South Asian Journal of Social Studies and Economics

Volume 21, Issue 12, Page 274-284, 2024; Article no.SAJSSE.128726
ISSN: 2581-821X

Potential of Refuse Derived Fuel (RDF) in Medan City's Waste Management Strategy

Taufik Affandi Siregar [a*], Agus Purwoko [b++] and Satia Negara Lubis [b++]

[a] Regional and Rural Development Planning, Graduate School, Medan, Universitas Sumatera Utara, Indonesia.
[b] Regional and Rural Development Planning, Medan, Universitas Sumatera Utara, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/sajsse/2024/v21i12936

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128726

Original Research Article

Received: 08/12/2024
Accepted: 19/12/2024
Published: 24/12/2024

ABSTRACT

Medan City faces significant waste management challenges, with increasing waste volumes and limited landfill capacity creating an urgent need for sustainable solutions. This study evaluates the potential of Refuse Derived Fuel (RDF) technology as an alternative waste management strategy. Using a qualitative descriptive approach and SWOT analysis, the research explores the strengths, weaknesses, opportunities, and threats associated with RDF implementation in Medan City. The findings highlight that RDF technology can reduce landfill waste by up to 86%, decrease carbon emissions, and create economic opportunities, such as new jobs and cost efficiencies in waste management. However, significant challenges remain, including high initial investment costs,

[++] Lecturer;
**Corresponding author: Email: taufikaffandi18@gmail.com;*

Cite as: *Siregar, Taufik Affandi, Agus Purwoko, and Satia Negara Lubis. 2024. "Potential of Refuse Derived Fuel (RDF) in Medan City's Waste Management Strategy". South Asian Journal of Social Studies and Economics 21 (12):274-84. https://doi.org/10.9734/sajsse/2024/v21i12936.*

limited infrastructure, and low public awareness of waste segregation. Government support, private sector partnerships, and community participation are identified as critical factors for successful RDF implementation. Quantitative analysis of RDF production data from the Terjun Final Disposal Site (FDS) reveals that from October 2022 to December 2023, a cumulative 146,727 kg of RDF was produced, achieving daily waste reduction of over 1 ton. This aligns with global circular economy goals by transforming waste into energy while mitigating environmental degradation. This research provides a framework for cities seeking to adopt RDF technology, emphasizing the integration of environmental, economic, and social strategies. By leveraging strengths and opportunities, Medan City can position RDF as a model for sustainable waste management and energy transition.

Keywords: Final disposal site; medan; SWOT; refuse derived fuel; economy.

1. INTRODUCTION

Rapid population growth and increasing urbanization have significantly impacted waste volumes, particularly in urban areas (Santoso & Wahyuni, 2021; Sari et al., 2022). Medan City, as one of Indonesia's major urban centers, faces considerable challenges in managing approximately 2,000 tons of daily waste, of which only 13% is sorted and managed. The remainder ends up in the overburdened Terjun Final Disposal Site (FDS), exacerbating an already limited capacity (Environmental Agency of Medan City, 2023). This situation necessitates urgent and sustainable waste management solutions (Putri, 2019).

Poor waste management often leads to severe environmental problems, including soil, water, and air pollution, as well as greenhouse gas emissions such as methane, which has a global warming potential significantly higher than carbon dioxide (Hardiansyah & Ramadhani, 2021). These challenges disrupt regional sustainable development and diminish environmental carrying capacities (Widodo & Santosa, 2020). Ineffective waste handling can also strain municipal budgets and reduce public health standards, further emphasizing the need for technological intervention (Ayunanto, 2021).

To address these issues, innovative, technology-based solutions such as Refuse Derived Fuel (RDF) have gained attention. RDF technology allows for the conversion of waste into an alternative fuel source, aligning with global efforts to reduce reliance on fossil fuels while managing waste sustainably (Chaerul & Wardhani, 2020). By integrating circular economy principles, RDF has the potential to transform urban waste management systems and enhance regional sustainability (Mujayyin, 2020).

