in 2024.

Figure 5.2. HCW generation in Brazil in 2024

Figure 5.3. HCW generation in Brazil by type of establishment



Although generated in significantly smaller quantities than MSW, HCW requires more attention in its handling and treatment due to its hazardous nature and greater potential for contamination and risk to human health and the environment. Additionally, the need for sterilization, decontamination, or special disposal of a fraction of these wastes also makes HCW management more costly than that of MSW, highlighting the importance of an adequate waste management plan.


06

REVERSE LOGISTICS

According to the PNRS, reverse logistics is one of the instruments established to ensure shared responsibility for the product life cycle, establishing the mandatory participation of different actors, such as manufacturers, importers, distributors, and retailers. The implementation of reverse logistics systems involves a set of actions that enable the collection and return of products or packaging to their manufacturers, with the aim of reusing the materials or sending them for environmentally appropriate final disposal.

The successful implementation of the systems allows for greater circularity of materials, reduced use of raw materials, and extension of the useful life of sanitary landfills, since the recovered materials are no longer sent to these units.

Currently, there are 13 reverse logistics systems operating in Brazil, established by legislation, commitment agreement, or sectoral agreement. Data relating to the actions performed by each system are presented in this chapter, in summary form, in order to provide an overview of the progress of this tool in the country in recent years.

The implementation and execution of actions for each reverse logistics system are carried out by a monitoring institution or managing entity, and the progress of these systems is monitored by the MMA through performance reports submitted annually by these institutions.

The table below lists the reverse logistics systems in operation in Brazil in 2024, as well as information about their responsible institutions or entities and their respective implementation instruments.

Figure 6.1. Summary table of materials with reverse logistics systems in Brazil.

No.	Material	Managing Entity/Institution	Implementation Instrument	Year of Instrument
1	Empty Crop Protection Packaging	inpEV	Decree No. 4,074	2002
2	Lead-acid batteries	IBER	Sectoral Agreement	2019
3	Electrical and electronic equipment	ABREE Green Eletron	Sectoral Agreement	2019
4	Steel packaging	PROLATA	Commitment agreement	2018
5	Glass packaging	*Circula Vidro*	Decree No. 11,300	2022
6	General packaging	Several Institutions*	Sectoral Agreement	2015
7	Lubricant oil packaging	*Jogue Limpo* Institute	Sectoral Agreement	2012
8	Used or Contaminated Lubricant Oils (UCLO)	ANP *Jogue Limpo* Institute	CONAMA Resolution No. 362	2005
9	Fluorescent, sodium vapor, mercury vapor and mixed light lamps	Reciclus	Sectoral Agreement	2014
10	Aluminum beverage cans	*Recicla Latas*	Commitment agreement	2020
11	Medicines and packaging	GAP	Decree No. 10,388	2020
12	Batteries and accumulators	Green Eletron	CONAMA Resolution No. 401	2008
13	Useless tires	Reciclanip	CONAMA Resolution No. 416	2009

*The reverse logistics of general packaging has several managing entities responsible for collecting system data.

In October 2025, Decree No. 12,688/2025, also called the "Plastic Decree," was signed. This decree established the 14th reverse logistics system in Brazil: for plastic packaging. As the system was not operational in 2024, the reference year of the 2025 Panorama, it was not included in this edition of the publication.

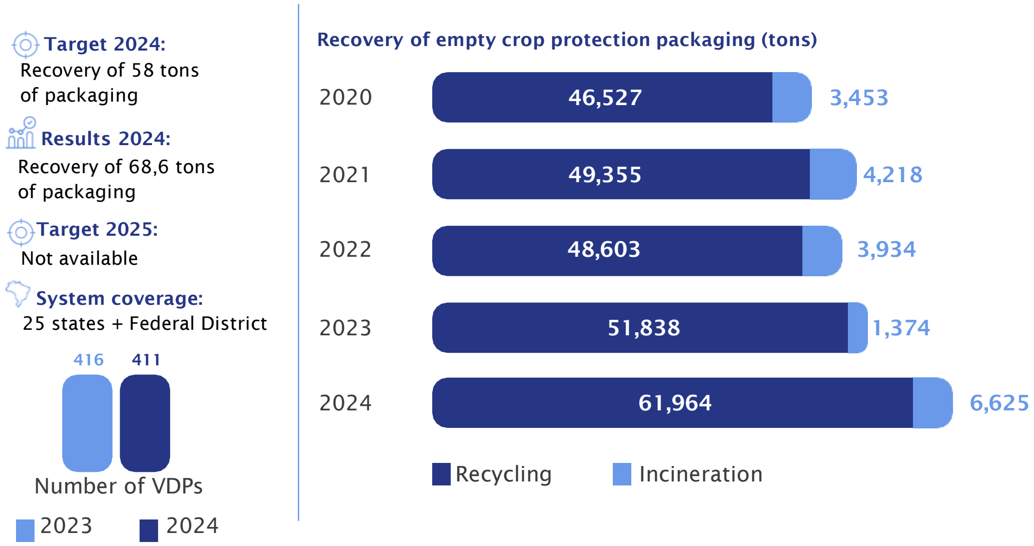
The following items present the proposed targets for 2024 and 2025, as well as the history of the systems' reach in the national territory in recent years, whether in relation to system coverage, the number of voluntary drop-off points (VDP), or the amount of material recovered. Data in this chapter were obtained directly from the institutions responsible for the reverse logistics systems, considering the performance year of 2024.

6.1. Empty Crop Protection Packaging

The National Institute for Processing of Empty Packaging (*Instituto Nacional de Processamento de Embalagens Vazias* - inpEV), which has been operating since 2002, is the managing entity responsible for the reverse logistics program for empty crop protection packaging, named *Campo Limpo* System. Currently, the system enables the proper final disposal of 100% of the packaging received, through recycling or incineration, when it comes to hazardous waste. The resins resulting from the recycling process of these materials are used to manufacture other products, such as effluent pipes used in civil construction and signage posts for the transportation sector.

In 2024, even with a slight decrease in the number of VDPs, there was a 29% increase in the amount of material recovered compared to the previous year, due to the increase in packaging returned by farmers. With this, the system once again exceeded its annual recovery target. Since the system began operating, more than 800,000 tons of pesticide packaging have been recovered.

