Gestão de Resíduos Sólidos

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APRESENTAÇÃO

A sustentabilidade do planeta está na dependência da ação humana, principalmente na adoção de consumo consciente, respeitando o meio ambiente. Neste volume 1 apresentamos 18 trabalhos que abordam o aspecto do uso correto e estratégias para a utilização de resíduos sólidos.

A Gestão Integrada de Resíduos Sólidos é definida como o conjunto de ações voltadas para a busca de soluções para os resíduos sólidos, de forma a considerar as dimensões política, econômica, ambiental, cultural e social, com controle social e sob a premissa do desenvolvimento sustentável. Contudo, para que a utilização do resíduo seja adequada várias estratégias gerenciais, técnicas, financeiras, urbanas e socioambientais precisam ser tomadas.

A redução significativa dos impactos ambientais e econômicos propiciados pela atividade de reciclagem, com relevância ao aspecto social ligado ao setor, são fundamentais neste contexto. Assim, na medida em que a reciclagem se caracteriza como um serviço ambiental urbano que contribui na significativa melhora dos serviços ambientais, do quais toda a sociedade usufrui, os seus prestadores podem ser recompensados.

Neste sentido, a busca por melhorias e o correto destina dos resíduos são estudados e requerem interação de todas as etapas da cadeia produtiva, inclusive na gestão reversa do resíduo.

Por fim, apresentamos as mais inovadoras pesquisas e estudos relacionados com o uso de resíduos, sejam urbanos ou rurais, de maneira sustentável.

Bons estudos.

Leonardo Tullio

SUMÁRIO

CAPÍTULO 16

CHALLENGING THE BRAZILIAN URBAN SOLID WASTE POLICY WITH A MINIMUM RECYCLING RATE FOR DISPOSABLES

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ABSTRACT: Launched in 2010, the PNRS (National Policy for Solid Waste) No.12,305/10 came to guide the solid residues management in Brazil. It represents a huge advance on reducing environmental impacts due to a large amount of waste produced daily.

With seven directives and 84 strategies, the policy requires from governments the establishment of favorable conditions to promote the reduction of consumption, reverse logistics, recycling and the usage of landfills as a suitable final disposal way to the waste generated in the cities. It criminalizes practices opposed to the recommend ones with heavy fines but also claims for tax and financial incentives to the companies willing to develop environmental management systems focused on using better practices of production and residues recovering.

The public sector is demanded to elaborate its solid public plan but ever under social control over planning and implementation phases. Both, public and private sectors, must cooperate to create alternatives of businesses to add value, income and job positions with cooperatives and associations of collectors considering subsidies if necessary.

But what's going wrong since 2010? Is the policy enough and complete to attend Brazilian needs?

This article comes to answer what's going on, and to propose some improvements from the perspective of best practices presented by the author. Everything is changing all the time and everywhere and it's recommended to revisit the policy to check the planned versus delivered and how efficient they were.

KEYWORDS: national policy for solid waste, municipal solid waste, recycling, disposable, apparent consumption.

1 I INTRODUCTION

The Law No.12,305/10 established in 2010 has come to give important mechanisms to solve the problem of waste generation and destination, avoiding social, economic and environmental problems caused by incorrect management. Sets the figure of shared responsibility where

residues producers (manufacturers, importers, distributors, traders, and consumers), sanitary services' entrepreneurs and government must work in consonance (BRASIL, 2011).

The first movement to guide residues management in Brazil was in 1991 with the Law Project No. 203 where packaging, collection, transport, and destination were discussed to cover the health sector.

In 1999 CONAMA's Proposition No. 209 was taken to the Congress of deputies. Technical directives to solid residues management were approved but not published.

Three years later, in 2001, deputies created and implemented an especial commission to a national residues' policy. The idea was to adopt practices from the Law's Project No. 203/91 and extend them to other sectors (ROLLEMBERG, 1991). But this commission interrupted their jobs without concluding the objective at the end of legislation. In the same year, it was possible to watch the first social movement, with 3,000 participants, called 1st Congress of Recyclables' Collectors. Specialists, members of Congress and mainly, homeless people, were addressing for waste as an alternative to income.

Later in 2003, the 1st Latin-American Congress of Collectors discussed professional training needs, dumps eradication and the responsibility of the residues producers. Due to this, it was created, by the Federal Government, the Interministerial Group of Environmental Sanitation which resulted in the Urban Solid Residues Program. In the same year, it was realized the 1st Conference of Environment in Brazil.

From 2004 to 2009, all initiatives were managed by Environment Ministry who involved other ministries, economy's sectors, associations and politics to get contributions to format a policy. During this period, it was seen the social aspect taking the place of the environmental one. Waste destination and treatment were not the final reason to establish a national policy but the way to create and distribute income to the poorest people working informally in the cooperatives of recyclables' collectors (AMBIENTE, 2018).