RDF technology is a strategic solution for waste management as it can reduce the volume of waste disposed of in landfills while adding value by producing renewable energy (Ardi, 2012). For instance, the implementation of RDF in Cilacap successfully reduced landfill waste by up to 86% while creating cost efficiencies in waste management processes (Nasyton, 2019). Similar outcomes have been observed in Shanghai, where RDF transformed industrial waste into an energy source, addressing environmental challenges and supporting urban sustainability (Li et al., 2024).

RDF is produced through mechanical and biological waste processing, resulting in a fuel with a high calorific value of approximately 15–23 MJ/kg (Nurhaliza, 2021). This makes it a potential alternative to coal in energy-intensive industries such as cement production and power generation (Bimantara, 2012). These attributes underscore the versatility of RDF in addressing both energy and waste management needs (Tun et al., 2020; Ghasemi Ghodrat et al., 2018; Zhang et al., 2021; Kansal, 2002; Mosler et al., 2006).

In addition to replacing up to 20% of coal in cement factories, RDF has proven effective in co-firing power plants, where it is used alongside coal to generate electricity (Mujayyin, 2020). This dual benefit of waste reduction and energy generation highlights RDF's role in achieving global climate targets by reducing greenhouse gas emissions, particularly methane and carbon dioxide (Bimantara, 2012; Santos et al., 2023).

The adoption of RDF technology in Indonesia is supported by Presidential Regulation No. 35 of 2018, which promotes the development of energy-based waste management infrastructure (Chaerul & Wardhani, 2020). This regulation encourages investments in RDF facilities to address waste management crises in cities like

Medan, where the Terjun FDS is nearing its capacity (Environmental Agency of Medan City, 2023). Strong policy support is crucial for accelerating RDF implementation (Ayunanto, 2021).

Despite its benefits, the implementation of RDF in Medan City faces several challenges, including high initial investment costs, infrastructure limitations, and community resistance, often due to the "Not In My Backyard" (NIMBY) phenomenon (Chaerul & Wardhani, 2020). Effective public awareness campaigns and government incentives are needed to overcome these barriers and ensure project success (Li et al., 2024; Koul et al., 2022; Fudala-Ksiazek et al., 2016, Petts, 1995).

The successful development of RDF facilities requires collaboration among government agencies, private sector investors, and local communities (Widodo & Santosa, 2020). Public-private partnerships can provide the financial and technical resources needed for RDF projects, while community engagement ensures long-term sustainability (Tun et al., 2020). Strengthening these partnerships is essential for achieving a circular economy (Atstaja et al., 2024).

Based on these issues, this study aims to analyze the potential for developing RDF technology as a waste management solution in Medan City. The research explores the opportunities and challenges faced in RDF implementation, including an analysis of economic, social, and technical factors (Mujayyin, 2020; Chaerul & Wardhani, 2020). By presenting strategic solutions, this study seeks to enable more effective and environmentally friendly waste management while supporting a circular economy framework.

2. METHODS

This study was conducted at the Terjun Final Disposal Site (FDS) in Terjun Village, Medan Marelan District, Medan City, covering an area of approximately ±16 hectares. The research was carried out from August to November 2024 using a qualitative descriptive approach to provide a clear and structured analysis of the research results. This approach facilitates a comprehensive understanding of the findings by utilizing narratives, tables, graphs, and simple diagrams. The data analysis focuses on real conditions observed at the site, using empirical methods to address the research objectives.

The study utilizes both primary and secondary data. Primary data were collected directly from the field through observations, interviews, and documentation. This includes information on the conditions of the Terjun FDS, waste processing procedures, and the potential for RDF (Refuse Derived Fuel) technology implementation. Secondary data were gathered from pre-existing sources, such as journals, books, research reports, and official documents from government agencies, particularly the Environmental Agency of Medan City. These secondary sources support and supplement the primary data collected.

