



Full length article

Recycling in Brazil: Challenges and prospects

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ABSTRACT

This article presents a comparative analysis of the performance in formal and informal areas that deal with solid waste in Brazil. The article demonstrates that there has been significant progress in areas related to recycling and that this progress has been based mainly on informality and on the precarious labour conditions for the pickers of recyclable materials. The article also focuses on the problems found in the model for waste recovery that is being implemented in Brazil and that is based on allocation of precarious waste recovery facilities; this model has mostly small operational capabilities even in large municipalities. These problems are discussed in contrast to the great challenges imposed by the new legal framework of the country. Finally, the article proposes a categorisation of the technological models of material recovery facilities (MRFs) based on their degree of automation and nominal capacities in a manner similar to that used worldwide for incineration plants.

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1. Introduction

People around the world are generating waste in raising quantities, and the composition of this waste is becoming increasingly complex. “These two trends pose a challenge to cities, which are charged with protecting their citizens from their waste” (Sintana, 2012). Industrialized countries usually generate far more waste than the others, but their waste tends to be best managed. As in many less industrialized countries, the wastes in Brazil are usually managed mixing formal actors in the regular collection and informal actors in selective collection and in the waste recovery. In this context, the big challenge is integrating the informal waste sector, by assuring adequate work conditions, increasing collection efficiency and improving waste treatment methods.

Municipalities around the world employ a variety of waste treatment options. Factors as local waste characteristics, qualification, cost and availability of local labour, and technological appropriateness should be considered to choose an option. Higher-income cities usually employ capital intensive technology for waste management activities and tasks, whereas lower-income cities tend to rely on labour-based technology options. “Regardless of the context, waste, directly and indirectly, is one of biggest challenges of the urban world” (UNHABITAT–2010, p.1). Recycling is the preferred option for the management of municipal solid waste, after

reducing the generation of solid waste at its source all over the word. Recycling has gained more attention in Brazil with the approval of the National Policy for Solid Wastes (PNRS). Law 12,305 passed in 2010. With this Law, the EPR (extended producer responsibility) was established as an instrument of economic and social development to facilitate the collection and return of solid waste to the corporate sector. Irrespective of support from governments at any level, manufacturers, importers, distributors and dealers of pesticides, including their waste and packaging; batteries; fluorescent, sodium vapour, mercury and mixed-light lamps; lubricating oils and their packaging and residues; tires; electric and electronic products and the components of the electric and electronic products are required to assume responsibility for the entire life cycle of their products.

Another relevant aspect of PNRS is the obligation of the Brazilian cities to deposit only the solid waste treatment tailings in sanitary landfills after August 2014. This policy implies the need to create material recovery facilities more adequate to the needs of waste recovery with a view to obtaining the least amount of residual material not amenable to solid waste treatment.

With these challenges posed by the new legal framework, this article has as its objective to record the current status of the recovery of recyclable solid wastes in Brazil, to review the background of this waste, to present the policies and plans currently being implemented and to identify elements for reform necessary to achieve the goals described in the National Plan of Solid Wastes (PNRS).

An approach to the recycling sector of Brazil has been established, encompassing the gravimetric composition of the solid

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Table 1

Forms of final disposal of domestic solid waste.

Final destination	Quantity in 2000 (t/day)	%	Quantity in 2008 (t/day)	(%)
Sanitary landfill	49.615	35.4	110.044	58.3
Controlled landfill	33.854	24.2	36.673	19.4
Dumping site	45.485	32.5	37.361	19.8
Composting plant	6.365	4.5	1.520	0.8
Material recovery facility	2.158	1.5	2.592	1.4
Incineration	483	0.3	65	<0.1
Wetland areas	228	0.2	35	<0.1
Unspecified sites	877	0.6	SI	–
Other units	1.015	0.7	525.20	0.3
Total	140.081	100	188.815	100

Source: [Brasil \(2012a\)](#).

waste and its recovery, the selective collection, and the characterisation of the material recovery facilities (MRFs). The conditions under which the waste pickers are permitted to pursue their activities and the results achieved by the waste pickers are examined and discussed.

This article presents the results of investigation of technical, environmental, social, and operating conditions of the “materials recovery facilities (MRFs)” deployed in Brazil and describes the challenges related to the management of waste in accordance with the new legal framework and the challenges associated with the National Plan for solid waste. The article proposes a definition and categorisation of MRFs according to their degree of automation and nominal capacity, similar to what is already known worldwide for incineration plants.

After this brief introduction, advantages and disadvantages of distinct models are discussed, and finally, conclusions and recommendations for the sector required reform are suggested.

