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NATIONAL SOLID WASTE POLICY IN THE BRAZILIAN BUSINESS CONTEXT: CASE STUDY OF COMPANY XYZ

POLÍTICA NACIONAL DE RESÍDUOS SÓLIDOS NO CONTEXTO EMPRESARIAL BRASILEIRO: ESTUDO DE CASO DA EMPRESA XYZ

LA POLÍTICA NACIONAL DE RESIDUOS SÓLIDOS EN EL CONTEXTO EMPRESARIAL BRASILEÑO: ESTUDIO DE CASO DE LA EMPRESA XYZ

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ABSTRACT

This study investigaste the implementation of Theo National Solid Waste Polley (PNRS) in a company located in Sorocaba, São Paulo, temporarily named XYZ. Using a case study approach, the research aims to understand how XYZ has adapted to the principles and guidelines established by the PNRS, analyzing its solid waste management practices. The methodology adopted included a literature review on the subject, followed by a documentary analysis of XYZ's Sustainability Report and the application of the case method. The results revealed that XYZ faced initial challenges, such as waste classification issues and infrastructure adaptation, but showed resilience and determination in overcoming these obstacles. In addition, the company has made significant efforts to develop innovative financial approaches, seeking not only to reduce the costs associated with compliance with the PNRS, but also to generate economic benefits in line with the principles of the circular economy and corporate sustainability. XYZ's commitment to the PNRS stands out, representing an example of how organizations can not only comply, but actively embrace the principles and objectives of this policy.

Keywords: Consumer electronics waste; PNRS; Reverse Logistics; Circular Economy;

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RESUMO

Este estudo investiga a implementação da Política Nacional de Resíduos Sólidos (PNRS) em uma empresa localizada em Sorocaba, São Paulo, denominada temporariamente como XYZ. utilizando uma abordagem de estudo de caso, a pesquisa visa compreender como a XYZ tem se adaptado aos princípios e diretrizes estabelecidos pela PNRS, analisando suas práticas de gestão de resíduos sólidos. a metodologia adotada incluiu uma revisão da literatura sobre o tema, seguida por uma análise documental do relatório de sustentabilidade da empresa XYZ e a aplicação do método de caso. os resultados revelaram que a XYZ enfrentou desafios iniciais, como questões de classificação de resíduos e adaptação de infraestrutura, mas demonstrou resiliência e determinação em superar esses obstáculos. além disso, a empresa empreendeu esforços significativos para desenvolver abordagens financeiras inovadoras, buscando não apenas reduzir os custos associados à conformidade com a PNRS, mas também gerar benefícios econômicos alinhados com os princípios da economia circular e da sustentabilidade empresarial. destaca-se o compromisso da XYZ com a PNRS, representando um exemplo de como as organizações podem não apenas cumprir, mas também abraçar ativamente os princípios e objetivos dessa política.

Palavras-Chave: Resíduos eletroeletrônicos; PNRS; Logística Reversa; Economia Circular;

RESUMEN

Este estudio investiga la implementación de la Política Nacional de Residuos Sólidos (PNRS) en una empresa ubicada en Sorocaba, São Paulo, llamada temporalmente XYZ. Utilizando un enfoque de estudio de caso, la investigación pretende comprender cómo XYZ se ha adaptado a los principios y directrices establecidos por la PNRS, analizando sus prácticas de gestión de residuos sólidos. La metodología adoptada incluyó una revisión bibliográfica sobre el tema, seguida de un análisis documental del Informe de Sostenibilidad de XYZ y la aplicación del método del caso. Los resultados revelaron que XYZ se enfrentó a dificultades iniciales, como problemas de clasificación de residuos y adaptación de las infraestructuras, pero mostró resistencia y determinación para superar estos obstáculos. Además, la empresa ha realizado importantes esfuerzos para desarrollar enfoques financieros innovadores, buscando no solo reducir los costes asociados al cumplimiento del PNRS, sino también generar beneficios económicos en línea con los principios de la economía circular y la sostenibilidad corporativa. Destaca el compromiso de XYZ con el PNRS, que representa un ejemplo de cómo las organizaciones pueden no solo cumplir, sino adoptar activamente los principios y objetivos de esta política.