Data collection techniques employed include observation, interviews, document analysis, and literature review. Observations involve monitoring waste management processes at the Terjun FDS, including waste reception, sorting, and processing with RDF technology. Interviews are conducted with key informants, such as officials from the Environmental Agency of Medan City, FDS operators, waste management experts, and local community members. Document analysis includes the review of official reports, previous research, and policies related to waste management in Medan City. The literature review involves examining books, journals, and scientific sources relevant to waste management and RDF technology.

The informants in this study are selected based on their relevance to the research topic. They include representatives from the Environmental Agency of Medan City, the Regional Development Planning Board (Bappeda) of Medan City, environmental and waste management experts, technical specialists in RDF technology, private sector stakeholders, NGOs, and community members living near the Terjun FDS. A purposive sampling method was applied to select informants with specific knowledge of RDF development and its application in Medan City. This selection provides a comprehensive perspective on RDF development, ensuring a holistic approach to the research.

Data analysis is conducted using a qualitative descriptive method. Information collected from observations, interviews, and document reviews is processed and presented in the form of narratives, tables, and graphs. The SWOT analysis in this study was constructed using a systematic approach to ensure data consistency and reliability. Inputs for the SWOT matrix were gathered from key stakeholders, including

government officials, waste management experts, and community representatives. Factor weights were assigned based on their relative importance and impact, as determined through stakeholder consensus during structured interviews and workshops. Each factor was rated on a standardized scale, reflecting its contribution to RDF development in Medan City. To validate the scoring process, comparative case studies from regions like Cilacap and Bali were used as benchmarks, providing empirical evidence to reinforce the analysis. This methodological rigor ensures that the SWOT matrix accurately represents the internal and external conditions influencing RDF implementation.

The analysis of Refuse Derived Fuel (RDF) in this study considers its calorific value, a critical factor in evaluating its energy potential. RDF's calorific value, ranging from 15 to 23 MJ/kg, positions it as a viable alternative to fossil fuels in industrial applications. This range is supported by findings from Mujayyin (2020), who demonstrated that RDF could effectively replace coal in cement factories and co-firing power plants, contributing to reduced dependence on non-renewable energy sources. Similarly, Nurhaliza (2021) highlighted RDF's energy efficiency in power generation, further substantiating its utility as a renewable energy source. These references validate the empirical basis for incorporating RDF as a sustainable waste-to-energy solution in Medan City.

3. RESULTS AND DISCUSSION

The results of this study reveal that the Medan City Government has initiated the implementation of Refuse Derived Fuel (RDF) technology in collaboration with the Pangkalan Susu Steam Power Plant (PLTU). This initiative aims to reduce waste generation and achieve co-firing targets to decrease reliance on coal usage. The implementation of RDF in Medan City is still in its developmental phase, with waste processing and production of RDF fuel dependent on the technology and facilities provided by PLTU Pangkalan Susu.

Since October 2022, the Terjun Final Disposal Site (FDS) has produced Solid Recovered Fuel (BBJP) from waste. Production capacity increased gradually from 765 kg in October 2022 to 16,800 kg in December 2023, with a cumulative total of 146,727 kg sent to PLTU Pangkalan Susu. This increase in production was achieved through the operation of organic waste shredders, initially producing an average of 2 tons per month with 4 workers, and later stabilizing at 16 tons per month with 12 workers. The production of BBJP significantly contributes to waste reduction, with daily waste reduction surpassing 1 ton per day.

Although the production of BBJP at the Terjun FDS is still far from the co-firing target of 120 tons per day, RDF implementation has made a tangible impact on waste management. The

Table 1. BBJP production results at Terjun FDS

No	Month		Production Quantity (Kg)	Total Production (Kg) Sent to PLTU
1	October	2022	765	765
2	November		1,703	2,468
3	December		2,621	5,089
4	January	2023	3,749	8,838
5	February		3,627	12,465
6	March		2,240	14,705
7	April		1,465	16,170
8	May		16,207	32,377
9	June		16,240	48,617
10	July		16,080	64,697
11	August		16,030	80,727
12	September		16,200	96,927
13	October		16,200	113,127
14	November		16,800	129,927
15	December		16,800	146,727