Figure 6.2. Status of the reverse logistics system for empty crop protection packaging



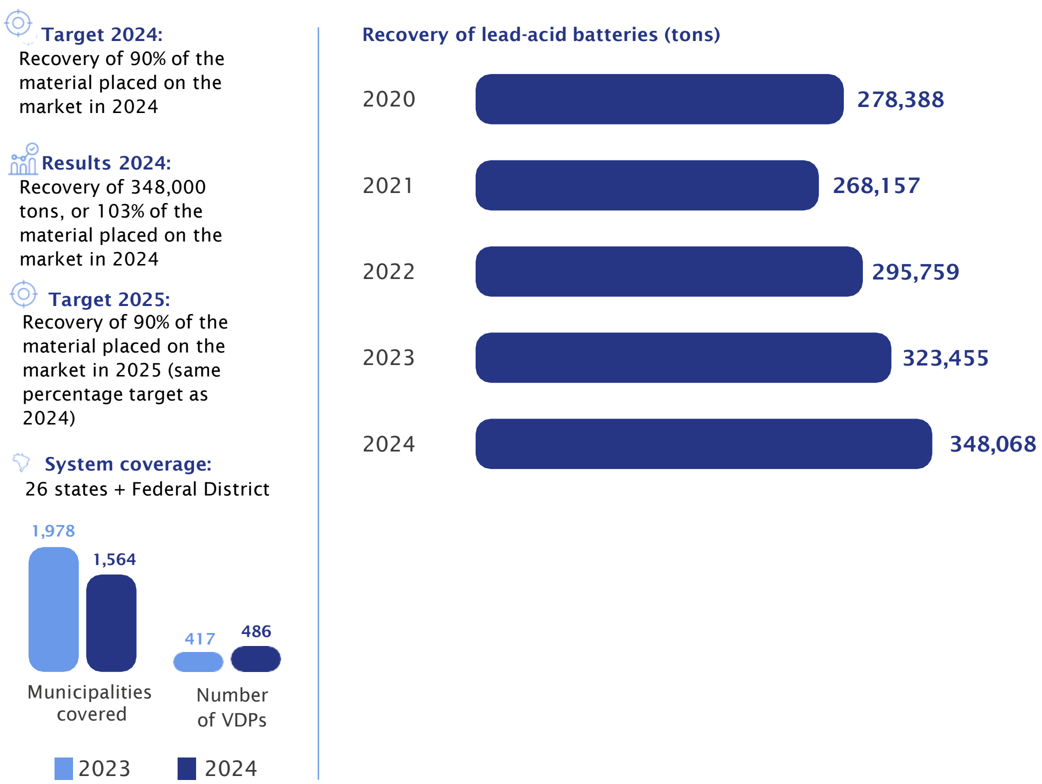
Source: inpEV 2024 Sustainability Report (*Relatório de Sustentabilidade 2024 - inpEV)* (2025)

6.2. Lead-acid Batteries

The reverse logistics system for lead-acid batteries is managed by the Brazilian Institute of Recyclable Energy *(Instituto Brasileiro de Energia Reciclável* - IBER), created in 2016. The institute's work began before the signing of the sectoral agreement, promoting the environmentally proper disposal of these materials, commonly used in automobiles. The system recovery target is defined each year, and for 2024, the target was collecting the equivalent of 90% of the material sold in the year.

The recycling of lead-acid batteries is done through processes of separation and purification of the material for use in new products, such as new batteries, PVC pipes, among others. In 2024, despite the decrease in the number of municipalities with movement of lead-acid batteries, there was an increase in the number of VDPs and an approximately 8% growth in material recovery compared to the previous year. Since the system began its operations, approximately 2.4 million tons of lead-acid batteries have been collected and disposed of in an environmentally proper manner.

Figure 6.3. Status of the reverse logistics system for lead-acid batteries



Source: IBER (2025)

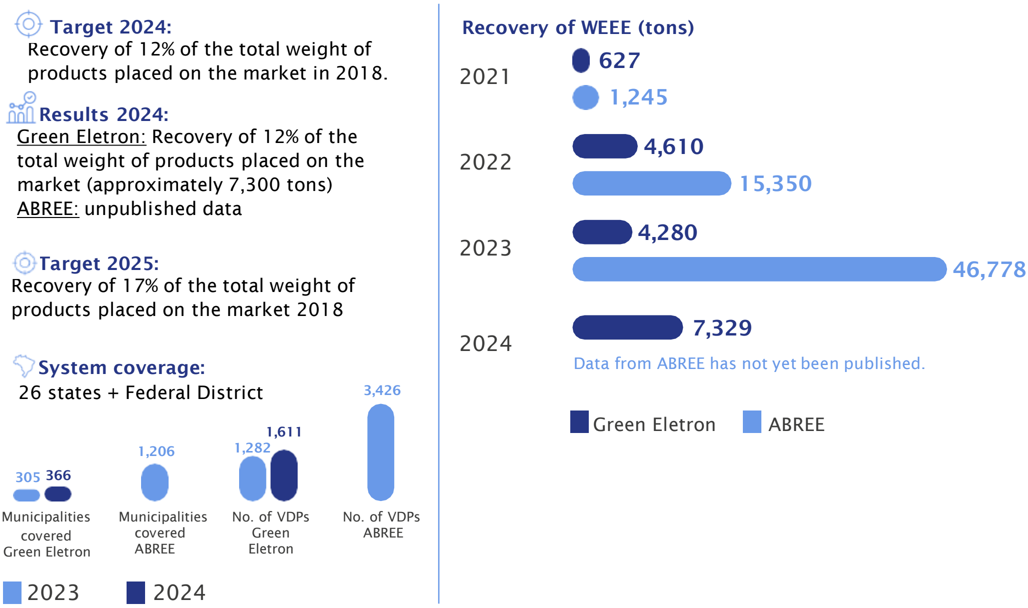
6.3. Electrical and Electronic Equipment

The reverse logistics of waste from electrical and electronic equipment (WEEE) is currently carried out by two managing entities: the Brazilian Association for Recycling of Electronic and Electrical Equipment (*Associação Brasileira de Reciclagem de Eletroeletrônicos e Eletrodomésticos* - ABREE) and the Reverse Logistics Management Company for Electronic and Electrical Equipment (*Gestora de Logística Reversa de Equipamentos Eletroeletrônicos* - Green Eletron). The progressive targets for recovering these materials are established by sectoral agreement and federal decree.

According to Green Eletron, all electronic products collected in 2024 were reused or recovered and reintroduced into the production chain. That year, this managing entity recovered approximately 7,300 tons of materials, reaching 100% of the established collection target. Since Green Eletron began operating in 2017, approximately 16,800 tons of material have been recovered.

To the date of publication of Panorama 2025, data from the managing entity ABREE were not yet published. From 2021 to 2023, ABREE recovered approximately 63,300 tons of electronic waste.

Figure 6.4. Status of the reverse logistics of WEEE

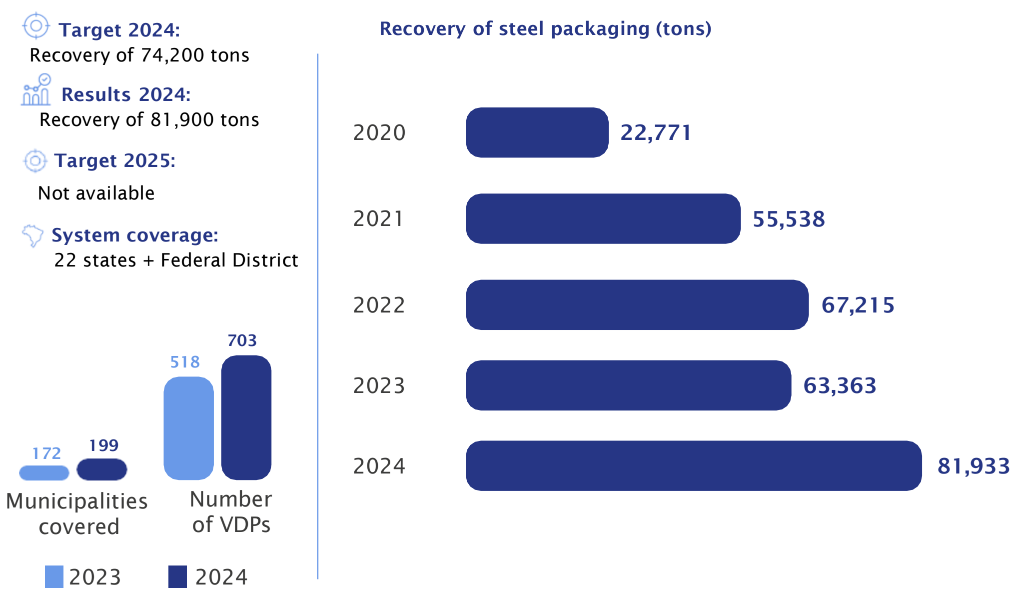


Source: Green Eletron and ABREE (2025)