Palabras clave: Residuos de electrónica de consumo; PNRS; Logística Inversa; Economía Circular;

1 INTRODUCTION

Solid waste management is an increasingly crucial issue amid global efforts to address environmental challenges and promote sustainable development. Within this context, reverse logistics and the circular economy emerge as fundamental approaches to optimizing solid waste management and promoting sustainability (Lenzi et al., 2024). This study aims to explore and analyze the advances, challenges and perspectives of solid waste management in the Brazilian context, emphasizing the importance of reverse logistics and the circular economy as key tools to promote more efficient and sustainable management of solid waste.

Growing awareness of environmental issues and the search for more sustainable practices have been prominent themes in global discussions. Within this scenario, adequate solid waste management emerges as an urgent challenge and an opportunity to boost sustainable

development in different contexts (Orieno et al., 2024). The relevance of this research is based on several factors that address a vital issue for Brazil and other countries.

However, despite legislative advances and growing awareness, the effective implementation of the National Solid Waste Policy (PNRS) (Brazil, 2010) and the sustainable management of solid waste in Brazil still face complex challenges. From the lack of adequate infrastructure to financing and environmental education issues, the obstacles are diverse and require a detailed analysis to identify gaps and opportunities for improvement.

The central problem addressed by this study lies in the urgency of developing effective and sustainable strategies for solid waste management in Brazil. Thus, the general objective of this article is to analyze the advances, challenges and perspectives of solid waste management in Brazil, highlighting the importance of effective implementation of the PNRS, as well as reverse logistics and the circular economy, and proposing recommendations for more effective management. and sustainable.

This study seeks to contribute to the field of solid waste management, providing an analysis of a sustainable practice promoted by company XYZ, highlighting the importance of reverse logistics and the circular economy. Furthermore, it aims to offer insights for decision makers and environmental managers, helping to formulate more effective strategies to face the challenges of waste management. Contributing to the debate on the transition to a more circular and sustainable economy, where waste is seen as valuable resources to be managed responsibly.

2. THEORETICAL BACKGROUND

The theoretical framework begins with the national solid waste policy in Brazil.

2.1 National solid waste policy in the Brazilian context

Law 12,305, which establishes the National Solid Waste Policy (PNRS) on August 2, 2010, represents a milestone in the multidimensional approach to waste management in Brazil (Trigo et al., 2023; Kim and Barros, 2023; Valadão and Silva, 2024). This legal framework is fundamental to dealing with the environmental, economic and social challenges associated with the generation, disposal and treatment of solid waste in the country. The PNRS, when promulgated, demonstrated Brazil's clear commitment to environmental sustainability and the promotion of shared responsibility in relation to waste (Brasil, 2010).

One of the distinctive features of the PNRS is the way it fits into a system of interconnected environmental laws. The PNRS does not operate in isolation, but is intrinsically linked to other environmental legislation, such as the Environmental Crimes Law, the Forest Code and the Water Resources Law, among others (De Mattos Gaudard and Fortunato, 2024; De Oliveira Silva et al., 2024). This creates a network of regulations that aim to promote environmental protection, public health and sustainable development.

The principle of prevention, one of the pillars of PNRS, aims to avoid the generation of waste and reduce the risks associated with it. It is an approach that emphasizes the importance of prevention in mitigating adverse environmental impacts (Trigo et al., 2023; Kim and Barros, 2023). This reflects the concern with minimizing environmental damage and protecting public health.

In addition to prevention, PNRS promotes sustainable development as a fundamental principle (Brazil, 2010). This approach aims to balance the production of goods and services with the reduction of environmental impact, establishing a necessary balance (De Mattos Gaudard and Fortunato, 2024). Sustainable development is a crucial factor of the PNRS, guiding actions and policies towards a more balanced future in environmental terms.