Source: Environtmental Office, 2023

Image 1. Terjun Final Disposal Site

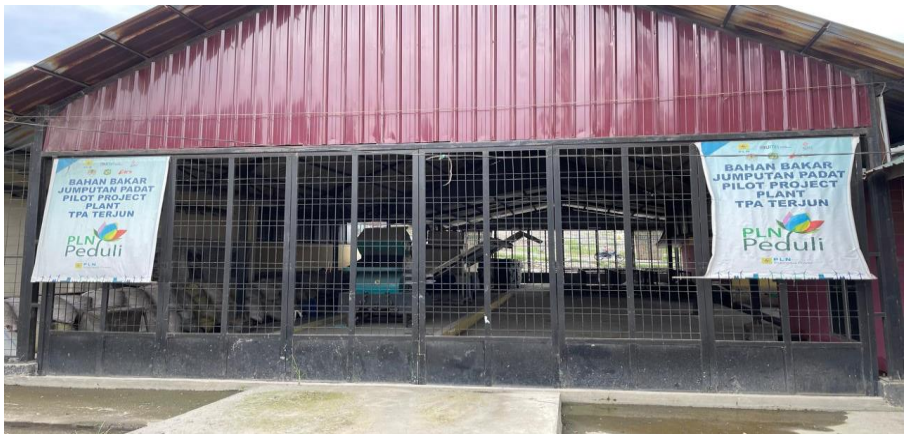

Image 2. BBJP Production Equipment at Terjun FDS

Medan City Government has assumed full control of the BBJP production equipment, which was previously managed by PLTU Pangkalan Susu. As the Terjun FDS nears its capacity limit, the city government has been compelled to find more effective waste management solutions. RDF is considered a strategic and viable alternative in this context.

However, the implementation of RDF technology in Medan City faces several challenges, including limited infrastructure, incomplete regulatory frameworks, and low public awareness regarding waste segregation. Moreover, Medan City has yet to establish specific regulations governing RDF handling and implementation. Nevertheless, existing waste management policies, such as Medan Mayor Regulation No. 26 of 2019, provide a basis for supporting RDF development.

From the perspective of spatial planning theory, RDF implementation in Medan City aligns with the theory of strategic facility placement. Placing RDF facilities near waste sources and industrial users, such as cement factories, enhances logistical efficiency. Sustainable development theory also supports RDF as a solution that integrates economic, social, and environmental aspects. RDF transforms waste into a valuable resource, reflecting the principles of a circular economy.

Experience from other regions shows that RDF can be an effective waste management solution. In Cilacap, Central Java, RDF has been used to replace coal in cement factories, reducing landfill waste by 30% and producing high-quality fuel. In Surabaya, RDF has helped reduce household waste while creating employment opportunities

through community participation. These experiences offer valuable insights for Medan City, which can strengthen its RDF infrastructure, enhance public awareness, and foster partnerships with the private sector.

The adoption of RDF technology in Medan City presents significant potential for supporting waste management and regional development. From an environmental perspective, RDF reduces the volume of waste sent to landfills, thereby extending landfill lifespan and producing cleaner fuel alternatives compared to fossil fuels. From an economic perspective, RDF reduces overall waste management costs, generates economic value from waste, creates new jobs, and attracts renewable energy investors. From a social perspective, RDF increases public awareness of improved waste management practices and enhances the quality of life for communities near landfill sites.

The development of RDF in Medan City is influenced by internal and external factors. Internal factors include the availability of infrastructure and technology, local government policy support, human resource capacity, community participation, and budget availability. External factors include market demand for RDF, national policies on waste management and renewable energy, technological advances, partnerships with external stakeholders, and public awareness. While these factors provide significant opportunities for RDF development, several threats, such as regulatory uncertainty, public resistance, and high infrastructure investment risks, must be addressed.