2. The sector of recycling in Brazil

According to Hoornweg, world cities generate approximately 1.3 billion tonnes of solid waste per year. “Waste generation rates will more than double over the next twenty years in lower income countries. Globally, solid waste management costs will increase from today’s annual \$205.4 billion to about \$375.5 billion in 2025. Cost increases will be most severe in low income countries (more than 5-fold increases) and lower-middle income countries (more than 4-fold increases)” ([Hoornweg, 2012](#)).

With the approval of a new legal framework for the management of solid waste in the country and the consequent increase in the costs involved in waste management, it is necessary to understand the problems associated with further analysis of the recycling sector.

Brazil has 5565 municipalities and a population in 2012 of approximately 1969 million inhabitants ([IBGE, 2012a,b](#)). About 70% of the municipalities have fewer than 20 thousand inhabitants, in contrast to the 15 largest metropolitan regions that contain 37% of the population, corresponding to 72 million inhabitants ([IBGE, 2012a,b](#)). These population differences dictate different regional, economic and cultural realities as well as distinct standards of living.

In 2008, approximately 1835 million t/day¹ of municipal solid waste were collected throughout the country ([IBGE, 2010](#)). The average collected municipal solid waste was 0.97 kg per capita per day (referred to 2008).

The collection of solid waste from homes has encompassed 98% of the urban population and 80% of the population of the whole country (PNAD, 2007). Of the waste collected, 58.3% was sent to

Table 2

Estimate of gravimetric composition of municipal solid waste.

Waste	Quantity (t/day)	Share (%)
Recyclable material	58.527	32
Organic matter	94.335	51
Other	30.619	17
Total	183.482	100

Source: [Brasil \(2012a\)](#) - data of 2008.

sanitary landfills, 19.4% was sent to controlled landfills, and 19.8% was sent to dumping sites, as shown in [Table 1](#).

2.1. Waste generation and recycling rates

Brazil, in accordance with the provisions for developing countries, presents a steady growth in per capita generation of waste that should continue for years to come ([Campos, 2013](#)).

This information is fundamentally important for understanding the evolution of the generation of the quantity and quality of waste and to study the strategies used for the management of this waste.

Studies conducted by the Institute of Applied Economic Research (IPEA) show that in 2008, 32% of the collected wastes were recyclable materials, corresponding to 58,527 t/day, as shown in [Table 2](#).

According to a 2008 survey of the National Information on Sanitation System (SNIS), covering a limited sample of municipalities, the per capita annual recovery of recyclable materials from waste was 3.4 kg of paper, 2.0 kg of plastic, 0.8 kg of metals and 0.6 kg of glass ([Brasil, 2009c](#)). The programs for the recovery of waste under the coordination of the local governments are just beginning, operate precariously and represent less than 4% of the recycled waste in the country ([Brasil, 2012a](#)).

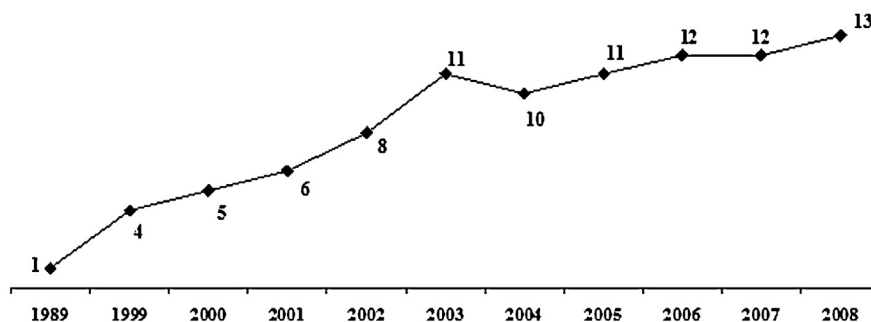
In recent years, there has been a relative increase in the recycling of solid waste in Brazil. Recycling of solid waste reached 13% in 2008, as shown in [Graph 1](#) ([Figueiredo, 2012](#)). In the case of aluminium beverage cans, the recycling rate reached 98% in 2010 ([CEMPRE, 2012](#)). The high recycling rates are achieved by the strong exploitation of the labour of hundreds of thousands of collectors of recyclable material.

The situation is favourable when compared to other countries of Latin America but far from the rates achieved in Organization for Economic co-operation and Development - OECD countries.

Waste exchange initiatives supported by industrial federations are being consolidated and are already operating in several Brazilian states, easing changes between companies and industries with offers of purchase and sale of recycled industrial waste ([Wolffebuttel, n.d.](#)).

