Energy Recovery from Municipal Solid Waste (Waste to Energy) in Salvador and Feira de Santana, Bahia, Brazil

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The generation of municipal solid waste (MSW) is closely related to the number of inhabitants and their income levels. Population growth increases MSW generation, causing economic, social, and environmental problems that the energy recovery of this biomass could mitigate. This solution is not only energetically viable but also economically attractive and environmentally beneficial, as it contributes to reducing the generation of greenhouse gases (GHGs) in landfills, thereby extending the useful life of these facilities. This work sought to identify in the literature the necessary characteristics for energy recovery from MSW and the properties of such waste in the metropolitan regions of Salvador and Feira de Santana, Bahia. Based on this analysis, new studies will be developed to investigate the composition, calorific value, and moisture content of the waste, as well as to assess the feasibility of implementation in other regions of the state. The method used included a literature review and consultation of relevant institutions in the field.

Keywords: Municipal Solid Waste. Biogas. Energy Recovery. Bahia.

Brazil generated more than 80 million tons of municipal solid waste (MSW) in 2023 [1], with various factors, including economic, social, geographic, educational, cultural, technological, and legal considerations, influencing the quantity and composition of waste [2]. Moreover, 42% of the total waste is disposed of in inappropriate sites, such as landfills and dumps [3].

The use of MSW for energy recovery, also known as waste-to-energy, involves technologies to treat waste to recover energy in the form of heat, electricity, or alternative fuels such as biogas [4]. This concept not only includes energy recovery but also helps reduce GHG emissions and decreases the volume of waste in landfills, thereby reducing final disposal, despite its high implementation cost [5].

This paper is part of a broader study on the current landscape of energy generation from MSW, focusing on the metropolitan areas of Bahia's two largest cities, Salvador and Feira de Santana. The objective is to survey the available biomass in these areas and the feasibility of energy recovery.

Materials and Methods

An extensive literature review was conducted using scientific databases such as Scielo®, Scopus®, and ScienceDirect®, as well as consultation of relevant legislation such as the National Solid Waste Policy (PNRS), the Solid Waste Outlook, and guidelines from the Energy Research Company (EPE), to understand better the regulatory and economic scenario related to energy recovery from municipal solid waste in Brazil.

Theoretical Framework

In effective waste management, it is essential to understand the quantity and type of discarded material, as this makes it possible to define more appropriate municipal policies for the waste of different regions, as well as to estimate the energy that can be generated from energy recovery, the

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amount of recyclable material, and the reduction in landfill mass [6].

Table 1 presents the main characteristics of the Municipal Solid Waste.

MSW IN FSA AND SSA

Table 2 shows the MSW data from Salvador and Feira de Santana, and Table 3 presents the generation of MSW.

Conclusion

Based on the information obtained, the conversion of municipal solid waste into energy can be a viable alternative in Feira de Santana and Salvador. Both cities show a high percentage of MSW generation compared to the state of Bahia, making this practice beneficial for reducing environmental impacts and optimizing the use of a material that would otherwise be discarded. However, this depends

Table 1. MSW characteristics.

Characteristics of Municipal Solid Waste (MSW)		
Gravimetric Composition	**Calorific Value**	**Moisure Content**
Percentage by mass of each component compared to the total mass [7], which is essential for evaluating the energy recovery potential of solid waste [8].	Related to the country or region's climatic characteristics, influenced by water presence and population income, which affect the carbon content in the solid portion of MSW [9].	It depends directly on the initial composition of the material, local climate, landfill operation processes, and the biological decomposition rate [10].

Source: Adapted from MMA, MCID, Sarker et al. 2024, Soares. 2011.

Table 2. MSW data.

MSW Material Composition	Gravimetric Composition (%)	
	Salvador	Feira de Santana
Organic	42	49
Plastic	22	19
Paper	8	20
Wood	0.3	4
Textile	5	3
Rubber	0.2	2
Glass/Ceramic	2	2
Metal	3	1
Other materials	17	-

Source: Adapted from Junqueira and colleagues, 2021 [11]; PMGIRS, 2016 [12]; Urban Cleaning Basic Plan, 2012 [13].