4. ANALYSIS OF RDF DEVELOPMENT STRATEGIES IN MEDAN CITY

The development of Refuse Derived Fuel (RDF) strategies in Medan City is guided by a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This approach aims to evaluate internal and external conditions, identify potential and challenges, and formulate strategic actions required for RDF development.

1. **Strengths**
- **Waste Volume Reduction**: RDF significantly reduces the amount of waste sent to landfills, extending the landfill's lifespan and decreasing waste management burdens.
- **Energy Production**: RDF converts waste into alternative fuel, which can be utilized in power plants and cement factories, reducing reliance on fossil fuels.
- **Carbon Emissions Reduction**: The use of RDF as an alternative fuel reduces greenhouse gas emissions compared to direct burning or unmanaged waste disposal.
- **Job Creation Potential**: RDF technology creates new employment opportunities in waste management and renewable energy production.
- **Cost Efficiency**: By converting waste into RDF, waste management costs are reduced, while generating new economic value.

2. **Weaknesses**
- **High Initial Investment**: RDF technology requires significant upfront investment to establish processing infrastructure.
- **Waste Quality Variability**: Not all waste types can be processed into RDF, making sorting and processing more challenging.
- **Limited Infrastructure**: Modern waste processing infrastructure is essential to ensure efficient RDF production.
- **Low Public Awareness**: Insufficient understanding of RDF and waste segregation among the public hinders effective waste management.
- **Dependency on Expertise**: RDF technology requires skilled personnel for its management and operation.

3. **Opportunities**
- **Government Policy Support**: National policies promoting renewable energy and waste-to-energy initiatives support RDF development.
- **Public-Private Partnerships**: Collaborations with private companies offer new investment and operational opportunities.

4. **Threats**
- **Regulatory Uncertainty**: Inconsistent regulations on RDF management hinder implementation.
- **Public Resistance**: Public opposition to RDF facilities may arise due to perceived environmental risks.

The SWOT matrix demonstrates the potential for optimizing RDF development in Medan City through partnerships, education, and investment in sustainable infrastructure.

5. INTERNAL AND EXTERNAL STRATEGY FACTOR MATRIX (IFAS AND EFAS)

5.1 Internal Factors

The development of RDF technology in Medan City is heavily influenced by internal factors that include both strengths and weaknesses within the existing waste management system. Among the strengths are the city's substantial waste generation, which provides a steady supply of raw material for RDF production, and the potential for economic and environmental benefits, such as cost efficiency and greenhouse gas emission reductions. However, significant weaknesses are also present, such as the high initial investment required for RDF technology, variability in waste quality, and the lack of modern waste management infrastructure. Addressing these internal challenges is essential to unlocking the full potential of RDF development.

5.2 External Factors

External factors also play a crucial role in shaping the development of RDF technology in Medan City. Opportunities such as strong government support for renewable energy initiatives, the potential for private-sector partnerships, and growing public awareness of environmental issues present a favorable environment for RDF adoption. Conversely, external threats include regulatory instability, community resistance to RDF facilities, and competition from alternative waste management technologies. Recognizing and navigating these external influences is critical to achieving sustainable RDF implementation.

Table 2. Strengths

No	Strength	Weight	Rating	Score
1	Reduction in landfill waste volume	0.30	3.75	1.13
2	Energy production from waste (alternative fuel)	0.20	3.75	0.75
3	Contribution to carbon emission reduction	0.15	3.625	0.54
4	Potential for job creation	0.20	3.75	0.75
5	Cost efficiency in waste management	0.15	3.5	0.53
Total Strength	1		3.7	

Table 3. Weaknesses

No	Weakness	Weight	Rating	Score
1	High initial investment cost	0.25	3.125	0.78
2	Variability in waste quality	0.25	3.125	0.78
3	Insufficient modern waste management infrastructure	0.20	3.25	0.65
4	Low public awareness of RDF technology	0.15	3.375	0.50
5	Dependence on technology and skilled labor	0.15	3.375	0.50
Total Weakness	1		3.21	