6.4. Steel Packaging

The managing entity responsible for the reverse logistics of steel packaging is PROLATA, which has been operating since 2013. During the recovery process, the steel packaging is sent to the steel industry, to be recycled. The recovery of materials in 2024 exceeded the established target, reaching a total volume of approximately 81,900 tons. This total value corresponds to a 29% increase in recovery compared to the previous year. The recovery target is established each year and, to the date of this publication, the target for 2025 had not yet been defined. Currently, the system has 867 active partners, including cooperatives, collection points, or VDPs. Since the system began operating, more than 322,000 tons of steel packaging have been recovered.

Figure 6.5. Status of the reverse logistics system for steel packaging



Source: PROLATA (2025)

6.5. Glass Packaging

The reverse logistics system for glass packaging is managed by *Circula Vidro*. The managing entity was created in 2023 and currently represents 100% of the glass manufacturing industry and 80% of glass bottle filling industries in Brazil.

In 2024, approximately 597,000 tons of glass were recycled and reused as raw material in new glass packaging, an increase of 14.2% compared to the previous year. With this, the Recycled Content Index (RCI) – which indicates the proportion of recycled raw material used in the manufacture of new glass packaging – reached 37%, an improvement compared to the 32% achieved in 2023. The result exceeds the 27% target set in Federal Decree 11,300/22 for 2024 and surpasses the 35% mark set for 2032.

Regarding non-returnable or single-use glass packaging, 33% of the 1.2 million tons put into circulation in 2024 were recovered for recycling. This value, called the National Recycling Index (NRI), also exceeded the official target of 30% for the reference year. The recycled volume of 395,000 tons of glass packaging represents a 9% increase compared to 2023.

Figure 6.6. Status of the glass reverse logistics system

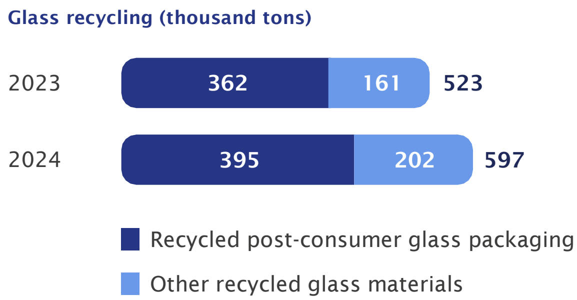
Target 2024:
RCI equal to or greater than 27%
NRI equal to or greater than 30%

Results 2024:
RCI: 37% (597,000 tons)
NRI: 33% (395,000 tons)

Target 2025:
RCI equal to or greater than 28%
NRI equal to or greater than 32%

System coverage:
26 states + Federal District

Data on municipalities covered and VDPs were not available to the date of this publication.

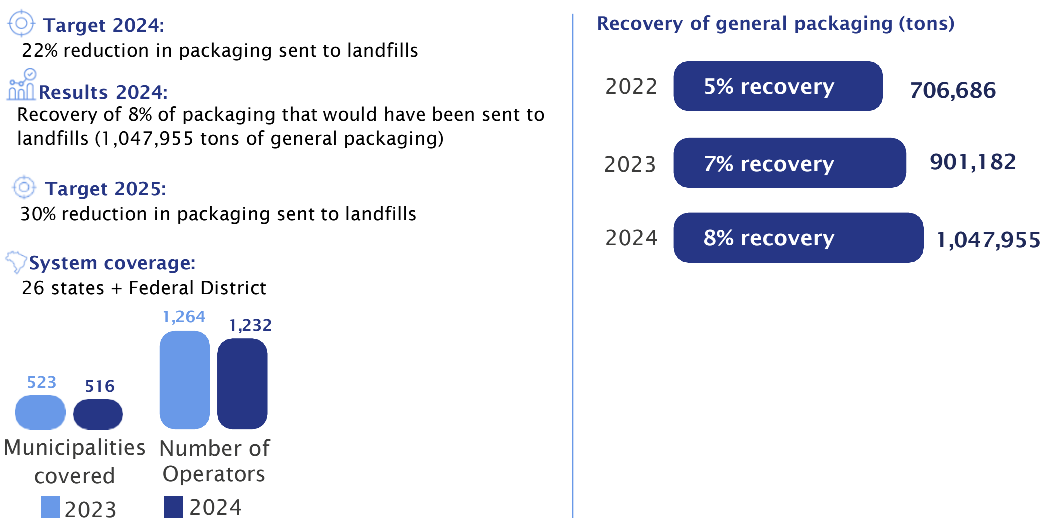


Source: *Circula Vidro* (2025)

6.6. General Packaging

Reverse logistics for general packaging was implemented in Brazil through a sectoral agreement signed in 2015. The system has several managing entities responsible for consolidating information on the recovery of this material. According to the institution responsible for verifying the results of reverse logistics for general packaging since 2021, named *Central de Custódia*, more than one million tons of post-consumer packaging were sent for recovery in 2024. This mass was composed of 31% paper, 31% glass, 20% plastic, 17% metal, and 1% other materials. Despite the decrease in the number of operators and municipalities covered in 2024, this amount represents an increase of approximately 16% in the material recovered compared to the previous year. Since the beginning of the *Central de Custódia* operations, approximately 2.6 million tons of general packaging have been recovered, with the participation of 1,336 municipalities in total.