Published and working from 2010, the PNRS presents some challenges and goals to achieve:

- Selective collection with organic composting in 100% of Brazilian cities
- Achieve a recycling rate of 20% by 2015
- Eradication of dumps by 2014
- Achieve 22% of recovering products (e.g., plastic vessels for chemicals, tires) through Reverse Logistics

Already used in 2003, the interministerial committee was restored in 2011 to monitor the evolution of the plan. This committee is responsible for establishing the policy in all national territory, and its tasks are:

- Review
- Monitor
- Encourage

- Discuss

This group and specialists, led by Ministry of Environment, started to review the PNRS in Jan./2017 and planned to finish it in 20 months, or up to Sep./2018. And it seems to be a good opportunity to review the policy with updated aspects. Reverse logistics, such as new environmental legal requirements, social and corporate responsibilities, sustainability versus competitiveness, activities and their activities' sequences, all applied to post-consumption recycling must be taking into account as detailed in AGRAWAL's article (AGRAWAL et al., 2015).

Looking at waste management activities developed by USA and Germany, as a European's representative, what calls most attention are how long they take and strategies that have chosen.

In USA's case is found the creation the creation of the RCRA (Resource Conservation and Recovery Act) in 1976 by the Congress (EPA, 1976). This act has been the most important movement to establish the mechanisms for waste destination and treatment. After that, US government created the PPA (Pollution and Prevention Act) in 1990 who formally put EPA (Environmental Protection Agency) in charge of monitoring challenges and goals defined by this last act (EPA, 1990).

Germany started earlier and since the 1920s discussing waste as a source of raw materials and energy. It was the first country in the EU to introduce producer responsibility with a packaging waste regulation in 1991 (EU, 1991). According to this principle, which is a core tenet of German waste legislation, the producer of a product is generally responsible for the product when it becomes waste. Twenty European countries are using a landfill tax, but this does not include Germany. Germany has a very high level of recycling of MSW, and it is interesting that Germany has achieved this without using a landfill tax. The requirement of pre-treatment of MSW before disposing of it in landfills combined with other management activities such as producer responsibility have been strong drivers in diverting MSW away from landfills and towards recycling.

Brazilian's waste management has a well succeed initiative of treating post-consumed residues where producers are responsible for their treatment, just as postulated by Germans. In case of tires, there is a resolution from CONAMA (National Council of Environment), a collegiate organism in the Ministry of Environment, No. 258/99 which established the goal of 1 tire recycled per each one produced (CONAMA, 1999). In this act, producers are in charge of collecting and recycling, but users are responsible for leaving them in the collection points. And, as Americans have done, the Brazilian Government has created a resolution to track and control these activities. CONAMA No. 416/09 allowed to identify what are producers' (local and foreigners) responsibility and IBAMA (Institute of Environment and Renewable Natural Resources) has been designated to monitor the statistics and apply penalties when necessary, similar to what EPA has done in USA (CONAMA, 2009).

As a result of this measures, the level of recycling for tires in Brazil is not lower than 80%. In fact, if considered only local producers, this is pretty much higher than

100% through collection points in cities with more than 100,000 people. This amount would represent 29% of total cities, or 60% of cities with more than 20,000 citizens (almost 50% of Brazilian municipalities), as shown in **Figure 1a** and **Figure 1b**.

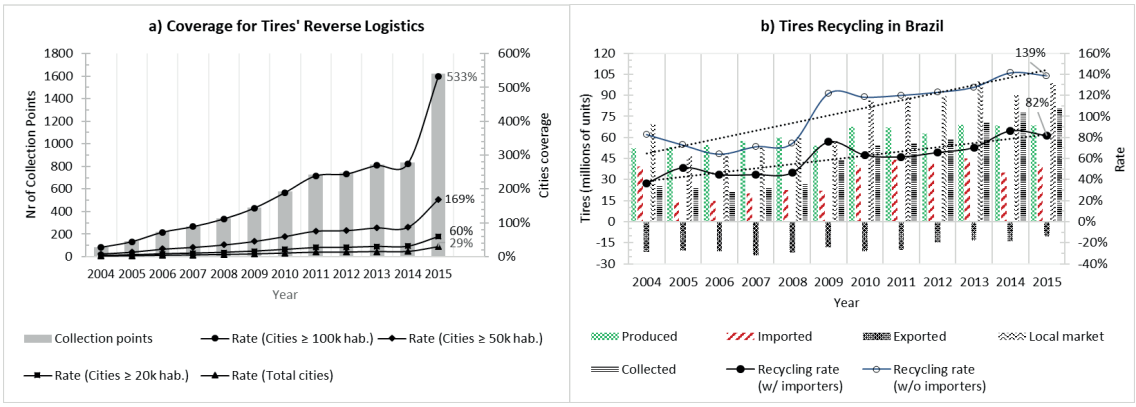

Figure 1. Collection coverage for tires (a) and Tires Recycling in Brazil (b)

Source: Data compilation from ANIP (MARRONE and Al., 2015) and IBAMA (IBAMA, 2016)

Reacting to this remaining passive of 18% (see **Figure 1b**), caused by importers who are not recycling as requested, one of the mechanisms used to force importers to recycle is raising the import tax. Another one is to limit the number of an import quota.

But, what are producers doing to recycle as much as the law requires once recycling could represent value destruction in the production chain? The answer is in **Figure 2** below, where the tire's cycle of production and destination's breakdown is shown in image and numbers, respectively.