[Figueiredo \(2012\)](#) considers that the recycling of the waste by industry exclusively meets the demands of economic production chains of the sector and is not of importance to environmental

¹ t – tonne or metric ton (1000 kg).



Graph 1. Evolution of recycling rates of solid waste in Brazil, 1999–2008 (%).

Source: Figueiredo from data of CEMPRE (2009), ABRELPA (2008) and SNIS (2007).

management. However, he emphasises the role of the economy in stimulating the recycling of certain materials.

For Gonçalves-Dias (2009), the recycling industry takes ownership of environmental discourse and earns the reputation of being environmentally correct, thus exhibiting a positive reflection on business. She recognises that there has been progress in the interaction between actors in the recycling chain but that structural issues such as the mode of production based on poor working conditions of the waste pickers remain unchanged.

Bosi (2008) reinforces the observation that the recycling industry has the waste pickers as the autonomous basis of support for waste recovery, which explains the high percentage of waste recycling recorded by industry.

2.2. The selective collection

The first official data on the selective collection of solid waste in Brazil were issued by the National Sanitation Research Survey (PNSB) of 1989, with 58 municipal programs recorded. This number has been increased in the subsequent annual editions. In 2000, 8.2% of municipalities had selective collection initiatives and 17.9% in 2008.

Selective collection in Brazil has been performed by the local governments, by municipal contractors, by associations and by cooperatives of waste pickers for recyclable materials and by scrap dealers. In most cases, both the formal and informal collections are carried out by waste pickers who very often use human- or animal-drawn vehicles without following the minimum conditions required by national legislation that, as Art. 57 of Law 11.445/2007 postulates, “the use of equipment that is compatible with the technical standards, environmental and public health”.

There is no reliable information on the scope of the selective collection programs.

The most frequently collected materials are paper, cardboard, plastic, glass and metal. However, according to data from SNIS-2011, only 15 kg/hab. year of the potential 112 kg/hab. year of dry domestic wastes are collected for reuse (Brasil, 2012b). A need therefore exists to add 98 kg/hab. year or increase the current amount by a factor of 7.5 to meet the current legislative goals.

The selective collection in Brazil is performed both on a door-to-door schedule or adopting Small Volume Delivery Stations (PEVs) (NBR 15.112/2004) that receive not only dry solid waste recyclables but also small quantities of construction waste, bulky waste and waste resulting from pruning of trees. Local voluntary delivery (LEVs) are usually installed in public buildings, parks, schools, supermarkets, and shopping centres to receive dry recyclable solid waste.

A combination of these various alternatives for garbage collection usually exists in the same municipality, and the PEVs and LEVs are options made available to virtually the entire population to separate and deliver dry recyclable solid waste. In general, the

door-to-door selective collection schemes occur in central commercial areas and are almost randomly performed by autonomous waste pickers. The majority of selective collection programs operated by municipalities use door-to-door schemes, corresponding to 88% of the total and 53% have installed Small Volume Delivery Stations - PEVs (CEMPRE, 2008).

2.3. Material recovery facilities

The capabilities and technologies of MRFs created in Brazil are quite variable, ranging from outdoor areas where sorting is done on the ground, facilities in covered areas and complex units with a variety of electromechanical components. The MRFs may have static tables with masonry or conveyor belts for material sorting, as well as various components that contribute to the separation of waste, depending on the size, weight and attractiveness of the waste, among others. The most commonly used components are vibrating or trommel screens, conveyor belts, presses, balers, small and road scales, mill grinders, magnets and electromagnetic separators, shaky ground feeders, flow controllers, bag strippers, bioreactors and pneumatic classifiers, among others.

Some of the models of mechanised MRFs were adapted from mining equipment. Between 1960 and 1990, some MRFs relying on European technologies for Mechanical Biological Treatment (MBT) were purchased. The importation of these facilities began in 1962 with the acquisition of a DANO plant with a processing capacity of 600 t/day to be installed in the newly opened capital, Brasília.

In later years, the municipalities of Belo Horizonte, São Paulo, Santo André, and São José dos Campos (among others) have acquired similar models with different capacities (Brasil, 2010). In 1977, the city of Rio de Janeiro acquired an Italian-made facility, Sorain Cecchini brand, to process 150 t/day.

In the years 1986 and 1992, the cities of Brasília and Rio de Janeiro purchased French-made facilities, both TRIGA brand, with operational capacities of 600 and 1,200 t/day, respectively. Many municipalities acquired and adapted units from different manufacturers: IGUAÇUMEC, MAQBRT, GAVAZZI, STOLLMEIER, LIXOK, FABER AMBRA, and CLEAN WORLD (BARRIER, 2006) (MMA, 2010).