Figure 6.7. Status of the reverse logistics system for general packaging

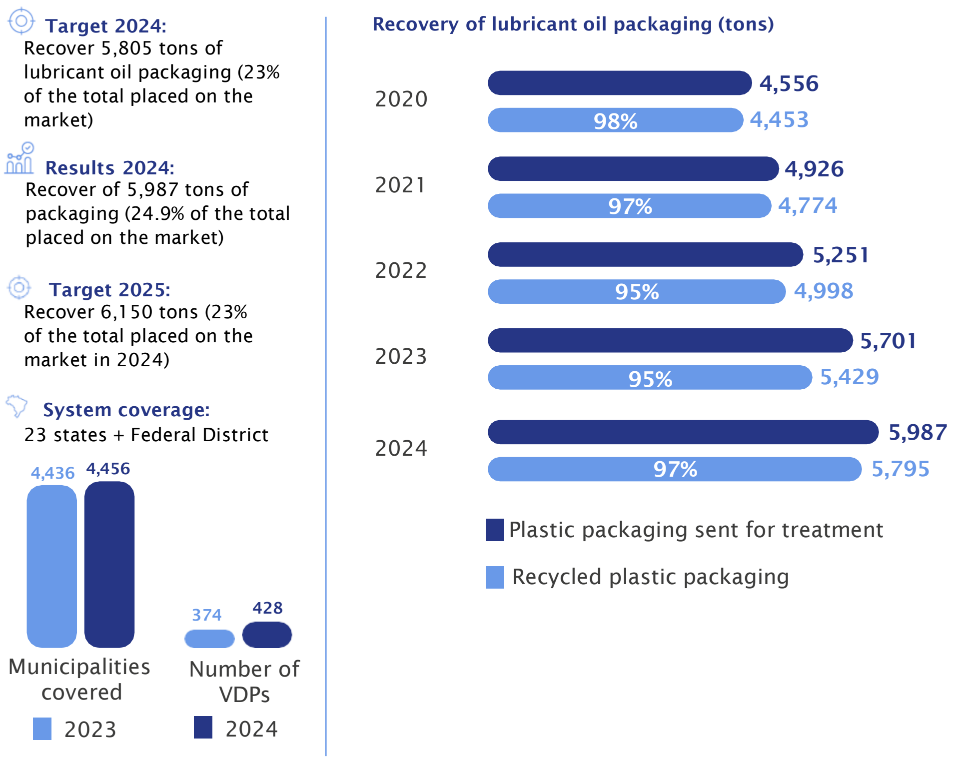


Source: *Central de Custódia* (2025)

6.7. Lubricant Oil Packaging

The reverse logistics system for plastic lubricant oil packaging is managed by Jogue Limpo Institute (*Instituto Jogue Limpo)*, which has been operating since 2005. In 2024, the system properly disposed of more than 5,900 tons of plastic packaging, representing an increase of approximately 5% compared to the previous year. This total represents about 25% of the total materials placed on the market by manufacturers and importers. In relation to the plastic packaging disposed, 97% was sent for recycling. Since 2010, more than 61,000 tons of plastic packaging have been sent for recycling.

Figure 6.8. Status of the reverse logistics system for lubricant oil packaging

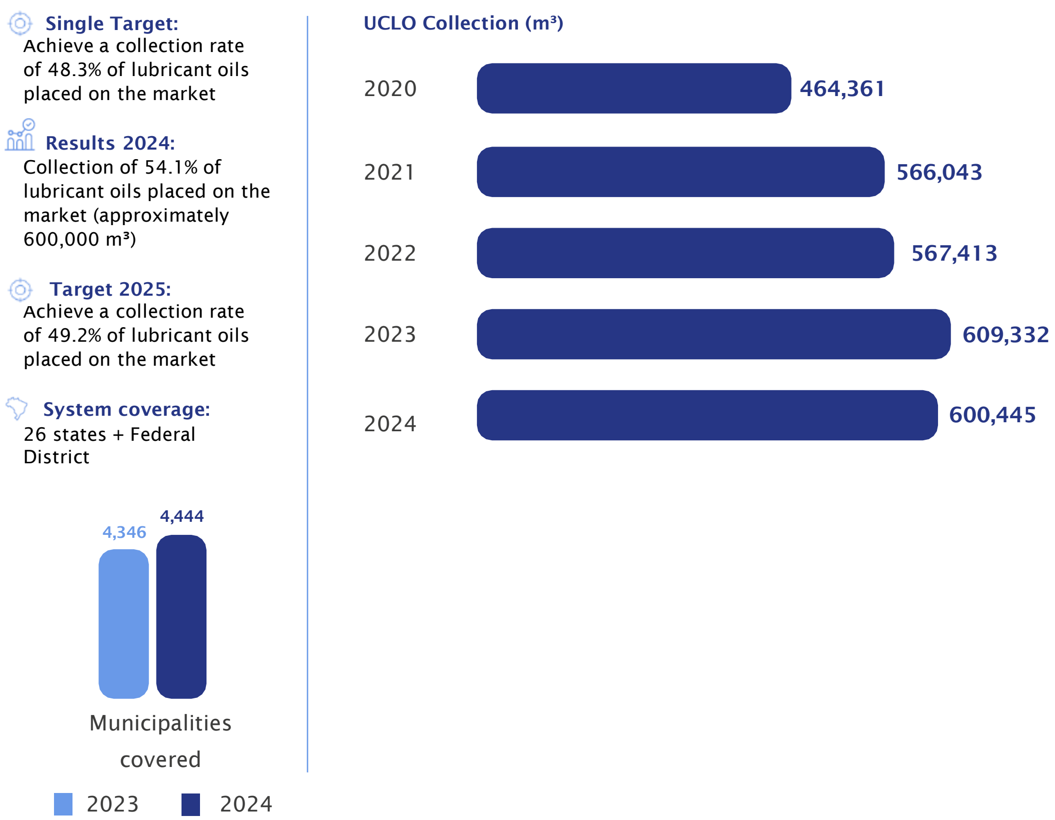


Source: *Relatório de Desempenho Annual* 2024 – *Instituto Jogue Limpo*, 2025
(Annual Performance Report 2024 – Jogue Limpo Institute, 2025)

6.8. Used or Contaminated Lubricant Oils (UCLO)

Producers and importers of lubricant oils are responsible for promoting the collection and final disposal of used or contaminated lubricant oils (UCLO) in the same quantity as they place new product on the market. The system's targets are established by the MMA and the Ministry of Mines and Energy (*Ministério de Minas e Energia* - MME) and are calculated based on the amount of material traded. The institution responsible for regulating and overseeing the system is the National Agency of Petroleum, Natural Gas and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis* - ANP), which provides data on sales, production, and collection locations. The amount of UCLO collected in 2024 was approximately 600,000 m³, and, as in previous years, the collection target was exceeded. According to the Dynamic Panel of the Brazilian Lubricants Market (*Painel Dinâmico do Mercado Brasileiro de Lubrificantes*), since 2015, the total collected nationally has been approximately 5 million m³ of UCLO.