Shared responsibility, also promoted by PNRS, is another area where thinking can be realized. This approach involves all sectors of society in solid waste management, from manufacturers to consumers (Hernández and Silva Bitencourt, 2024; De Melo et al., 2024. It is an approach that aligns with the idea that everyone has a role to play in protecting the environment and meeting sustainability goals.

Waste classification, which is an essential part of the PNRS, is based on the origin and dangerousness of the materials. The importance of this classification to guide appropriate waste management and disposal procedures, thus minimizing environmental and health risks (Hernández and Silva Bitencourt, 2024; De Melo et al., 2024). This approach also reflects the desire to achieve effective and safe management of solid waste in Brazil.

The PNRS establishes ambitious goals that include protecting public health and environmental quality, reducing waste generation and encouraging responsible production and consumption (Brasil, 2010). Such goals are a clear manifestation of the country's commitment to continuous improvement in relation to solid waste management. However, its achievement is not without challenges.

Effective implementation of PNRS faces complex obstacles such as funding issues, inadequate infrastructure and lack of public awareness. Integrated solid waste management requires coordinated cooperation between different spheres of government, the business sector and civil society (Brumatti et al., 2024; De Melo et al., 2024). Continuous technical training is also essential to ensure the effectiveness of the measures adopted.

Promoting recycling and developing the recycling industry are important objectives of the PNRS. This involves investments in infrastructure and support for waste picker cooperatives, as well as policies that encourage selective collection and recycling. This approach contributes to the transition towards a more circular economy, aligned with sustainability principles. Another important dimension of the PNRS is the assessment of the product's life cycle and the promotion of sustainable government purchases. These tools play a fundamental role in promoting eco-efficient practices. However, its implementation can be challenging, especially in economic sectors that have not yet adopted sustainable approaches. Therefore, it is essential to balance economic and environmental interests, encouraging the transition to a more circular economy (Brasil, 2010; Brumatti et al., 2024; De Melo et al., 2024; De Mattos Gaudard and Fortunato, 2024).

In addition to PNRS, other regulations and initiatives play an important role in solid waste management in Brazil. For example, the National Environmental Education Policy (Law 9,795/1999) plays a crucial role in raising public awareness about the importance of reducing consumption and proper waste disposal (BRASIL, 1999). Trigo et al., 2023 and Kim and Barros (2023) highlight the need for environmental education as a tool to promote behavioral changes in relation to waste.

The Basic Sanitation Law (Law 11,445/2007) complements the PNRS, focusing on the regularity and functionality of urban cleaning and waste management services. This complementarity is fundamental to ensure that basic sanitation services are aligned with the objectives of the PNRS (De Oliveira, 2024; Vicente et al., 2024).

The PNRS represents an advance in solid waste management in Brazil, incorporating principles of sustainability, shared responsibility and prevention. However, its effectiveness depends on a multidisciplinary approach, cooperation between different stakeholders and investments in infrastructure and technical training. Furthermore, it is essential to consider the interconnection between the PNRS and other environmental and sectoral legislation to promote effective and integrated solid waste management in Brazil (Brasil, 1999; Brasil, 2007; Brumatti et al., 2024; De Melo et al. , 2024; De Mattos Gaudard and Fortunato, 2024).

The National Solid Waste Policy (PNRS) plays a prominent role in modeling and improving the solid waste management scenario in the country. This approach strengthens the incessant search for more sustainable and responsible solutions in solid waste management, consolidating the commitment to environmentally balanced development and the quality of life of Brazilian society.