Several of these units have been closed or abandoned, but others are still in operation, having been refurbished, adapted or extended. The number of MRF in Brazil grew from 189 to 445 in the 2000–2008 period (Brasil, 2002–2010).

Although the number of MRFs more than doubled from 2000 to 2008, the amount of waste recovered increased only 21%, from 2.148 to 2.592 t/day.

Public health inspections would be sufficient to close almost all of these facilities as a consequence of the generally poor operating conditions.

Recent years have shown a trend for the deployment of small units. The last large MRF installed in Brazil was a TRIGA facility

located in the district of Caju, city of Rio de Janeiro, in 1992, with a 1200 t/day capacity. At present, this unit is handling approximately 230 t/day of dry solid waste, involving 99 waste pickers. However, since the beginning of the nineties, big cities such as Belo Horizonte, Rio de Janeiro and São Paulo have begun to use simplified small units. This movement resulted in the need to obtain various areas to locate these facilities where the labour of waste pickers organised in associations and cooperatives has been used.

2.4. The waste pickers

In low and middle-income countries, millions of workers earn a living by collecting and processing urban waste through informal systems. These workers are often referred to by the term “waste pickers”. As noted by Dias (2013), the term “can range from poor people rummaging through garbage in search of food, clothing and other basic needs for daily consumption to informal private collectors of recyclables for sale to middlemen or businesses, as well as organised collectors/sorters of recyclables linked to unions, cooperatives or associations” (p.1).

The waste pickers face many challenges: deplorable living and working conditions; low social status; violence inflicted by the police; in general, little support from local government. They are exposed to serious occupational hazards due to daily exposure to contaminants and hazardous materials (Cointreau, 2006; Da Silva et al., 2006).

The work they perform very often subsidises the formal system and can be considered as a positive externality that municipalities enjoy “... without having to pay for it because the environmental gain is a by-product of the economic interests of informal recyclers” says UN Spies, S.; Scheinberg, A. 2010 (p.131). However, the waste pickers are not acknowledged as legitimate economical actors.

Over the last 15 to 20 years, waste pickers have managed to organise into collectives to represent some of their demands in various countries, especially in Latin American. In countries like Brazil, for example, associations and cooperatives of waste pickers have gained considerable visibility, and public policies for their integration have been designed at many levels of government—national, subnational, and local (Dias, 2012). Municipal program selective collection initiatives in partnership with waste pickers date back to the early 1990s in Brazil.

The waste pickers produce, at the same time, goods and services. They recover waste, turning the waste into raw materials for industry, and provide waste management public services that should be provided by local governments (Abreu, 2009). In almost all Brazilian municipalities, regardless of the population size, the MRFs for sorting, pressing, baling and trading of materials recovered from dry waste are informally operated by waste pickers, in an irregular and precarious way. For Cavalcante (2007), the main task of the waste pickers consists of feeding the formally established

companies that take advantage of the waste recovered to resell or manufacture other products.

Burgos (2009) researched the recycling industry structure and its main characteristics: abundance of municipal solid waste, poor urban workers, jobless individuals from various productive sectors working as waste pickers, carrying out activities at the base of the recycling industry without being employed, and impoverished urban territories where the set of activities making up this industry is developed.

Belo Horizonte, the capital of Minas Gerais, was the first municipality in Brazil to recognise waste pickers as agents of the selective collection, in 1993 (Dias, 2002). This model “which today is seen as obvious, at that time presented an extremely audacious approach which was politically sustained by the local government” (Abreu, 2009). From this experience, the waste pickers began to be recognised on the national scene. In 1997, the United Nations Children’s Fund (UNICEF) conceived and articulated the implementation of the National Program “Garbage and Citizenship” and the campaign “Child in the garbage never more” that had repercussions in other Latin America countries, drawing attention to the thousands of families living and working at dumping sites (Campos, 1997).

The “National Forum Garbage and Citizenship” was created to promote an intersectoral approach by the articulation of actors from diverse fields of activity. State and municipal level forums were also created to mediate the dialogue between governments, society and waste pickers and to favour a participatory solution to the problems (Dias, 2009). Fig. 1

In 2001, the waste pickers created the National Movement of Collectors of Recyclable Materials (MNCR) during their First National Congress held in Brasília (MNCR, n.d.).