Figure 6.9. Status of the reverse logistics system for used or contaminated lubricant oils (UCLO)



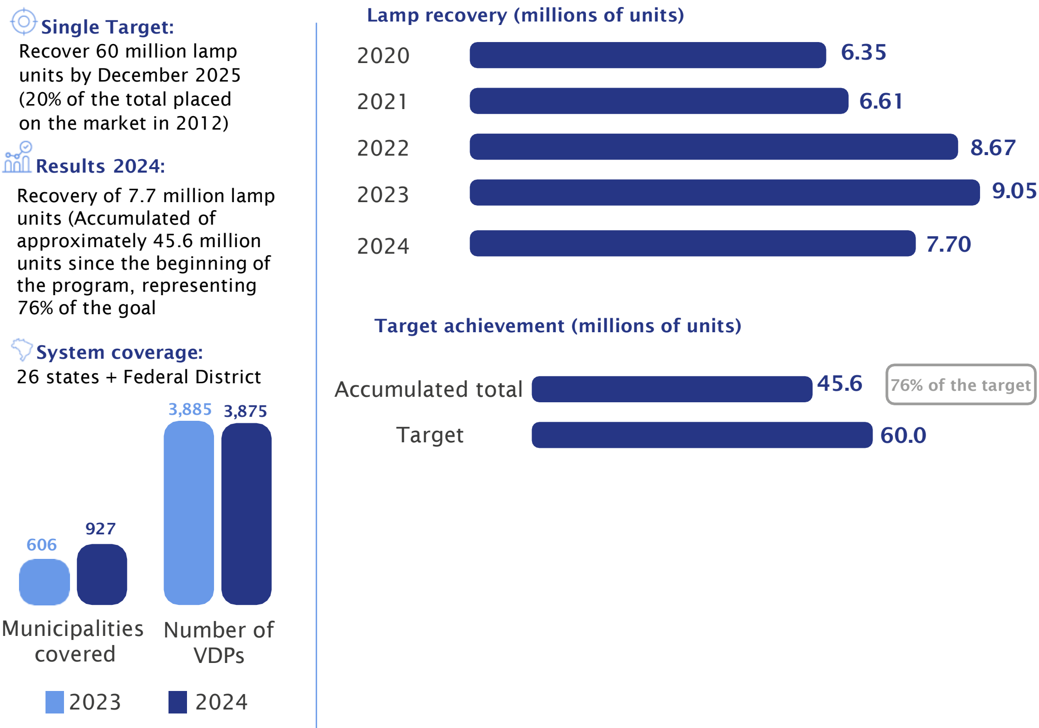
Source: ANP Dynamic Panel of the Brazilian Lubricant Oil Market - accessed November 2025

(*Painel Dinâmico do Mercado Brasileiro de Lubrificantes, ANP)*

6.9. Fluorescent, Sodium Vapor, Mercury Vapor, and Mixed Light Lamps

The reverse logistics of fluorescent, sodium vapor, mercury vapor, and mixed-light lamps is operated by the Brazilian Association for the Management of Reverse Logistics of Lighting Products (*Associação Brasileira para Gestão da Logística Reversa de Produtos de Iluminação* - Reciclus), which has been operating since 2017. Reciclus is responsible for collecting and forwarding the materials for recycling, where the byproducts are decontaminated and directed to industries. Since mercury is a heavy metal, harmful to health and the environment, the recovery of this chemical element is done through filters and other safe processes. In 2024, more than 7 million lamp units were collected, and the system operated in 3,875 municipalities, fulfilling its geographic target. Since the beginning of operations, the managing entity has collected and disposed of more than 45 million lamp units and 324 kg of mercury in an environmentally proper manner.

Figure 6.10. Status of the reverse logistics system for fluorescent, sodium vapor, mercury vapor, and mixed-light lamps

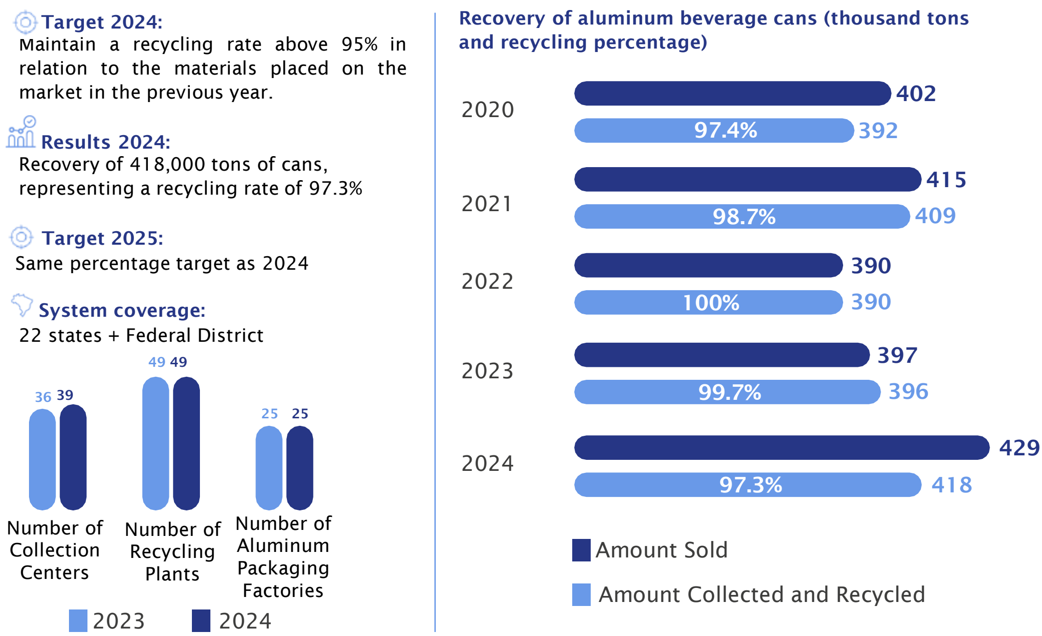


Source: Reciclus (2025)

6.10. Aluminum Beverage Cans

The reverse logistics system for aluminum beverage cans was implemented through a commitment agreement in 2020, and the managing entity responsible for executing the system is *Recicla Latas*. However, the recycling of aluminum cans began much earlier and is now well established in Brazil, maintaining a recycling rate above 95%. Aluminum recycling is a great example of circularity, since this material is 100% recyclable, can be subjected to this process infinitely, and has a short life cycle, approximately 60 days from commercialization to recycling and return to consumption. Regarding the scope of the system, it is worth noting that the collection of aluminum beverage cans has a very present participation of independent waste pickers, cooperatives, VDPs, and selective collection via public services.