2.2 Reverse logistics of waste electrical and electronic equipment in Brazil

The management of Waste Electrical and Electronic Equipment (WEEEs) in Brazil is becoming increasingly relevant in the context of the National Solid Waste Policy (PNRS), as established by Law No. 12,305/2010. This legislation, which outlines guidelines for the appropriate treatment of solid waste in the country, devotes special attention to the implementation of reverse logistics systems (SLRs) for several product categories, including WEEEs (Brasil, 2010; De Oliveira Morais et al. 2024 ; De Souza and Medeiros, 2024).

Reverse logistics, defined in the PNRS, consists of a set of actions and procedures aimed at enabling the collection and return of solid waste to the business sector, with the aim of reusing or environmentally appropriate disposal (Brasil, 2010; Novi et al., 2024 ; De São Bento e Carneiro, 2024). This approach represents a significant advance, aligning solid waste management with principles of environmental and social responsibility.

Among the product categories subject to reverse logistics, WEEEs occupy a prominent position. They include electronic equipment such as computers, cell phones, televisions, among other devices that, due to rapid technological innovation, have a considerable rate of obsolescence. This factor contributes to the significant growth in the generation of WEEEs, both in Brazil and globally (Neto et al., 2023; Prajapati et al., 2023; Mayanti and Helo, 2024). The reverse logistics of WEEE covers several stages, from post-consumer or post-sales disposal to collection, sorting, reuse or recycling, and, finally, environmentally appropriate disposal.

One of the innovations introduced by PNRS is the creation of the Steering Committee for the Implementation of Reverse Logistics Systems (CORI), responsible for coordinating actions related to reverse logistics in the country (MINISTÉRIO DO MEIO AMBIENTE [MMA], 2018). This committee, composed of representatives from several ministries, plays a crucial role in supervising and guiding activities related to reverse logistics, providing a more robust regulatory framework for the management of WEEEs.

Reverse logistics, previously seen by some companies as an additional cost, has proven to be a strategic opportunity to add value to business. Modern organizations are embracing reverse logistics not only for environmental reasons, but also as a way to achieve greater market competitiveness and increase their profits. This occurs because reverse logistics enables process innovations, such as the reuse of inputs, resulting in resource savings (Mallick et al., 2023; Ding et al., 2023; De Almeida et al., 2024).

In addition to the economic benefits, reverse logistics contributes to improving the corporate image of companies, as consumers are increasingly attentive to sustainable practices.

Ding et al. (2023), emphasize that organizations that adopt active socio-environmental actions have greater chances of growth in the market.

However, despite the benefits of reverse logistics, its implementation is not without its challenges. Effective e-waste management requires the creation of efficient and sustainable reverse distribution channels. Planning these channels, especially for household waste, is challenging due to the low financial returns associated with recycling these materials (Mallick et al., 2023; Ding et al., 2023; De Almeida et al., 2024).

It is important to highlight that reverse logistics is not limited to an economic benefit. It also plays a crucial role in reducing pollution and promoting the reuse and recycling of waste, thus contributing to socio-environmental sustainability (Mallick et al., 2023; Anuardo et al., 2023; Pouyamanesh et al., 2023).

The alarming growth of electronic waste is one of the most pressing challenges in reverse logistics. Obsolete equipment, such as cell phones, contains substances that are harmful to human health and the environment, and improper disposal of this waste can lead to serious problems (Ni et al., 2023; Mishra et al., 2023; Najm and Asadi-Gangraj, 2024) . Therefore, responsible management of WEEEs is crucial to mitigate negative impacts.

Brazil, like other countries, is beginning to recognize the importance of reverse logistics as a strategy to reduce the environmental footprint and promote sustainability. Braga Jr et al. (2023) and Mota et al. (2024) highlight the need for more studies and actions to improve reverse distribution channels, especially for domestic waste.

The management of Waste Electrical and Electronic Equipment (WEEEs) through reverse logistics is a fundamental approach for sustainable waste management in Brazil. The PNRS has established important guidelines in this regard, and companies that adopt reverse logistics practices not only contribute to the preservation of the environment, but can also obtain economic benefits and strengthen their image in the market.