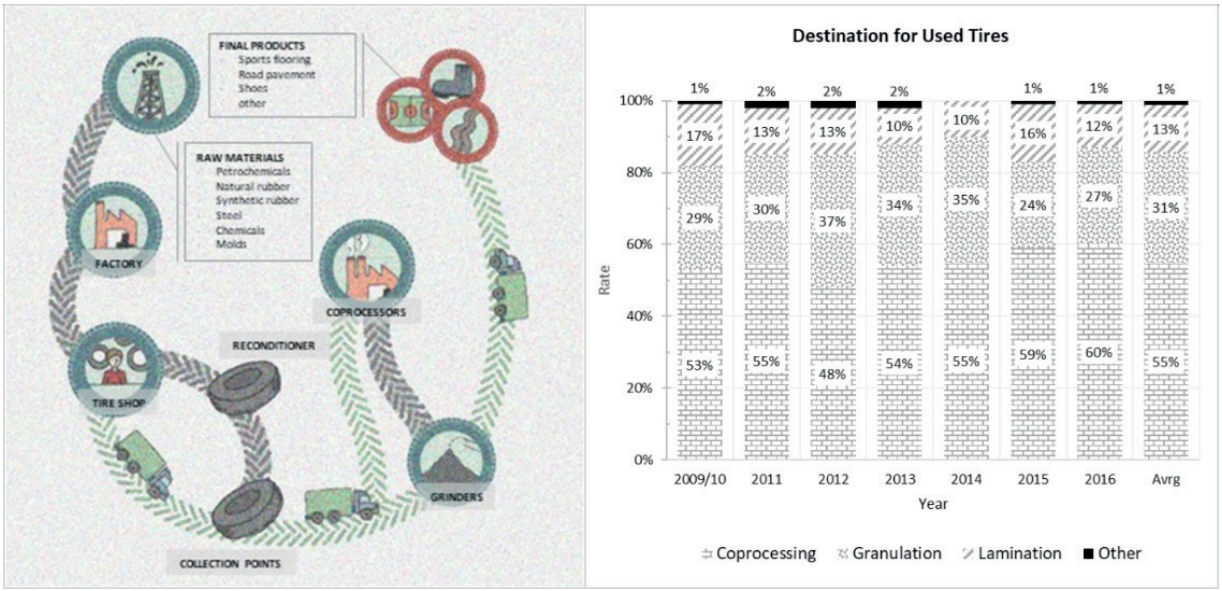

Figure 2. Life Cycle and Final Destination for Used Tires

Source: Data compilation from ANIP (MARRONE and Al., 2015) and IBAMA (IBAMA, 2016)

In summary, producers quickly have transformed expenses in revenues when developing applications and markets for products from discarded tires. Almost 60% is

now used by cement industry, reducing oil demand. Almost 27% is granulated to use in the pavement (concrete or asphalt), 12% used to produce rubber mats and 1% used in the shale industry, pyrolysis and other more, but never being used to produce new tires or compete with them.

Another important initiative done by the government was the normative CONAMA No. 452/12 which prohibits used tires imports whatever the application (CONAMA, 2012).

2 I OBJECTIVE

Presenting a balance of results after the National Policy for Solid Waste in Brazil, this article intends to propose an improvement based on well-succeeded initiatives and policies through calculated goals for plastic, glass, and paper.

3 I METHODOLOGY

This article brings a status' update from all challenges established by the PNRS, and all information based on recognized Brazilian offices, associations and institutes which manage sanitation' data, especially those who are specialized on waste and recycling.

Once clearly shown evolution and current situation, the author intends to approach with tire's recycling initiative in Brazil which places goals to achieve its challenges. The suggestion to improve Brazilian's policy is to define some goals to materials, such as paper, plastic, and glass and charge them from their producers, as suggested by ROGOFF (ROGOFF and ROSS, 2016). The policy, as it is originally, requires only a global level of 20% and let to the municipalities to define their strategies. But, as described ahead, this empowerment is not working.

Here the idea is to propose a technique based on the fraction of materials available in the market to calculate a minimum recycling rate to be reached globally, per material and tracking who and from where would be the producer (petrochemical, paper, and cellulose, glass, imported or local one).

Taking this parameter as the apparent consumption which is possible to recycle and measuring the market sources, it's possible to discover the minimum recycling rate for each material. Similar to what tires' case shows, where is used a wear fraction of 30% for replacement, the following equation (I) could be:

$$AR = AC \times DF \qquad (I)$$

Where:

- AR (Amount to be Recycled)

- AC (Apparent Consumption)
- DF (Disposable Fraction)

To track possible sources of materials and later attribute their goals, equation (II) follows:

$$AC = (LP + I) - I \quad (II)$$

Where:

- LP (Local Production)
- I (Imports)
- E (Exports)

And finally, equation (III) through (II) in (I) to calculate the recyclable amount:

$$AR = [(LP + I) - E] \times DF \quad (III)$$

Economy effects, such as a crisis or sudden growth which can impact consumption and its demand profile for durable or disposable applications, will be mitigated in this article presenting results through the average of the last four years.

4 I RESULTS AND DISCUSSIONS

As established by the PNRS, 100% waste generated in Brazil would be destined to landfills from 2014. Despite penalties imposed on municipalities who do not comply with, entities, such as ABRELPE (Brazilian Association for Public Cleaning and Special Residues' Companies), are warning in all their reports that they are neglecting this challenge (see **Figure 3**) (ABRELPE, 2016).