The daily life of the waste pickers was disclosed to the general public by movies such as the internationally award-winning short film “Island of Flowers” and the feature films “Estamira”, “Lixo Extraordinário”, and “À Margem do Lixo”. The waste pickers are also present in marketing campaigns as the one promoted by Coca Cola

In recent years, the Brazilian waste pickers have therefore played a distinguished role in the waste management, economic and political worlds, and obtained a social visibility. Organised at the national level, this social movement has showed a steady mobilisation and capacity to claim its demands. However, all this mobilisation, visibility, public and political recognition have not been sufficient to generally improve the work and living conditions of this labour category. The number of waste pickers in Brazil is estimated to be approximately 600 thousand (PNRS, 2012a), the great majority of them without formal instruction and even civil registration.

The working conditions of waste pickers on the streets of major Brazilian cities today still match the situation portrayed by Abreu, 2009 in 1993: the strong connection with the life on the streets, the physical violence, in addition, the use of “human traction” to transport the collected material. All these difficulties increased the



Fig. 1. President of Brazil Dilma Rousseff and ministers, in an event with the waste pickers. Agency Brazil <www.agenciabrasil.ebc.com.br> - São Paulo 22/12/2011. The symbol of the campaign “Child in the garbage never more” Photo: Mila Petrilo Date: July 1998. Manifestation of the MNCR at the World Social Forum in Porto Alegre 2003. Source: <http://gilwarley.blogspot.com.br/Advertisement> with leader of the MNCR.

rejection of the waste pickers by a considerable part of the population who did not want the deployment of recovery facilities close to their place of work or residence.

The productivity is very low, corresponding to the low income obtained once the waste pickers trade the waste they recover. In three associations of collectors investigated in Brasília, the national capital, the monthly revenue was approximately 2/3 of the national minimum wage, without any legal labour rights (Campos, 2012).

With the enforcement of the Federal Policy for Basic Sanitation, which passed in 2007, the hiring of the waste picker associations for the provision of public services was encouraged (MNCR, 2011). Therefore, in general, the waste pickers are not receiving any remuneration for performing materials screening, even considering that this activity avoids land filling expenditures. Training on the spot and the incorporation of cooperatives and associations can be found as embryonic initiatives. The great majority of waste pickers work without technical guidance and the basic benefits of work.

Not having formal jobs, the vast majority of waste pickers do not have legal labour rights such as a 44 working hour week, remunerated weekly rest and paid annual leave, 13th salary, and paternity or maternity rights, among others. Most of the waste pickers do not receive a salary for rendered services and are poorly paid by recovered materials.

Selective collection in Brazil is undoubtedly based on blatant exploitation of the work force of the waste pickers by local governments and by recycling industries.

3. Legal framework

A great change in the legal system for the sanitation public services in Brazil occurred in this century, with important legal instruments adopted.

The Solid Waste National Policy (PNRS - Law 12,305/2010) (Brasil, 2010) established the EPR of solid wastes and the shared responsibility between producers, users and governments to set up specific tasks for each one. The following hierarchy for the solid waste management is adopted: no generation, source reduction, reuse, recycling, waste treatment, and environmentally appropriate final disposal of the tailings.

The associations and cooperatives were defined as priority agents to carry out the selective collection. Support to achieve the goals defined by the PNRS should be provided to municipalities to broadly implement selective collection, applying the EPR instrument and developing environmental education. In this context, the role of material recovery facilities is strategic.

In 2002, as recognition of the relevance of the work of the waste pickers, their professional activities were introduced into the Brazilian Code of Occupations (BOD) of the Ministry of Labor. Thereafter, some companies have been formally hiring these professionals, with legal rights guaranteed. More than 11 thousand cases had been registered up to the year 2006 (Besen and Dias, 2011).

The governments were allowed to contract the services of waste picker associations and cooperatives without the need of a bidding process in 2007, by means of the Sanitation Public Services Federal Policy (Law 11,445).

The Federal Decree 5940/2006 made mandatory in federal administration requires the source separation of recyclables that should be delivered to waste picker associations and cooperatives. This decree was replicated in various states and municipalities.

4. Challenges of the national plan for solid waste

According to the Solid Wastes National Policy (PNRS), no generation and source reduction are the first priorities. However, study

of the evolution of generation per capita of solid wastes in Brazil (as well as other developing countries) indicates a greater tendency to growth as a result, mainly, of income improvement of the poor population and socio-cultural factors such as the reduction of the size of families and the stronger presence of women in the labour market (Campos, 2012).

These goals must be recognised at municipal and state levels and require the planning, design, implementation and operation of the selective collection and of the necessary MRFs.

Packaging of agrichemicals and used or contaminated lubricating oil are the wastes that already have operating EPR systems (Brasil, 2012b). EPR systems are being carried out for lamp bulbs, packaging in general, electric and electronics goods and medicines as well. There are currently important initiatives promoted by the Federal Government to encourage the recycling of solid waste in Brazil, aiming at the implementation of the Solid Wastes National Policy. However, there is still much to be done. The present recycling rates are still insufficient, and the determinant factors to improve this performance are complex and depend on deep changes in political, institutional, technical, economic, environmental and social nature.