Table 4. Opportunities

No	Opportunity	Weight	Rating	Score
1	Government support for renewable energy and waste management	0.20	3.5	0.70
2	Potential partnerships with the private sector and industry	0.25	3.625	0.90
3	Opportunities for international funding for green projects	0.20	3.5	0.70
4	Increasing public awareness of environmental issues	0.15	3.625	0.54
5	Reduction in energy costs through RDF usage as an alternative fuel	0.20	3.5	0.70
Total Opportunities	1		3.54	

Table 5. Threats

No	Threat	Weight	Rating	Score
1	Regulatory instability in RDF management	0.20	3.5	0.70
2	Community opposition to RDF facilities	0.10	2.25	0.23
3	Competition with alternative waste management technologies (incinerators, landfill gas)	0.15	2.75	0.41
4	Fluctuations in fossil fuel prices	0.25	3.125	0.78
5	High initial investment risk for RDF infrastructure	0.30	3.5	1.05
Total Threats	1		3.17	

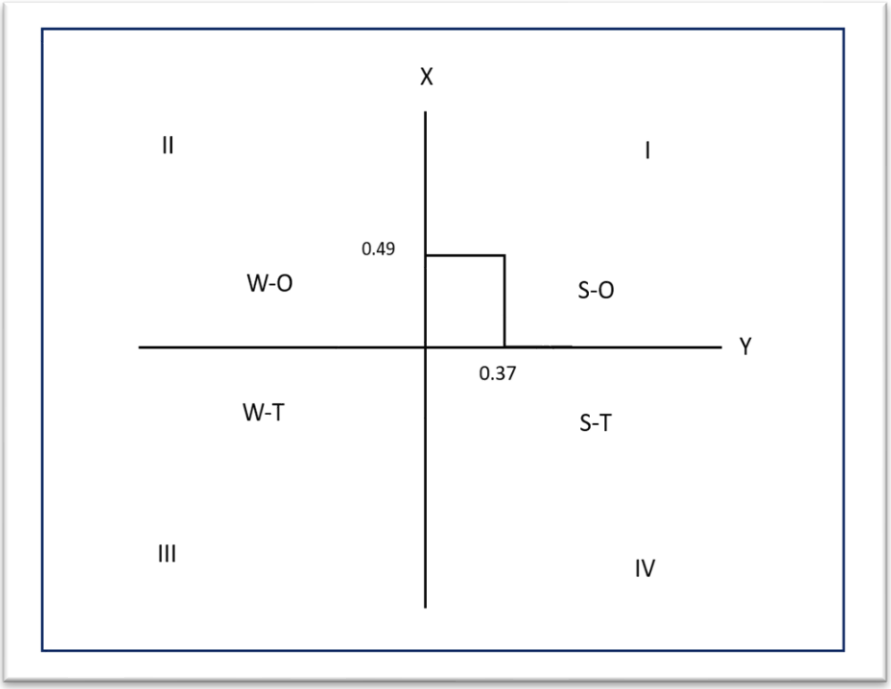

Image 3. SWOT analysis quadrant for RDF development in Medan City

The SWOT matrix indicates that RDF development in Medan City can be optimized by leveraging its strengths and opportunities, such as the availability of waste raw materials, support from the industrial sector, and advances in waste processing technology. By capitalizing on these potentials, the Medan City Government can address its weaknesses, such as inadequate infrastructure and low public awareness. One strategic approach is to foster partnerships with the private sector and strengthen public education programs to increase community participation in waste separation initiatives.

The strategies derived from this SWOT matrix aim to mitigate external threats, such as competition from fossil fuels and regulatory uncertainties. This can be achieved by enhancing the quality standards of RDF and offering incentives to industries adopting RDF as an alternative fuel. These efforts not only support the resolution of waste management issues in Medan City but also promote the transition towards more sustainable energy management.

5.3 Development of Refuse Derived Fuel (RDF) Technology in Medan City

The development of RDF technology in Medan City is a strategic initiative that addresses waste management challenges while simultaneously providing an alternative energy source. RDF is a fuel produced from processed municipal solid waste that meets industry-specific energy requirements. This approach offers dual benefits: reducing waste in landfills and decreasing reliance on fossil fuels.