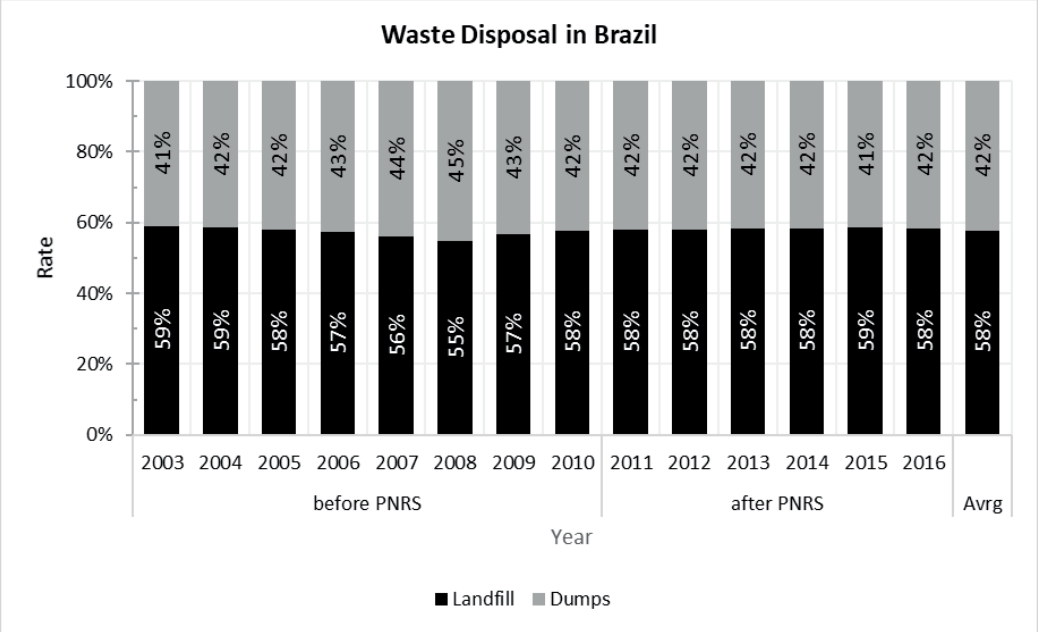

Figure 3. Waste Disposal in Brazil

Source: Data compilation from ABRELPE (ABRELPE, 2016)

Unfortunately, it's clear to verify that dumps remain as a destination for waste since 2003, without or with low progress on landfills' services. Level of investment on sanitary services does not seem to be the main reason for not achieving dumps eradication, even considering that it's tough to manage them to have a budget with a budget with ±50% of deviation from 2007 to 2015. In average in this period, Brazil had USD 14 per capita-year of investment which should be used to treat 2.3 pounds per capita-day of waste. This amount was equivalent to what EU-28 invested with the almost double amount of waste produced (see **Figure 4**).

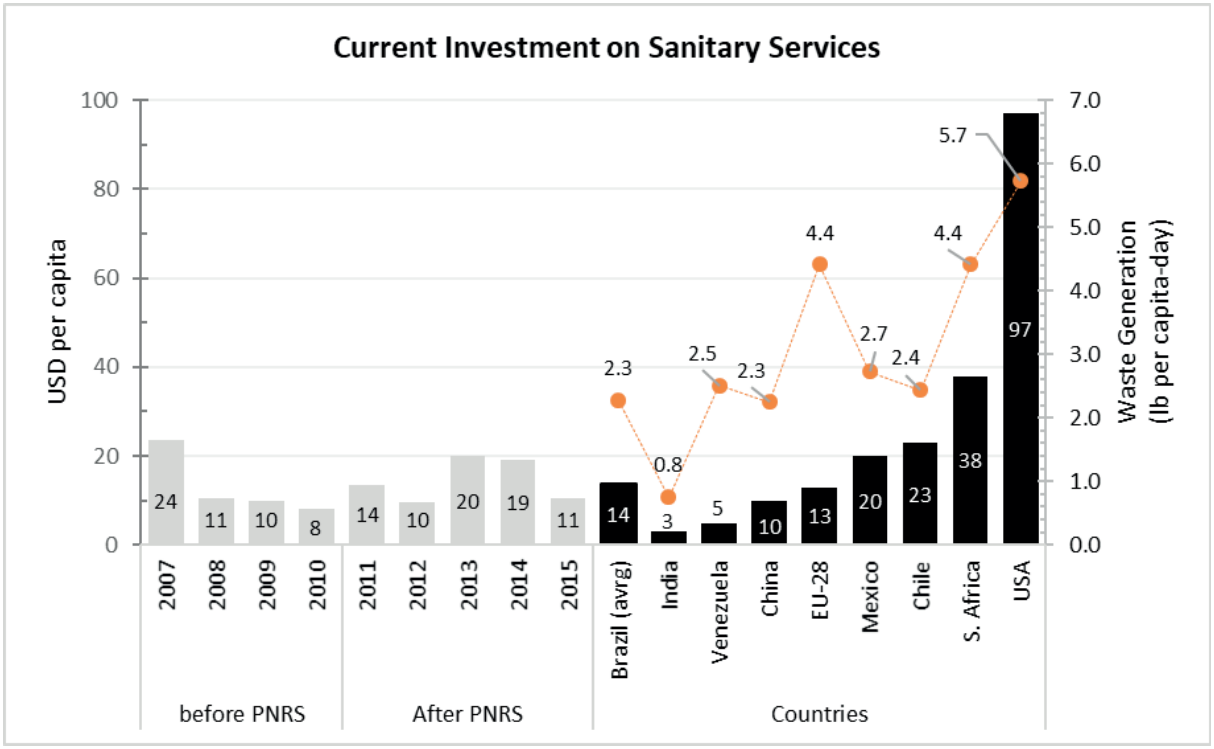

Figure 4. Investments in Sanitary Service

Source: Data compilation from ABRELPE (ABRELPE, 2016) and The World Bank (HOORNWEG and BHADA-TATA, 2012)