Structural deficiencies in the municipal solid waste management systems are demonstrated by the many treatment and final disposal facilities that were abandoned or damaged after being installed. There is a general lack of capacity to manage, maintain and technically operate facilities, not only but mainly in the smaller cities. Essentially the installed technical and management capacity available in the country does not meet the size of the proposed challenge.

The provision for capacity building of the agents that operate in the sector - managers, technicians, public officials, waste pickers, and users are still in its early stages. The majority of existing initiatives are focussed on the technology issues, which do not incorporate relevant socio-environmental and cultural aspects (Campos, 2009).

The evaluation of effective performance of selective collection in Brazil should consider at least two situations: the formal systems operating with the knowledge and/or support of public power, and the informal processes performed by street waste pickers and scrap dealers, which are not included in official statistics.

There was a significant advance in the last few decades with respect to the information related to the sector. The Basic Sanitation National Survey (PNSB) conducted by the Brazilian Institute of Geography and Statistics (IBGE) in the years 1989, 2000, and 2008, and the annual inquiries on solid waste encompassing an increasing number of municipalities, held by the National System of Information on Sanitation since 2002, are key contributions. Nevertheless, none of these gatherings includes information on the informal waste collection systems, in which the waste pickers are totally disorganised and working individually, trading directly with scrap dealers who sell the material to the recycling industry. To know this business effectively, it is necessary to face a challenge. A correct evaluation of how this business segment is currently acting is fundamental to propose the role it could play in the implementation of EPR, as well as the legal obligations.

Few municipalities have institutionalised the selective collection and the transportation of dried solid waste, in accordance with Brazilian laws. Thus, other challenges relate to the difficulty of mobilising the population for the source separation of recyclable materials, the precarious situation of the existing MRFs, and the necessity of building capacity into the waste municipal management systems to prioritise the recovery of recyclables.

Perhaps the greatest challenge is to eradicate the destitution of the waste pickers' situation, as widely presented in this article.

5. The reforms required

In 1998, the National Program “Garbage and Citizenship” was established. The Garbage and Citizenship Program proposed the integration of the social and environmental dimensions for formulation of policies for management of urban solid waste. This approach has been fully adopted by the Solid Waste National Policy. The implementation of this policy, as has already been stated by that Program, requires the permanent articulation and integration of a wide range of institutions related to solid waste management, aiming at the construction of a joint strategy for the sustainability of the scheduled actions.

A comprehensive intervention must therefore be capable of responding to socio-environmental demands in areas such as education, health, environment, urban policy, housing, job, and income generation and social development, as well as the specific technical and operational demands related to urban cleaning and solid waste management. (Campos, 2009)

There is also a need for a national strategy to integrate and coordinate efforts at the federal, state and municipal levels of government—to create the necessary conditions for the attainment of the Solid Waste National Plan goals, focussing on building capacity.

The approval of the Solid Waste National Policy in 2010 creates the opportunity to change the current situation, with the implementation of proper management of the recycled waste recovery system, also bringing generators of the solid waste to assume their responsibilities.

The deployment of the Solid Waste National Plan demands an evaluation of the achievements of each municipality and the challenges associated with the performance of the selective collection. A model for the definition of municipal targets for the diversion of

dry recyclable solid waste from landfills must be discussed, taking into account different local conditions. One of the issues that will arise during the development of local plans for selective collection and waste recovery is the choice of capacity, type of technology and the labour productivity to be adopted in each case.

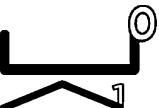




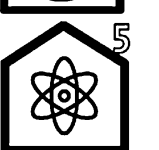
A study conducted by the author involving 12 MRFs in Brazil found 92 kg/waste picker/day of dry solid waste and 293 kg/waste picker/day of composting and dry solid waste as an average productivity.

The total amount of municipal solid waste collected in 2008 all over the country, according to PNSB/IBGE, was 183.000 t/day, which would make 60 billion tonnes of dry materials capable of being recovered for recycling. Thus, considering the productivity values for dry solid waste, approximately 640 thousand waste pickers would be required to promote the recovery of waste in the entire country, adopting the technology of manual selection with static tables or conveyor belts supplemented by other electromechanical components.

To meet the requirements of solid waste treatment and land filling (only the small details of the waste treatment, according to National Law), it is convenient to determine recommended capacities for the deployment of MRFs in municipalities of small, medium and large sizes. In each case, the technical, economic, financial, environmental, and social dimensions must be analysed.