2.3 Circular economy and green supply chain management

The linear economy, characterized by the traditional sequence of extraction, manufacture, use and disposal of resources, has been the dominant paradigm throughout the Industrial Revolution and, for decades, underpinned global economic development. However, this linear model currently faces critical challenges that threaten its long-term viability. Among these challenges, the growing scarcity of natural resources and the consequent increase in raw material costs stand out (Ellen Macarthur Foundation, 2017).

Faced with this problem, the concept of Circular Economy (CE) emerges as an innovative and promising approach, inspired by nature, which seeks to redefine the fundamental principles of production and consumption. CE is founded on the premise of maintaining products, components and materials at their highest level of utility and value throughout their life cycle (Ellen Macarthur Foundation, 2017; Kirchherr et al., 2023; Ncube et al., 2023; Ossio et al., 2023).

For the Ellen MacArthur Foundation's Circular Economy 100 (2017), CE is guided by restorative and regenerative principles. This means that its main objective is to extend the useful life of products, components and materials as much as possible, keeping them in circulation in the economy. Kirchherr et al. (2023) emphasize that, although CE often encompasses reduction, reuse and recycling activities, its essence lies in the need for systemic change. Therefore, CE is

not merely a waste management approach, but rather a new paradigm that demands a deep and comprehensive review of our production and consumption systems (Ncube et al., 2023).

It is important to highlight that, although CE's main focus is economic prosperity and environmental quality, its impact on social equity and future generations must be considered (Ossio et al., 2023). This approach aims to promote development, where economic, environmental and social aspects are intrinsically interconnected.

Green Supply Chain Management (GCSV) plays a fundamental role in realizing the Circular Economy. This approach covers the entire life cycle of a product, from the responsible selection of suppliers, through the manufacturing and consumer delivery processes, to end-of-life management. GCSV is more than a simple environmental practice; it involves the integration of environmental considerations at all stages of the supply chain (Mondal et al., 2023; Zhang et al., 2023; Lu et al., 2024).

Mondal et al (2023) highlights that GCSV aims to transition from reactive environmental management approaches to more proactive practices. This includes strategies such as reduction, remanufacturing, repair, refurbishment, reuse, cannibalization, recycling, waste management and reverse logistics. These practices not only minimize environmental impact, but also create business opportunities and contribute to economic efficiency.

The current linear economy model, which follows the "make-use-dispose" cycle, faces obvious limitations, especially in relation to the product life cycle. This approach, often referred to as "cradle to grave", results in waste that is not reincorporated into new production cycles. This linearity has led to serious problems, including the depletion of natural resources and adverse environmental impacts (Maleviti, 2023; Katiyar and Gedam, 2023).

The linear economy is gradually giving way to the circular economy, which focuses on reducing the use of non-renewable resources and extending the useful life of materials. The circular economy is based on the fundamental idea that "in nature, nothing is created, nothing is lost, everything is transformed". Therefore, CE aims to extend the useful life of materials and promote recycling, reducing environmental impacts and the use of energy resources (De Jesus Pacheco et al., 2024; Ghosh et al., 2024).

The search for sustainability and environmental awareness have gained prominence in recent decades, driven by events such as the United Nations Conference on Environment and Development, also known as ECO-92 (Barros et al., 2024). In this context, the concept of sustainable development was consolidated, recognizing the interconnection between the environment and economic development.

It is crucial to highlight that the transition to the circular economy is not only an economic and environmental issue, but also an opportunity to address social issues such as reducing poverty and improving well-being (Halkos and Aslanidis et al., 2024; Ayaz and Tatoglu et al., 2024). CE offers the prospect of transforming waste into valuable resources, contributing to more equitable and sustainable development.