So, what would be the possible reason for not achieving the same European results? The answer seems to be found in **Figure 5**, below. Both, USA and Europe have a matrix of destination with more than one solution, what is favorable to use multiple strategies and accomplish reliable challenges and goals. Considering a more resilient infrastructure is possible to mitigate the usage of land, where availability is a problem in metropolitan regions, save resources with recycling, produce organic fertilizers with organic composting and generate energy (electricity and steam) with the thermal process. As an example, in his most recent article, YILI has pointed out a comparison where waste-to-energy plants are 127% more efficient than landfills, but not all regions of China could have enough demand to justify a higher investment (YILI et al., 2017).

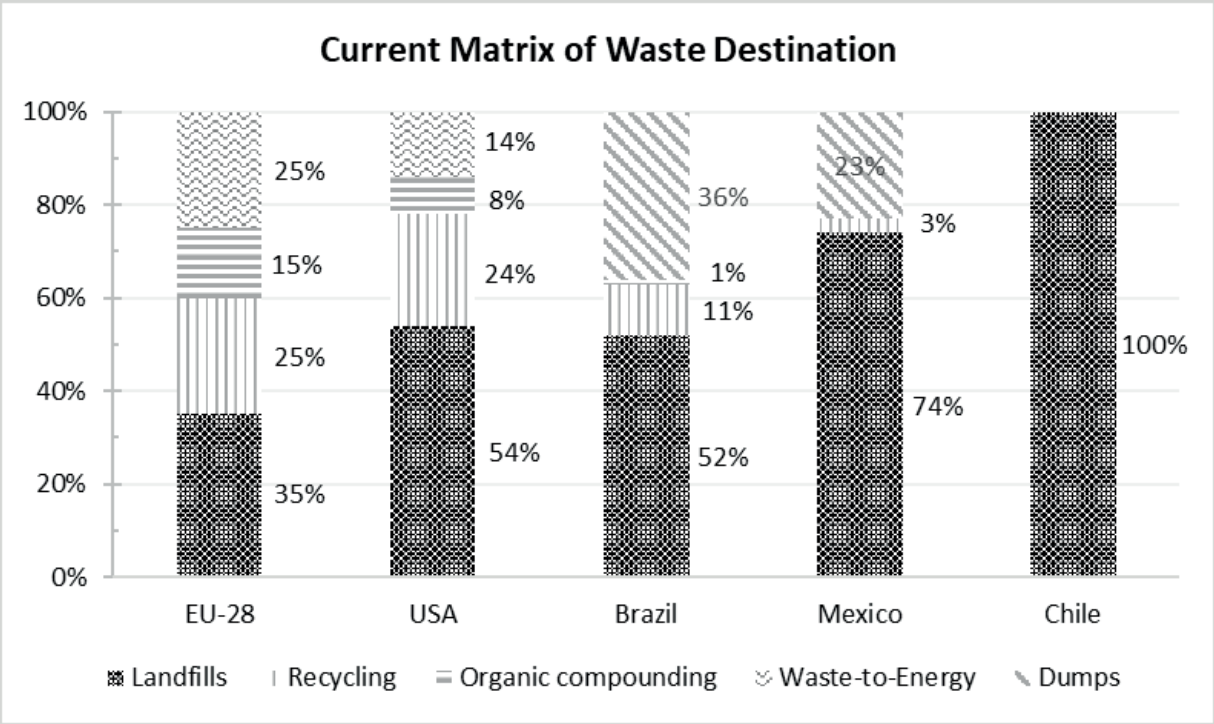

Figure 5. The matrix of Waste Destination

Source: Data compilation from ABRELPE (ABRELPE, 2016) and The World Bank (HOORNWEG and BHADA-TATA, 2012)

Even having recycling in its matrix of treatment, Brazil still shows only 11% of waste recycling rate. While PNRS established 20% by 2015, this insufficient rate comes due to the level of organics and other (mainly electronics) represent no more than 1% of their amounts found in municipal residues. Looking especially at organics seems to be strange to face that developing countries, where people are still starving, have their waste with up to 70% of rest of food. And not only in Brazil, but this also happens with the too low rate of recycling, or organic composting. YUNMEI presents in his article that China dropped its rate of organic treatment from 10% to 2% in the last 15 years, in contrast with what is happening in Europe where this rate rounds 15% and raising from time to time (IPEA, 2012).

Plastic's rate (11%) is also low in comparison with paper and glass (46%), or even if compared with steel and aluminum ones (98%), shown in **Figure 6a**.