Figure 6.11. Status of the reverse logistics system for aluminum beverage cans

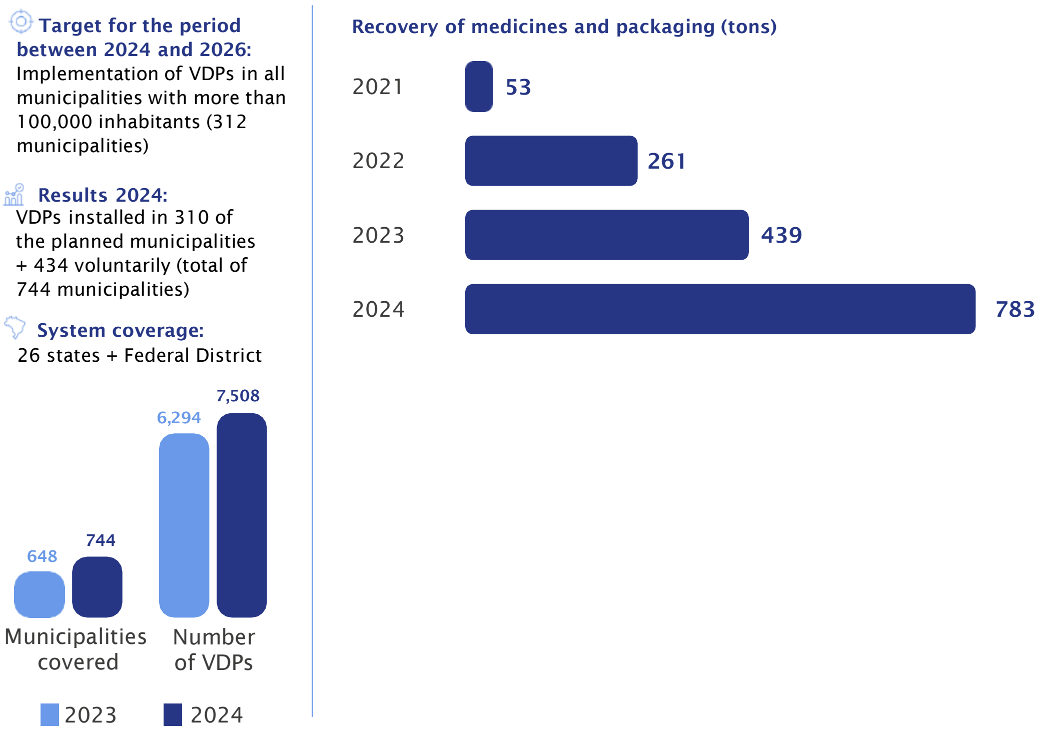


Source: *Recicla Latas* (2025)

6.11. Medicines and Packaging

The Performance Monitoring Group (*Grupo de Acompanhamento de Performance* - GAP) monitors the reverse logistics system for medicines – which includes expired or unused household medicines, for human use, manufactured and compounded, and their packaging. The group has been operating since 2021 through the program called LogMed, which consists of 17 entities representing the sector. The program's goal is established by federal decree and foresees the installation of VDPs in the 312 Brazilian municipalities with a population of over 100,000 inhabitants by 2026. In addition to the 310 municipalities in the target, the program is also already present in 434 municipalities through voluntary initiative. In 2024, 783 tons of medicines and their packaging were collected and disposed of in an environmentally proper manner: an increase of approximately 78% compared to the previous year. Since the system began operating, more than 1,500 tons of medicines have been collected and disposed of in an environmentally sound manner.

Figure 6.12. Status of the reverse logistics system for medicines and packaging

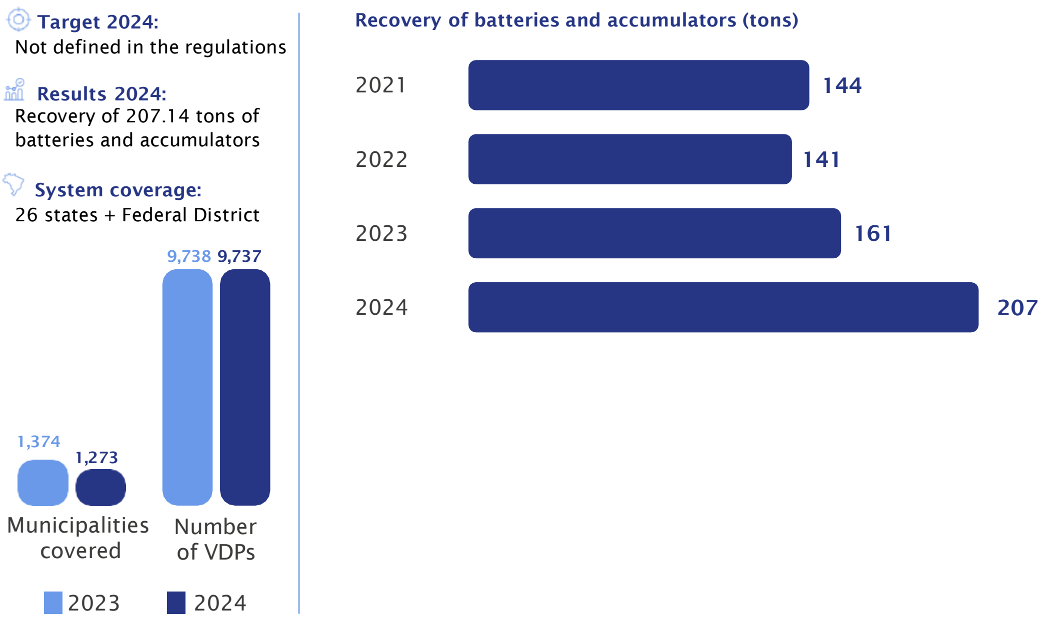


Source: Pharmaceutical Products Industry Union (*Sindicato da Indústria de Produtos Farmacêuticos)* - Sindusfarma (2025)

6.12. Batteries and Accumulators

The reverse logistics system for batteries and accumulators is operated by the managing entity Green Eletron. The system's regulations do not establish a federal target for the collection and recovery of these materials; however, it mandates the implementation of appropriate collection points in all establishments that sell batteries and accumulators. In 2024, the system collected approximately 207 tons of batteries and accumulators, representing an increase of about 29% compared to the previous year. Since the system was implemented in 2017, approximately 1,050 tons of batteries and accumulators have been collected.

Figure 6.13. Status of the reverse logistics system for batteries and accumulators



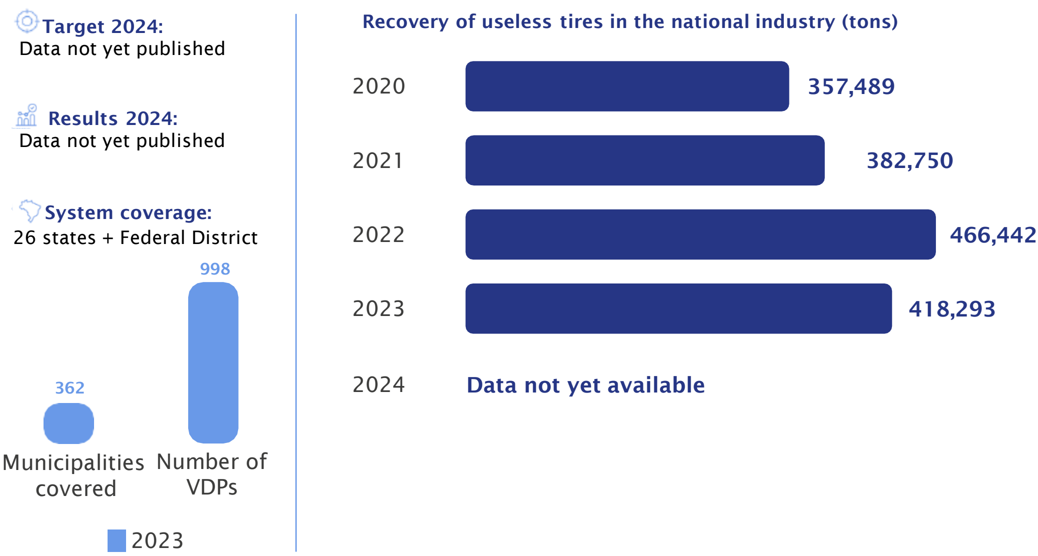
Source: Green Eletron (2025)

6.13. Useless Tires

When tires are no longer usable and become unusable, they must be sent to appropriate collection points. For reuse, the materials can be used as alternative fuel (Refuse-Derived Fuel - RDF) in cement kilns, or in the manufacture of other items such as car mats, industrial flooring, asphalt, and shoe soles.