Based on the research findings, several RDF development strategies in Medan City have been formulated. The SO (Strength-Opportunities) Strategy seeks to utilize the abundant supply of waste raw materials to attract local industries to use RDF as an alternative fuel. The WO (Weakness-Opportunities) Strategy emphasizes overcoming infrastructure deficiencies by leveraging opportunities from national policies and fostering public-private partnerships. The ST (Strength-Threats) Strategy aims to reduce pressure on the Terjun landfill by constructing eco-friendly waste processing facilities, thereby addressing community resistance. Finally, the WT (Weakness-Threats) Strategy underscores the importance of increasing public awareness through education and waste separation campaigns to minimize community opposition to RDF facilities.

The analysis of Refuse Derived Fuel (RDF) in this study considers its calorific value, a critical factor in evaluating its energy potential. RDF's calorific value, ranging from 15 to 23 MJ/kg, positions it as a viable alternative to fossil fuels in industrial applications. This range is supported by findings from Mujayyin (2020), who demonstrated that RDF could effectively replace coal in cement factories and co-firing power plants, contributing to reduced dependence on non-renewable energy sources. Similarly, Nurhaliza (2021) highlighted RDF's energy efficiency in power generation, further substantiating its utility as a renewable energy source. These references validate the empirical basis for incorporating RDF as a sustainable waste-to-energy solution in Medan City.

These strategies align with the principles of sustainable development, which stress the importance of collaboration between the government, community, and private sector. Previous research by Nasyton (2019) in Cilacap highlighted the significance of synergy between the government and private sector in the successful implementation of RDF as a waste management solution. This collaboration can ensure the sustainability of RDF-based waste management systems and strengthen Medan City's position as a pioneer in renewable energy-based waste management.

6. CONCLUSION AND RECOMMENDA-TION

The implementation of Refuse Derived Fuel (RDF) technology in Medan City remains suboptimal. This is primarily due to the limited capacity of RDF machinery, which is still unable to meet market demand, thereby reducing its impact on waste management. However, RDF holds significant potential as an alternative waste management approach, a renewable energy source, and an economic opportunity. This potential aligns with the principles of a circular economy, which aims to transform waste into valuable economic resources.

The adoption of RDF in Medan City is influenced by both internal and external factors. Internal factors include the readiness of infrastructure, the quality of human resources, and the availability of technology. External factors encompass government policy support, regulatory frameworks, partnerships with the private sector, and public awareness of waste segregation. Collaboration between the government and private sector is a key element for accelerating RDF implementation in Medan City. The SWOT analysis reveals that RDF development is positioned in Quadrant I, indicating that the development strategy should focus on leveraging internal strengths to seize external opportunities.

To optimize RDF management in Medan City, it is recommended that the government continues to develop RDF technology by maximizing its strengths and opportunities. Supportive policies from the local government are crucial to strengthening RDF development. These include the establishment of clear regulations, enhancement of legal frameworks, and provision of incentives to the private sector for adopting RDF. Additionally, the Medan City Government should build modern RDF processing facilities, strengthen the capacity of human resources, and increase public awareness through educational campaigns and waste segregation initiatives.

As a strategic measure, it is suggested that the Medan City Government capitalize on the abundant availability of waste and strengthen partnerships with local industries. Collaborations with RDF-consuming industries, such as cement factories and power plants, should be intensified to create a stable RDF market. With the right strategy, RDF-based waste management in Medan City could become a national model for renewable energy-based waste management. This initiative would create an efficient, environmentally friendly, and sustainable waste management system.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Ardi, B. C. (2012). Analysis of refuse derived fuel (RDF) potential from waste processing units (UPS) in Depok City (Case study of UPS Grogol, UPS Permata Regency, UPS Cilangkap).