Another important issue comes from the fact of PNRS has not achieved 100% cities engagement's goal. As shown in **Figure 6b**, despite growing more than 137%, the engagement's rate only reached 19% after six years from the policy's establishment.

Steel and aluminum rates of recycling seem to be a solved problem in the Brazilian MSW management, and certainly, the reason comes from the commodities' high value per weight. In these examples are possible to see an organized work between society and producers. One sees the possibility of an extra-income for families and other, an opportunity to reduce production costs with raw materials and, mainly, energy.

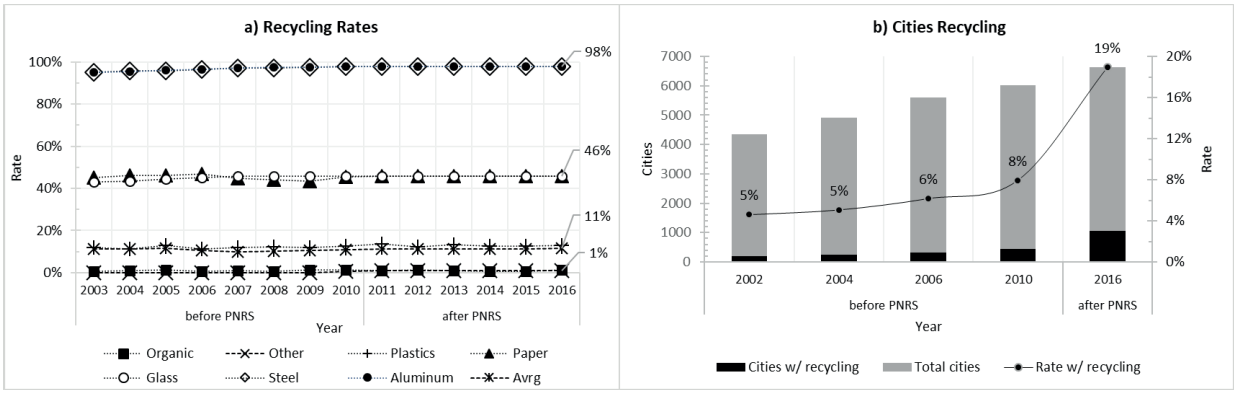

Figure 6. Recycling Rates (**a**) and Cities Recycling (**b**)

Source: Data compilation from ABRELPE (ABRELPE, 2016) and IPEA (IPEA, 2012)

But what to do with other commodities, such as paper, glass, and plastic? Are they within the optimal rate of recycling?

This analysis must follow their possible applications in the market, and package one must be the focus due to its disposable, or short shelf life, characteristic.

These materials have low value per weight and interests on recycling them are equally low for society and producers. And sometimes, even in developed countries, where recycling seems to be under control, the prices of these recyclable commodities are too low that can compromise the whole system, as mentioned ROGOFF is his article (ROGOFF and ROSS, 2016).

Based on these aspects, the pneumatics' program could be a good benchmark case to reproduce and encourage better rates of recycling.

A good initial parameter to take is the rate of disposal application of each material, or what fraction is used to attend the market of packaging (see **Figure 7**).

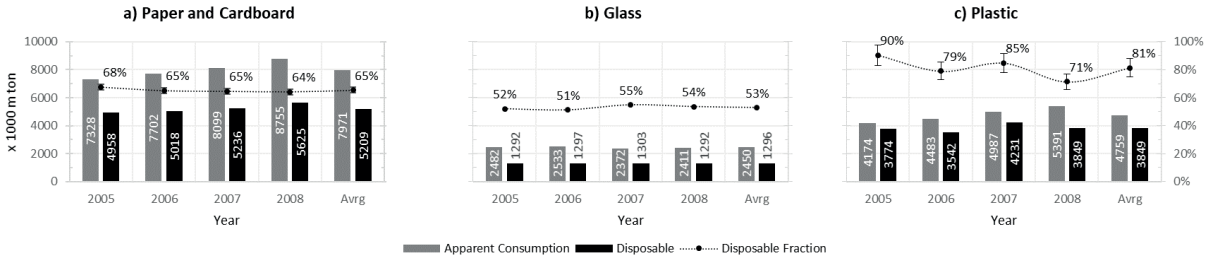

Figure 7. Disposable Fraction: Paper and Cardboard (**a**), Glass (**b**) and Plastic (**c**)

Source: Compilation data from ABRE (ABRE, 2017), ABTCP (ABTCP, 2016), ABIVIDRO (ABIVIDRO et al., 2016) e ABIQUIM (ABIQUIM, 2015)

In case of plastics, the rate is 81%, with a standard deviation of ±7%, due to several types used for packaging and each one has your fraction of destination to a disposable application. For example, frequently more than 30% of all PE produced is for packaging purposes. In cases like PS and PET usually, are used 100% to attend the market of disposables. PVC most used in the past, but now less than 10% is used

in this market which is attended by PE and PP (30%), mainly with flexible films and injected or molded containers.

As an open market with local and foreigner players, another important parameter is the market share to attribute responsibilities and goals. In **Figure 8** is shown the most recent apparent consumption and respective local production, import and export amounts for each material.