Currently, the linear economic model is reaching its limits as the extraction of natural resources reaches unsustainable levels. CE emerges as a viable alternative, promoting the regeneration of capital value and minimizing the extraction of finite resources. The shift to the circular economy is seen as a radical innovation that requires substantial changes in production systems, technologies, organizational structures and social behaviors (Kirchherr et al., 2023; Ncube et al., 2023).

Implementing the circular economy requires simultaneous changes across multiple sectors, including value chains, product design, business models and consumer behavior.

Overcoming the linear consumer mentality and embracing a circular approach is a considerable challenge (Ossio et al., 2023).

The circular economy represents a necessary and urgent paradigm shift aimed at economic, environmental and social sustainability. Green Supply Chain Management plays a crucial role in this transition by integrating environmental considerations at every stage of the supply chain. The successful implementation of the circular economy requires effective collaboration between diverse stakeholders and a profound transformation in our production and consumption systems**.**

3 METHOD

The methodology adopted in this study is based on a case study conducted in a company located in the city of Sorocaba, temporarily referred to as XYZ, due to the lack of availability of the organization's 2023 Sustainability Report. The choice of this method is supported by the need to investigate a contemporary phenomenon inserted in a real context. Furthermore, we seek to use different sources of evidence to obtain a comprehensive understanding of the topic in question, following the precepts of qualitative research, which emphasizes understanding the facts to the detriment of simple measurement (Lakatos and Marconi, 2021).

To meet the objectives of this study, a literature review was carried out on the topic (Perovano, 2016), followed by document analysis |(Estrela, 2018), of the Sustainability Report of company XYZ, in order to extract relevant information for the study in question. Subsequently, the case study method was applied according to the approach proposed by Yin (2014). This project fits into type I case study, characterized as a single case study with a single unit of analysis. This implies that the research will be focused on a specific situation or context related to the circular economy, with the aim of deepening the understanding of that particular case.

4 RESULTS AND DISCUSSION

The company under analysis, referred to as XYZ for strategic reasons, is part of a multinational conglomerate dedicated to electronic equipment and solutions. Founded in 2012 in Sorocaba, São Paulo, XYZ stands out as a pioneer in the adoption of sustainable practices and responsible management of waste from electrical and electronic equipment (REEs) in Brazil.

A success story concerns the partnership between HP Brazil and Company XYZ. The initiative, which has the motto “Creating a reverse logistics ecosystem”, was the first in circular economy in Brazil's electronics sector. Through it, costs for customers were reduced by up to 30%, while the time to collect end-of-life products was reduced by 50%. Additionally, 97% of materials collected by Company XYZ are reincorporated directly into the supply chain (Ellen Macarthur Foundation, 2020).

Thus, HP, together with Company XYZ, established expertise in reverse logistics, and to enable the success of the program, installed a recycling and innovation center close to the

manufacturing site of electronic equipment. Strong communication between the companies allowed the formation of more up-to-date knowledge about product disassembly and the development, through joint research, of recycled white plastic, with quality and aesthetic criteria, implemented in the production of electronic products. The process to develop this material, made from 94% recycled plastic and 6% pigments and additives, reaching a purity of 96%, is very rigorous, as it is necessary to maintain the required color. In addition, handles for product packaging are also now made from electronic product waste.

An essential issue for a TPR, which stands for "Third-Party Remanufacturing". It is a process in which used products are purchased back from customers or collected from other sources, and then remanufactured to be sold again. Typically, this remanufacturing is done by a third-party entity, not the original manufacturer of the product. Third-party remanufacturing can offer benefits such as cost reduction, efficient use of resources and minimization of environmental impact. are how to attract the OEM, which stands for "Original Equipment Manufacturer". This term is commonly used in industry to refer to companies that produce components or products that are incorporated into other products by other companies, known as "assemblers" or "systems integrators". OEMs are responsible for manufacturing the original components that are later used in the assembly of products by other different companies (Fang et al., 2023). For example, a computer chip manufacturer may be an OEM, providing its chips to be incorporated into laptops or smartphones by other companies. to cooperate, which depends on your remanufacturing advantages.