The reverse logistics system for useless tires is operated by the managing entity Reciclanip, which has been operating since 2007. According to the system's regulations, its goal is that for every new tire sold, and manufacturing or importing companies must dispose of an unserviceable tire in an environmentally proper manner. According to Reciclanip, the consolidation of data for the reference year 2024 is still underway; however, in 2023, the national industry disposed of approximately 418,000 tons of useless tires in an environmentally proper manner, reaching 101.3% of the target. Between 2011 and 2023, more than 5.1 million tons of unserviceable tires were collected.

Figure 6.14. Status of the reverse logistics system for useless tires



Tire Report CONAMA Resolution No. 416/09 (2024) and Reciclanip (2025)

6.14. Discussion

The data presented in this chapter show that, in general, the reverse logistic system has been growing, both in amount of material and geographic scope — with expanded operations in new states, municipalities, and voluntary drop-off points. Most systems met or exceeded the targets set for 2024, demonstrating significant progress in the quantity of materials recovered and reintegrated into the production chain. The reverse logistics system for medicines showed the greatest increase in recovery, of 78%, compared to the previous year. In addition, reverse logistics of aluminum beverage cans, maintained recovery rates of over 90% of the materials placed on the market. Despite the progress, there are still important challenges to be faced so that the systems reach their real recovery potential and effectively contribute to a more circular economy. Continuous improvement of targets is essential, and should be ambitious, yet realistic, considering the progress already achieved.

In line with recently presented initiatives, such as the implementation of Decree No. 12,082 of June 2024, which establishes the National Circular Economy Strategy, and Decree No. 11,413/2023, which establishes the Reverse Logistics Recycling Credit, further progress is expected in the coming years. However, for significant progress to occur, both in volume and in the inclusion of new materials in reverse logistics systems, it is essential to create and implement effective means of oversight, as progress will not materialize without this control. In addition, it is essential that shared responsibility goes beyond the simple acquisition of certificates, requiring concrete actions such as structuring projects, transparent communication, and the active engagement of all stakeholders. Finally, another important point is the need to unify state and federal legislation systems to allow for an integrated analysis of data, contributing to the effectiveness and comparability of results.

07

BIO-ENERGETIC RECYCLING

This year, Panorama addresses, in its special chapter, the theme of bio-energetic recycling, in perfect alignment with the concept of recycling brought in the PNRS. By including this dimension, it is possible to highlight the entire spectrum of positive impacts, from the generation of renewable energy, fuel, compost, among others, to the reduction of emissions, highlighting how each bio-energetic recycling technology contributes to a smarter, more sustainable and complete management cycle.

In nature, there is no "waste". What we observe is a continuous process of transformation, where matter breaks down and rebuilds itself incessantly. A leaf that falls from a tree will not become another leaf: its chemical energy will be released, and its components will be available for new forms of life. This is the cycle: not a linear repetition where a product always generates the same product, but a constant reconfiguration of molecules and energy, recycling everything.

However, we are stuck with the idea that recycling is just transforming a PET bottle into another PET bottle or an aluminum can into another can, but the PNRS offers a more comprehensive and accurate view. It defines recycling as the process of transforming solid waste that involves altering its physical, physicochemical, or biological properties, with the aim of giving the waste characteristics that make it a raw material or new products again.

While dry recycling focuses on materials with consolidated market value, bio-energetic recycling advances on deeper material transformations. Its innovation lies in reinserting waste into the production cycle, not in the same previous form, but in the form of energy, fuel, compost, etc.

This chapter focuses on bio-energetic recycling, an essential and innovative complement in the integrated solid waste management scenario, which considers several technologies that are not currently properly accounted for when discussing recycling: biogas and biomethane production, composting, RDF, among others.

7.1. Bio-Energetic Recycling Technologies

7.1.1. Biogas Valorization: From Emissions to Renewable Energy

Decomposing organic matter is a significant source of methane, a gas with a global warming potential 28 times greater than that of carbon dioxide. Bio-energetic recycling incorporates the generation and collection of this gas and transforms it into a resource through different technological processes:

In Sanitary Landfills: Collection systems capture the biogas, which is burned to generate electricity and heat, mitigating emissions and producing renewable energy. The evolution of this process involves purification of the biogas to obtain biomethane, a gas interchangeable with fossil gas (natural gas), ready to be injected into the grid for industrial or domestic use or used as biofuel for vehicular use, contributing to the decarbonization of the economy.

Anaerobic Digestion (Biodigesters): Selected organic waste (from food industry, agriculture or municipal selective collection) is processed in closed reactors. This process allows for the production of biogas and a pasty byproduct, digestate, a biofertilizer that can return to the soil, contributing to the nutritional cycle.

7.1.2 Refuse-Derived Fuel (RDF): Energy Recycling of the Dry Fraction

Mechanical recycling has limits, being applied to a limited range of materials, such as aluminum cans, PET, cardboard, etc. RDF emerges as the solution for the remaining materials. In this case, the dry, high-calorific-value fraction of the waste is processed (shreded, dried, and homogenized) to create a solid fuel. This pellet or "fluff" replaces fossil fuels such as coal in cement kilns and thermal power plants, promoting the circular economy and reducing the carbon footprint of products such as cement and clinker.

7.1.3. Waste Incineration

Modern incineration plants are technological centers with proven efficiency and environmental safety. Previously unused waste is burned at temperatures exceeding 850°C, destroying hazardous compounds and reducing the volume of material by more than 90%. The heat released is converted into steam to generate electricity or for district heating. Metals are recovered from ashes for recycling, and state-of-the-art filtration systems ensure that emissions remain below the strictest legal limits.

7.1.4. Composting: Nutrient Appreciation

Composting is a fundamental pillar of bio-energetic recycling, understood as the valorization of the organic fraction of waste. By transforming organic matter into compost, this process returns nutrients to the soil, improving its structure, water retention, and carbon sequestration capacity. Healthy soil is a vital carbon sink in the fight against climate change.

7.1.5. Advanced Thermal Technologies: Pyrolysis and Gasification

In addition to traditional incineration, more advanced thermal conversion technologies are emerging, operating with little or no oxygen, offering greater efficiency and emission control.

Pyrolysis: consists of heating waste to high temperatures (between 400°C and 800°C) in the absence of oxygen. This process decomposes the material, producing pyrolysis oil (a liquid fuel), synthesis gas (syngas), and biochar. Biochar can be used as a soil improver or as a solid fuel.

Gasification: converts waste into a synthesis gas (composed mainly of carbon monoxide and hydrogen) through a reaction with a controlled amount of oxygen or steam at very high temperatures (above 700°C). Syngas is a versatile fuel that can be used to generate electricity, produce biofuels, or bio-based chemicals.