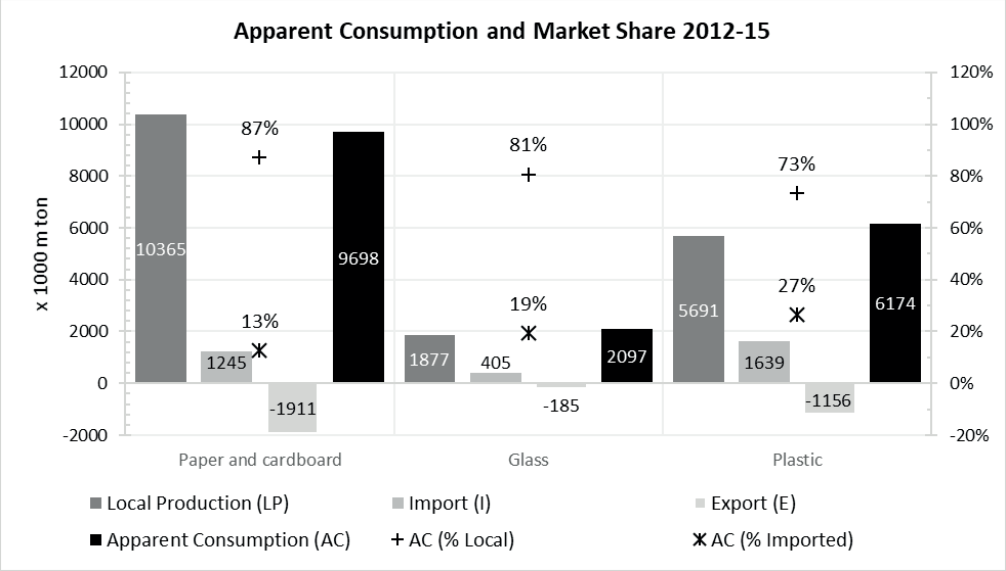

Figure 8. Apparent Consumption and Market Share

Source: Data compilation from ABRE (ABRE, 2017), ABTCP (ABTCP, 2016), ABIVIDRO (ABIVIDRO et al., 2016) e ABIQUIM (ABIQUIM, 2015)

The apparent Brazilian consumption for paper and glass is more than 80% supplied by local companies. In case of plastic, 73% of it is local, and 27% comes from foreigner companies. It means that each category of material (paper and cardboard, glass and plastic) must have its current market suppliers responsible for their share. Despite several players in each category, organization and information management is not a problem. They have specific institute or association, such as Brazilian Technical Association of Automatic Glass Industries (ABIVIDRO), Brazilian Association of Chemical Industries (ABIQUIM) and Technical Brazilian Association of Pulp and Paper (ABTCP) (ABIQUIM, 2015; ABIVIDRO et al., 2016; ABTCP, 2016). These entities can supply all information about amount produced, exported, customers and their applications for the local market. In case of imported materials, Brazilian Federal Income Bureau (RFB) can track their players and movements through their Common Mercosur Classification (NCM) code (RFB, 2018).

Using the equation (III), considering data from **Figure 8** – *Apparent Consumption and Market Share* and **Figure 7** – *Disposable Fraction*, is possible to calculate a minimum average recycling rate for materials and a new minimum national goal for Brazilian's policy (see **Figure 9**).

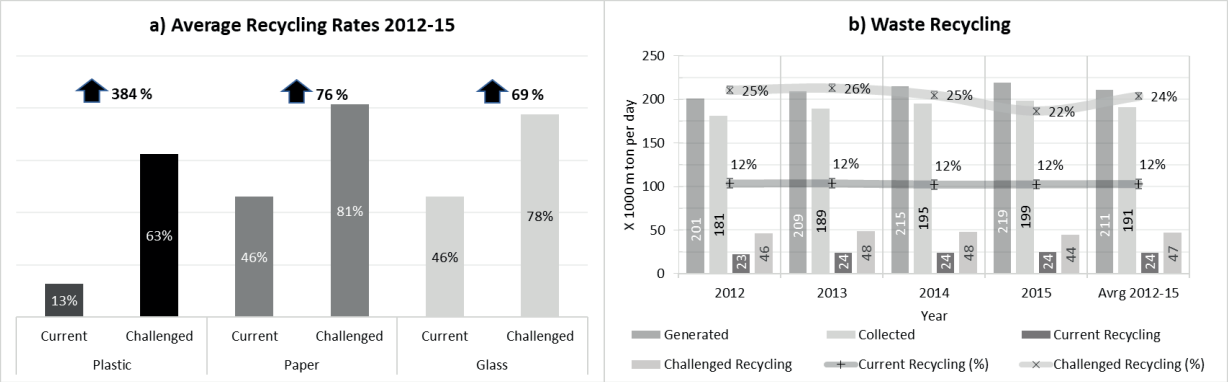

Figure 9. Recycling Rates (**a**) and Waste Recycling (**b**)

Source: Author's calculation

It is possible to define a realistic minimum rate of recycling based on the disposable factor. In case of plastic, its rate could jump from current 13% to 63%, representing a growth of almost five times. Even glass and paper with their 46% of recycling rate could rise to 80% more on average.

The national rate of recycling could be twice higher than the current one and reach a level found in developed regions like Europe and USA.

An advance in this proposal is to allow how to track what is weighing more in a category (e.g., plastic) with multiple materials. **Figure 10** shows a breakdown based on application's market share for most used plastics.