Table 3. MSW generation.

Location	MSW Generation (tons)	
	2000	2010
Bahia	3,743,388	4,951,225
Salvador	740,030	1,286,990
Feira de Santana	140,000	186,515

Source: Panorama dos Resíduos Sólidos no Brasil, 2003 [14] and 2010 [15], Freitas and Filho, 2009 [16].

directly on factors such as gravimetric composition, calorific value, and moisture content of the MSW, as well as the development of technologies and implementation of effective public policies.

Therefore, to adopt this perspective, it is essential to expand the collection of experimental data and enhance research on the subject, thereby contributing to more sustainable management of municipal solid waste.

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References

1. Associação Brasileira de Resíduos e Meio Ambiente. Panorama dos resíduos sólidos no Brasil 2024.
2. Melo FHF. Caracterização e estudo do gerenciamento dos resíduos sólidos urbanos em um consórcio municipal do estado do Pernambuco [dissertação]. Caruaru (PE): Universidade Federal de Pernambuco, Centro Acadêmico do Agreste; 2015. 123 p.
3. Banco Nacional de Desenvolvimento Econômico e Social. Resíduos Sólidos Urbanos. 2018.
4. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Opções em Waste-to-Energy na gestão de resíduos sólidos urbanos: um guia para tomadores de decisão em países emergentes ou em desenvolvimento. Bonn: GIZ; 2017.
5. Varjani S, Agarwal S, You S, Wong JWC, Zhang Z, Ngo HH, et al. Sustainable management of municipal solid waste through waste-to-energy technologies. Bioresour Technol. 2022 Jul;355:127247.
6. Fricke K, Pereira C, Leite A, Bagnati M, coordenadores. Gestão sustentável de resíduos sólidos urbanos: transferência de experiência entre a Alemanha e o Brasil. Braunschweig: Technische Universität Braunschweig; 2015.
7. Ministério do Meio Ambiente (BR). Plano Nacional de Resíduos Sólidos. Brasília: MMA; 2022. Ministério das Cidades (BR), Secretaria Nacional de Saneamento Ambiental. Glossário de termos técnicos: limpeza urbana e manejo de resíduos sólidos. Brasília: SINISA; 2024.
8. Sarker TR, Khatun ML, Ethen DZ, Ali MR, Islam MS, Chowdhury S, et al. Recent evolution in thermochemical transformation of municipal solid wastes to alternate fuels. Heliyon. 2024;10:e37105.
9. Soares ELSF. Estudo da caracterização gravimétrica e poder calorífico dos resíduos sólidos urbanos [dissertação]. Rio de Janeiro (RJ): Universidade Federal do Rio de Janeiro, COPPE; 2011.
10. Junqueira HS, Medeiros DL, Cohim E. Gerenciamento de resíduos sólidos urbanos de Feira de Santana: demanda energética e pegada de carbono. Rev Ambient Soc. 20XX;XX(XX):XX–XX.
11. Prefeitura Municipal de Feira de Santana. Plano Municipal de Gestão Integrada de Resíduos Sólidos. Feira de Santana: Prefeitura Municipal; 2016.
12. Prefeitura Municipal de Salvador. Plano Municipal de Saneamento Básico: limpeza urbana e manejo de resíduos sólidos. Salvador: Prefeitura Municipal; 2012.
13. Associação Brasileira de Resíduos e Meio Ambiente. Panorama dos resíduos sólidos no Brasil 2003.
14. Associação Brasileira de Resíduos e Meio Ambiente. Panorama dos resíduos sólidos no Brasil 2010. Freitas LFS, Filho JDO. Potencial econômico da reciclagem de resíduos sólidos na Bahia. Rev Econ Nordeste. 2009;2.