The parent company, which is responsible for XYZ, won the "Sustainable Development Leadership Award 2020" for the third time, which it attributes to an Internet of Things (IoT) device called Smartbin developed by its subsidiary. Company XYZ uses Smartbin to collect electronic materials for refurbishment or remanufacturing, ensuring the manufacturer can deal with electronic waste and pollution in the IT industry. The new device improves the electronic waste collection process and reduces return costs by 40% in the testing phase. Therefore, TPR remanufacturing would be more cost-effective and environmentally friendly. Additionally, TPRs can achieve a higher quality of returns than OEMs by expanding recycling channels through their recycling platforms.

For example, Aihuishou is a successful online recycling platform in China, whose annual transaction volume is more than 22 million units, valued at more than 20 billion RMB (official currency of the People's Republic of China), and physical stores cover more than 140 cities in 2022. Aihuishou has an excellent quality assessment system and advanced processing technologies to deal with the various quality levels of used products. Therefore, in practice, a wider recycling channel is another competitive advantage of TPR in remanufacturing, that is, TPR remanufacturing would be more effective in terms of quality than OEM. As there are two different efficiencies/advantages in TPR remanufacturing, the choice of OEM can lead to drastically different results (Fang et al., 2023). Although cost and quality effectiveness have been widely recognized in remanufacturing, it is unclear from the existing literature what role they will play in the selection of the OEM's remanufacturing strategy.

A pioneering initiative in the country was the signing of a The Term of Commitment for the Reverse Logistics of Electronic Equipment in the State of São Paulo was established by the Government of the State of São Paulo through Decree No. 62,817, of February 20, 2017. This decree establishes guidelines for the implementation of the reverse logistics system for electronic equipment in the state, in accordance with the National Solid Waste Policy (PNRS). The decree number is the official reference of this term of commitment in the state of São Paulo, with the creation of a Management Entity for the Waste Electrical and Electronic Equipment collection system to be implemented in this State. This Entity, called Green Eletron (Green

Eletron, 2022), was created by ABINEE, which is the acronym for Brazilian Association of the Electrical and Electronic Industry. It is an entity that represents companies in the electrical and electronic sector in Brazil, seeking to promote the sustainable development and competitiveness of these industries, in addition to defending their interests before the government and society and is a signatory to the São Paulo Term of Commitment (São Paulo, 2017).

The management of reverse logistics of waste electrical and electronic equipment is assigned to entities such as the National Electrical and Electronic Equipment Waste Management Association, hereinafter referred to as Green Eletron, according to available documentation (Green Eletron, 2022). This association, of a civil nature and nationwide in scope, operates without economic purposes, aiming to manage and complete contracts related to the management of electronic products and their components in the context of reverse logistics.

The function of the managing entity is to enable reverse logistics, carrying out the operationalization and dissemination of the program. This includes the implementation of Voluntary Delivery Points (PEVs), the collection of materials left by domestic consumers and the environmentally appropriate destination for recyclers, who transform Waste Electrical and Electronic Equipment (WEEE) into raw materials. This raw material then returns to the production chain to manufacture new products (Green Eletron, 2022).

The system under Green Eletron's management in the State is still expanding since the signing of the Term of Commitment and, by August 2021, it had installed 65 standardized delivery points in partner stores and commercial representatives, having collected a total of 98 tons of Waste of Electrical and Electronic Equipment. These drop-off points allow the collection of electronic waste in separate drawers for IT equipment (computers, printers, tablets); mobile phones; and screens (bottom drawer). This system is operated by two contracted companies: GM&CLOG and Company XYZ, which are responsible for all operational stages, from collection to processing and destination.

In a survey conducted by Green Eletron, in 2021, it was found that Brazilians still do not have adequate knowledge about Waste Electrical and Electronic Equipment (WEEE) and how to dispose of them. The study, which covered more than 2 thousand people across the country, revealed that the appropriate disposal of this type of waste continues to be a challenge in Brazil (Green Eletron, 2021).