MRFs are industrial facilities and therefore must be properly planned and designed. A building program must be defined, and the corresponding urban and architectural requirements must be identified and studied. Structural, electrical and plumbing designs must be prepared, taking into account the activities that will be carried out in the building. Production equipment must be specified accordingly. An MRF must have its operation supervised by a qualified professional and have the proper maintenance programs. In

Table 3
Data on MRFs relative to technology, capacity, waste origin and verified productivity.

Gene-ration	Symbology	Technology	Size class	Capacity (t/day)	Waste origin	Productivity (kg/waste picker/day)
G0		TMA - Manual treatment in the ground	Does not apply	Does not apply	Selective collection	95
G1		TMA - Manual treatment in static table	Small	7	Selective collection	70
G2		TME - Manual and semi mechanised treatment	Medium	30	Selective collection	92
G3		TME - Manual and mechanised treatment continuous flow, without return	Large	Above 30	Selective collection	259
G4		TMB - Mechanical biological treatment, continuous flow, with return	Large	Above 30	Standard and selective collection	240 ^a
G5		TMB - Mechanical biological treatment,	Large	Above 30	Standard and selective collection	Does not apply

^aThe productivity values verified in the two studied G4 TMB continuous flow MRFs with return facilities were quite distinct, one presenting very low performance which led the media to stay below the G3 TMB, continuous flow, without return, which supposedly should have a lower productivity.

Source: prepared by the author.

Table 4

Advantages and disadvantages in the choice of small MRFs for municipalities of medium and large size.

Advantages	Disadvantages
Smaller area needed for each facility	Greater number of building sites needed
Simpler construction techniques needed	Different facility designs needed
Lower cost of deployment	Weaker and less durable buildings
Less skilled labour needed	More people required for maintenance
Easier adaptation of existing installations	Probable increase of number of conflicts with the neighbours
Less complexity in maintenance	Smaller processing capacity
Lower heavy vehicle traffic	More red tape (for instance, a multiplicity of expenses to be processed and paid)
Easier maintenance	Increased cost for building security
Pace of work dictated by waste pickers	Increased costs of collection of tailings
Lower noise generation	Intense physical wear for the operator pushing the waste
Easier environmental licensing	Lack of economies of scale

Source: prepared by the author.

Table 5

Advantages and disadvantages in the choice of medium and large MRFs for medium and large size municipalities of.

Advantages	Disadvantages
Smaller number of building sites needed	Large area required for an installation
Smaller number of facilities to be designed	More complex construction
More robust buildings and facilities	Greater cost of deployment
Fewer people involved in maintenance	More skilled labour needed
Smaller number of conflicts with the neighbours	Greater difficulty to adapt and use existing structures
Increased processing capacity	Maintenance tasks more complex
Less red tape (for instance, a smaller number of expenses to be processed and paid)	Intense heavy vehicle traffic on access roads
Lower costs of collection of tailings	Greater operational cost
Less physical stress for operators	Increased noise generation
Lower cost for building security	The pace of work will require greater effort and concentration
Economy of scale	Probable odour generation in TMB facilities

Source: prepared by the author.

the same way, staff training and management must rely on qualified professionals. The decision to deploy an MRF must be supported by the proper planning and design so that its adequate technical and financial operation will be assured. The choice of model of MRF must consider the needs of the given case, local conditions, and the specific type of wastes that will be treated, aiming at the best possible performance.

At present, the title of the proposition and classifications for different types of MRFs on the basis of the technologies used are based on the types of waste that they will receive in the standard collection or curbside collection, the nominal capacity and the technical characterisation of the waste.

Table 3 displays the characterisation of some typical MRFs presently found as the result of the study previously conducted by the author at the 12 facilities in Brazil.

Different possibilities of arrangements were studied to support the choices of types of MRFs. For small municipalities collecting up to 20 tons of solid waste per day, the most suitable solution should be one small size MRF that handles up to 7 tonnes per day or a few facilities of smaller capacity.

Planning for medium and large municipalities is a more complex problem. The best performing arrangement will be found by choosing between a single facility solution and a network of different facilities designed to better respond to the specific nature of local demands.

The main sustainability-related aspects of these installations should be examined, considering:

- availability of conveniently located public-owned sites or private sites able to be expropriated, not too far from the urban network;
- availability of conveniently located sites with infrastructure already built, to be reformed and adapted as MRFs;
- definition of catchment areas for dry solid waste corresponding to the available sites for location of MRFs;

- relevant legal, financial, and management requirements to operate as an efficient industrial facility;
- existence of waste picker associations or cooperatives because, according to the Law, the waste pickers should have priority to operate MRFs.