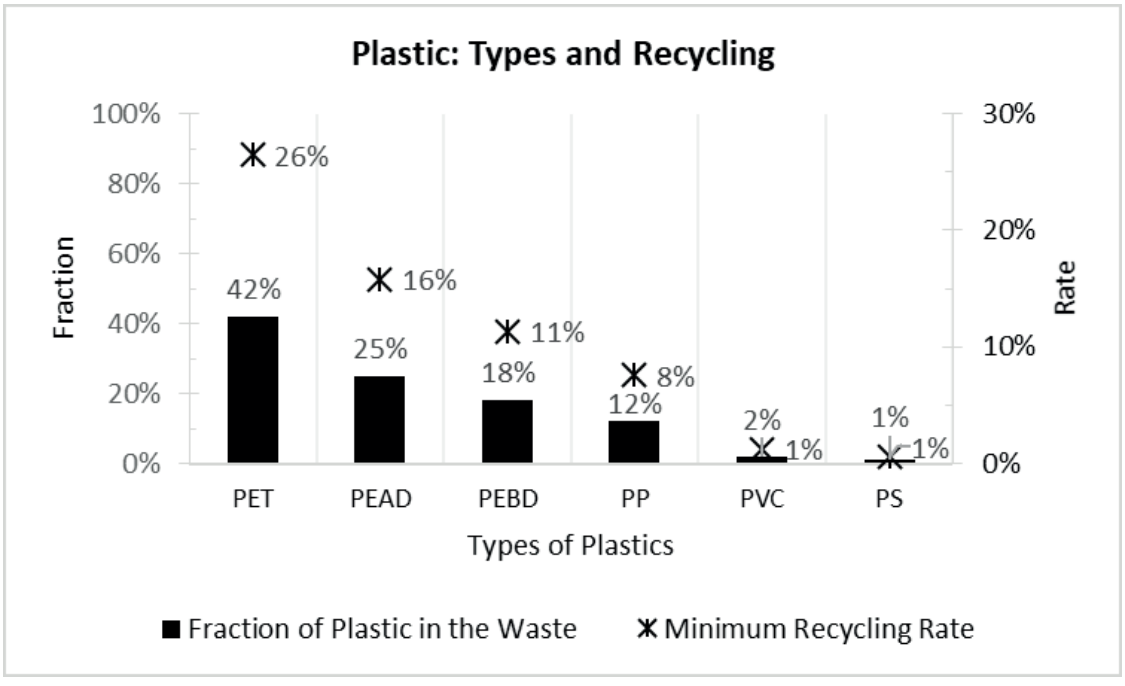

Figure 10. Plastic: Types and Recycling

Source: Author's calculation

Most found plastic in the waste, PET (42%) must be challenged to recycle at least 26%, mainly the bottle grades, due to your volume and the ease of recycling because

it's cleaner than containers.

The biggest challenge is with polyolefins (PEAD, PEBD, and PP). Together, they represent 55% of all plastics discarded as films, vessels, containers, bags and 35% would be a minimum rate for them.

With this recycling rate breakdown is possible to know who must be charged to accomplish its calculated goal. And, as EPA has done in the USA, IBAMA could be in charge of monitoring these categories and their players, making annual reports to ME (Ministry of Environment). This mechanism already works for managing discarded tires, and based on IBAMA's reports to ME, this one has all conditions to apply, when necessary, tax penalties to those companies, or their associations, who don't meet the goals.

5 I FINAL CONSIDERATIONS AND CONCLUSIONS

When idealized, the solid waste policy in Brazil expected that assigning shared responsibilities to society and companies, and empowering municipalities to deploy directives and strategies, would be enough to mitigate waste impacts. However, in over six years the policy shows practically stagnation. There's a willingness to contribute to the selective selection in the society, but it's discouraged by the lack of infrastructure. The door-to-door collection and voluntary delivery points (well known as PEVs in Brazil) are few or do not exist, in most Brazilian cities, and cooperatives of recyclable materials collectors, when available, are pretty inefficient.

Unfortunately, the State has already proved to be incompetent to manage the waste problem, and on the other hand, the companies have worked hard to optimize their processes to produce even more and cheaper, boosting the consumption.

Many initiatives in the world are recognized as successful when they set goals for companies to mitigate the disposal of their products after consumption. Usually, when they emerge, the industry quickly develops partnerships, processes technologies that turn a "problem" into solution. The example of the tire industry in Brazil is a typical case.

A routine for building reasonable recycling rates for post-consumer materials (plastic, glass, and paper) and challenge their supplier industries, could be a way to help the policy to achieve levels of waste recovery equivalent to the developed countries.

However, this would be an additional tool, since the Brazilian waste disposal matrix needs to have more technological solutions, as seen in other countries. And this recognition should be included in a PNRS' forthcoming revision, to provide legal certainty to upcoming entrepreneurs.

Despite not addressed in this study, the absence of organic waste treatment is extremely uncomfortable. The recycling of this material, predominantly rest of food, hangs heavy on low Brazilian recycling levels. But this will be an author's future study, proposing that organic treatment can be led by the food and fertilizer industries with

significant potential gains by mitigating fertilizer's import and producing bioenergy for their consumption.

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