The results indicated that the majority of the population (87%) has heard of electronic waste, but does not fully understand its meaning. There is confusion between what is considered digital waste (such as spam) and physical electronic waste. Furthermore, 71% of respondents agreed that there is a lack of information in the media about electronic waste and its proper disposal. Among those interviewed, 87% admitted to keeping some type of electronic device unused at home for more than 2 months, while 25% of the population never took their electronic waste to a collection point (Green Eletron, 2021).

Given this scenario, environmental education emerges as a crucial element for the effectiveness of reverse logistics in general. Brazilians' lack of knowledge about the appropriate disposal of WEEE highlights the need for improvements in the dissemination of information. In addition to activities related to reverse logistics management, such as transportation and reverse manufacturing of waste, management entities play a fundamental role in disseminating information to the population.

Although Green Eletron carries out communication initiatives, there is still a long way to go to promote an effective change in the population's behavior. The implementation of more waste collection campaigns, partnerships with universities, offering courses and workshops, as

well as actions on social media, among other activities, could significantly contribute to this objective.

In addition to these systems that focus on end consumers, there are also formal collection schemes implemented by specific companies to recover their end-of-life products. Brands such as Dell, HP and Lexmark have their own collection schemes, operated by partners such as Company XYZ, following demand from consumers willing to hand over their used products.

5 FINAL CONSIDERATIONS

The analysis carried out in this study on the implementation of the National Solid Waste Policy (PNRS) in the Brazilian business context, with emphasis on the case study of Company XYZ, highlights the organization's commitment to the principles and guidelines established by the PNRS. Through a literature review and analysis of organizational practices related to solid waste management, a comprehensive view of the efforts undertaken by the company to align its operations with regulatory requirements and environmental needs is provided.

Company XYZ illustrates the challenges faced by organizations when adapting to PNRS. Initially faced with issues regarding waste classification, infrastructure adaptation and understanding the shared responsibilities outlined by the policy, XYZ demonstrated resilience and determination to overcome such obstacles. Over time, a continuous commitment to improving its waste management practices was consolidated, demonstrating a proactive stance in relation to regulatory requirements and society's expectations.

Additionally, Company XYZ has made significant efforts to develop innovative financial approaches to strengthen its waste management practices. Through the exploration of tax incentives and the establishment of strategic partnerships, it not only sought to reduce the costs associated with PNRS compliance, but also aspired to generate tangible economic benefits, aligned with the principles of the circular economy and corporate sustainability.

Given these results, Company XYZ's commitment to the PNRS stands out, representing an example of how organizations can not only comply, but also actively embrace the principles and objectives of this policy. XYZ's trajectory illustrates not only the challenges faced, but also the opportunities and benefits inherent in adopting waste management practices aligned with the highest standards of environmental and social responsibility. This study reinforces the crucial importance of collaboration between the private sector and public authorities in promoting sustainable waste management, thus contributing to a more resilient and equitable future for all.

Furthermore, even though the state of São Paulo is a pioneer in its own legislation on reverse logistics, including WEEE, there is a need to reevaluate waste collection targets, including national targets. This need is in line with the principles, objectives and instruments of the National Solid Waste Policy, in force since 2010 and regulating reverse logistics, and is reinforced when analyzing the Brazilian panorama, comparing it with the reality of other countries whose indicators and targets are in more advanced stages, like Portugal.

REE reverse logistics has been gaining importance on the national and state scene and has great potential for improvement. Society's engagement and concern about solid waste have led to the signing of responsibility terms and sectoral agreements in recent years. However, there is still a lot of waste that can be recycled and reintegrated into the circular economy, but

which ends up being inappropriately disposed of in landfills. Therefore, it is essential to continue contributing to the environment, allocating solid waste for recycling, reuse or recovery, and encouraging a more sustainable and circular economy.

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