7.2. Measuring Bio-Energetic Recycling and the Conversion Challenge

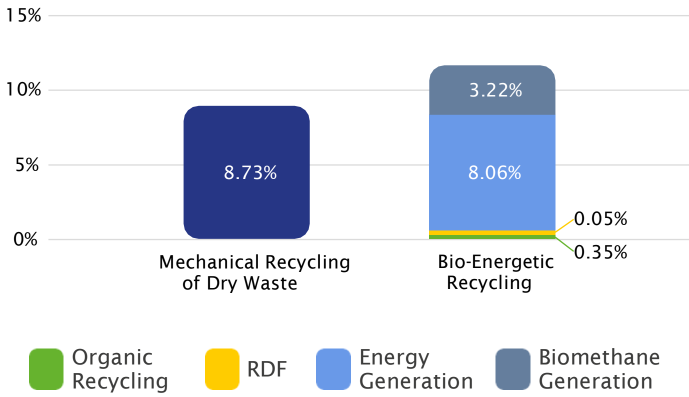
The main challenge in measuring bio-energetic recycling is the range of different products with distinct metrics. An incineration plant generates megawatt-hours of energy, an anaerobic digestion plant generates cubic meters of biomethane, and a pyrolysis plant can generate pyrolysis oil. Thus, it is necessary to establish a common metric so that the technologies can be compared.

Since the gains of each process cannot be measured by comparing megawatt-hours with cubic meters, for example, it is necessary to resort to the common denominator, that is, the amount of waste that needs to be recycled to obtain each of these units in the various categories. The great challenge is precisely this inverse conversion, from the final product to the mass of waste that was necessary to produce it[6].

7.3. Results

The incorporation of bio-energetic recycling into national waste utilization indexes represents an essential paradigm shift, revealing the real recycling potential contained in urban waste. This more comprehensive approach will not only more accurately reflect the country's progress in circular economy, but also shows that bio-energetic recycling accounts for 11.7% of the total waste generated, while mechanical recycling of dry materials accounts for 8.7%. By unifying metrics and recognizing all forms of recycling, a reliable picture of the national scenario is created, underpinning more effective public policies and demonstrating that the path to sustainability requires the full utilization of waste, whether through material or energy recovery.

Figure 7.1. Mechanical Recycling of Dry Materials and Bio-Energetic Recycling in Brazil



Bioenergy recycling does not compete with mechanical recycling - it complements and enables it. By accounting for the benefits of the various treatment processes, the new concept reflects a more complete and adequate picture of all waste fractions effectively utilized and causes the current national recycling rate of 8.7% (dry) to increase to 20.4% of total resource utilization, combining mechanical and bio-energetic recycling in a comprehensive system.

[6] The proposed conversion values, along with the calculation report, are presented in the Panorama 2025 Methodology.

CONCLUSION

CONCLUSION

The year 2025 is shaping up to be a crucial moment for Brazilian environmental policy, with the country hosting COP30 in a global context of increasing demand for concrete actions in face of climate change. In this scenario, solid waste management assumes a central role as a tangible indicator of the national capacity to effectively implement internationally assumed commitments.

A comparative analysis of the 2023 and 2024 data reveals an overview of gradual progress, but insufficient to meet the country's ambitious climate goals. The generation of municipal solid waste showed growth of 0.75%, reaching 81.6 million tons in 2024, thus maintaining a trajectory compatible with economic development, but still far from the circular economy standards observed in developed nations.

In terms of collection, measurable progress was observed, with a 1% expansion in public collection and a 4% reduction in uncollected waste. These numbers reflect a slow but consistent expansion of coverage for essential sanitation services, which is fundamental for both social inclusion and environmental protection.

Regarding final disposal, the data point to moderate progress, with proper disposal in sanitary landfills increasing from 50.1% to 51.0% of MSW generated, while the improper disposal decreased by approximately one percent. Despite these advances, the persistence of 34% improper disposal in 2024 represents a structural challenge that demands bolder and more effective interventions.

Although the sorting of dry recyclable materials has expanded significantly by 5.7%, reaching 7.1 million tons, it remains below the existing potential in the country. Furthermore, composting of household organic waste has remained stagnant at the same level of 300,000 tons processed annually.

On the other hand, bio-energetic recycling stands out as a fundamental complementary strategy to leverage waste recycling in the country. By converting organic waste and fractions that are difficult to recycle into renewable energy, fuels, or other products, this approach has the potential to significantly increase the national waste recycling index, revealing a previously unaccounted-for recovery volume that already exceeds that of mechanical recycling of dry waste. In addition, by capturing greenhouse gases (such as methane from waste decomposition) and replacing fossil energy sources, bio-energetic recycling directly contributes to mitigating climate change. Strengthening this strategy, in addition to mechanical recycling of dry waste, is therefore an indispensable way to increase the sustainability of the waste sector and bring Brazil closer to its environmental and climate goals.

The Panorama 2025 thus presents itself as a turning point. Data from the last two years demonstrate that Brazil has the foundations to build a modern waste management system but lacks the necessary acceleration to transform potential into concrete reality. The ability to adequately respond to this challenge will define not only the success of sectoral policies, but also the country's environmental credibility on the global stage. The window of opportunity remains open, but the time for decisive action is getting shorter. The year 2025 should mark not only the holding of COP30, but the beginning of a new and more ambitious trajectory for solid waste management in Brazil.

INSTITUTIONAL

The Brazilian Association of Waste and Environment – ABREMA – has established itself as the leading representative entity of the urban cleaning and solid waste management sector in Brazil, acting as an active and qualified voice in defending the interests of the companies that make up this essential chain of services. As a result of the strategic unification, in 2023, of pioneering organizations with extensive experience and sectoral expertise, the association quickly established itself as a national benchmark, bringing together organizations from all segments of the value chain: from fundamental street sweeping and waste collection services, through transportation, treatment and landfill operation, to the most modern initiatives in energy recovery, reverse logistics and innovative technological solutions for waste valorization.

On the global stage, ABREMA is the official representation of the *International Solid Waste Association* (ISWA) in Brazil, strategically positioning the country in the main global forums and discussions on sustainable waste management. This privileged position ensures the national sector direct access to international best practices, emerging technological trends, and opportunities for cooperation between countries, strengthening the competitiveness and modernization of Brazilian companies.

Since its foundation, the entity has acted as a strategic and productive bridge between the public and private sectors, actively promoting the exchange of knowledge, developing specialized technical studies, and providing essential sectoral data for decision-making – as exemplified in this new edition of the acclaimed Panorama of Solid Waste in Brazil, a reference publication for managers, researchers, and public policy makers.

Reaffirming its unwavering commitment to sustainability, technological innovation, and operational excellence on a daily basis, ABREMA continues to work intensively to raise public awareness and promote structuring public policies that build an environmentally responsible and economically viable future for the sector. This edition of the Panorama embodies that commitment, offering a comprehensive analysis and up-to-date data that reflect the sector's evolution. We would like to express our sincere gratitude to all collaborators, experts, and partner institutions that made this essential publication possible, reinforcing our catalytic role in the positive and continuous transformation of waste management in the country.

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Published on: December 2025
Graphic design and layout: Grappa Marketing Editorial

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