The planning of the deployment of MRFs in larger cities must consider and compare advantages and disadvantages of the different options. Table 4 presents advantages and disadvantages to be considered for the deployment of small MRFs, and Table 5 presents advantages and disadvantages to be considered for the deployment of medium and large MRFs.

Thus, the choice of types and sizes of MRFs to be installed in a given medium or large size municipality should be contemplated individually, considering local conditions and applying requirements for each situation.

6. Conclusions and recommendations

Some general aspects can summarise the situation currently found in the country, increasing the understanding of the nature of the challenges that must be faced to progress:

- there was an important advance in the relevant legislation, favouring the development of sustainable solid waste management;
- the recent increase in the income of poor families and the consequent rise of consumption may be reflected in the increased per capita waste generation;
- there is a strong trend to operate the MRFs informally, with no obedience to legal or technical requirements, without the adequate infrastructure and with little or no institutional control;
- MRFs are operated precariously, even in large municipalities that can rely on qualified professionals;

- basic health and sanitary conditions legally required for working environment such as adequate WCs and refectories are not found at MRFs, and public health surveillance is not effective;
- waste pickers working in MRFs are not being contracted and paid according to the legal provisions, even with inspection by the Labour Public Prosecutors;
- the incentives given under the Federal Law (bidding exemptions) to municipalities that establish contracts with waste picker associations and cooperatives have not been utilised;
- there is an obvious and general omission of local governments fulfilling their duties relative to the urban solid waste recovery.

There is a general conformism with the precarious conditions that are unworthy of the work of the waste pickers. The existence of many cases where these professionals are still working on dumping sites, including in Brasília (Federal District) indicates the length of the road to be travelled². The poorer working conditions found at dumping sites result in a tragic perception that the working in inadequate recovering facilities represents an upgrade. This almost general acceptance of inhumane working conditions for the waste pickers refers to the history of Brazil.

Thus, connivance with poor working conditions for the waste pickers is usually present as an institutional performance (or omission) of entities legally in charge at municipal, state and federal levels but also in the conduct of non-governmental organisations, sometimes including waste picker organisations pressed by the urgent day-to-day demands. In a broad sense, there are many actors directly or indirectly responsible for adequate provision of services.

It is reasonable to conclude that if each of these actors performs their primary duty related to the activities carried out in the MRFs, meaningful progress can be made, but coordinated solutions should be sought to gain efficacy and efficiency. This waste management situation needs to be the object of public debate, to gain visibility and change the general social perception of the activities performed in MRFs.

This discussion shows that the guidelines issued by the National Forum on Garbage and Citizenship are still sound, especially after the addition of the Solid Waste National Policy. The challenge is to shift the current paradigm by adopting an integrated approach that considers the complexity of the provision of adequate and updated services.

In conclusion, some suggestions to aid in the construction of a model for the management of MRFs adequate for the Brazilian context are presented:

- discussion and negotiation between the three levels of government to meet the national challenges, with due consideration of the regional peculiarities and places;
- social mobilisation and education encouraging the reduction in the generation and separation of waste at the source;
- building the capacity of local public administration focussing on rational planning and implementation of the public waste management systems looking for more effective, efficient and healthy solutions, with permanent technical assistance assured;
- choice of technologies with costs compatible with willingness of the population to pay;
- billing the population and the waste generators for services provided for selective collection and recovery of recyclable waste;
- design of MRFs, taking into account local conditions and operational capacity for the achievement of national targets observing compliance with the legal requirements and regulations;

- permanent training of technical and operational personnel for the appropriate planning and provision of services;
- capacity building of waste pickers associations and cooperatives, giving these organisations the necessary support to be hired by local governments to operate MRFs;
- improvement of the national information system for solid wastes to follow up recycling rates achieved by the municipalities and other relevant data.

The first step has clearly been taken. The commitment of the Ministry of the Environment technical team has led the process of approval of PNRS and is coordinating the implementation process of the Solid Waste National Plan.

The debate about the implementation throughout the country of the National Solid Waste Politics is the theme of the Fourth National Conference on the Environment in progress in 2013. This Conference occurs every two years and mobilises all 5564 municipalities with the election of delegates to discuss environmental issues relevant to the country. So this Conference can become a very special moment on the national level to develop a strategy to meet the requirements of recent legislation and the targets set by the National Solid Waste Plan.

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² Gramacho, the dumping site of Rio de Janeiro City, had thousands of waste pickers working until its closure in June 2012.

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