Atstaja, D., Mavlutova, I., Gusta, S., & Hermanis, J. (2024). Management of household-generated construction and demolition waste: Circularity principles and the attitude of Latvian residents. *Energies, 17*(1), Article 205. https://doi.org/10.3390/en17010205

Ayunanto, T. (2021). Status of RDF technology implementation for waste management in Cilacap Regency. Cilacap: Environmental Agency of Cilacap.

Bimantara, T. (2012). Refuse derived fuel: An alternative energy source. *Energy Journal, 4*(2), 101-110.

Chaerul, M., & Wardhani, A. K. (2020). Refuse derived fuel (RDF) from urban waste through the biodrying process.

Environmental Agency of Medan City. (2023). Waste management report of Medan City. Medan: Environmental Agency of Medan City.

Fudala-Ksiazek, S., Pierpaoli, M., Kulbat, E., & Luczkiewicz, A. (2016). A modern solid waste management strategy–the generation of new by-products. *Waste Management, 49*, 516-529.

Ghasemi Ghodrat, A., Tabatabaei, M., Aghbashlo, M., & Mussatto, S. I. (2018). Waste management strategies: The state of the art. In *Biogas: Fundamentals, Process, and Operation* (pp. 1-33).

Hardiansyah, R., & Ramadhani, F. (2021). Impact of greenhouse gas emissions from landfills: A case study of waste management in Medan City.

Kansal, A. (2002). Solid waste management strategies for India. *Indian Journal of Environmental Protection, 22*(4), 444-448.

Koul, B., Yakoob, M., & Shah, M. P. (2022). Agricultural waste management strategies for environmental sustainability. *Environmental Research, 206*, 112285.

Li, T., Lou, Z., & Wang, L. (2024). Comprehensive analysis of industrial solid-waste-to-energy by refuse-derived fuel technology: A case study in Shanghai. *Sustainability, 16*(10), 4234.

Mosler, H. J., Drescher, S., Zurbrügg, C., Rodríguez, T. C., & Miranda, O. G. (2006). Formulating waste management strategies based on waste management practices of households in Santiago de Cuba, Cuba. *Habitat International, 30*(4), 849-862.

Mujayyin, F. (2020). Reliability analysis of waste processing technology at landfills to produce refuse derived fuel (RDF) using the Six Sigma DMAIC approach.

Nasyton, K. (2019). Waste management model based on refuse derived fuel (RDF) through an economic valuation approach at the Tritih Lor landfill, Jeruklegi District, Cilacap Regency.

Nurhaliza, R. (2021). Feasibility study of recycling waste at the Tamangapa landfill into RDF (refuse derived fuel) material.

Petts, J. (1995). Waste management strategy development: A case study of community involvement and consensus-building in Hampshire. *Journal of Environmental Planning and Management, 38*(4), 519-536.

Putri, L. E. (2019). Manajemen Pengelolaan Persampahan Kecamatan Pulau Punjung, Kabupaten Dharmasraya. Padang: Sekolah Tinggi Teknologi Industri Padang.

Santos, S. M., Nobre, C., & Gonçalves, M. (2023). Brief overview of refuse-derived fuel production and energetic valorization. *Sustainability, 15*(13), 10342.

Santoso, T., & Wahyuni, S. (2021). Dynamics of urban waste generation: A case study of Medan City.

Sari, M. R., Wahyuni, T., & Setiawan, P. (2022). Urbanization and its impact on the increase of urban waste volume in Medan City.

Tun, M. M., Raclavská, H., Juchelková, D., Růžičková, J., Šafář, M., Štrbová, K., & Gikas, P. (2020). Spent coffee ground as renewable energy source: Evaluation of the drying processes. *Journal of*

Environmental Management, 275, 111204. https://doi.org/10.1016/j.jenvman.2020.111204

Widodo, W., & Santosa, J. (2020). Impact of waste management on the balance of urban environmental carrying capacity.

Zhang, J., Qin, Q., Li, G., & Tseng, C. H. (2021). Sustainable municipal waste management strategies through life cycle assessment method: A review. *Journal of Environmental Management, 287*, 112238.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/128726