Why It's Crucial for Indonesia to Fast-Track Refuse-Derived Fuel (RDF) Implementation

Fitri Wulandari

Summary

Indonesia faces escalating pressure on its landfills due to the rising volume of unmanaged waste. Moreover, there is a growing demand for energy and a necessity to reduce greenhouse gas emissions, as outlined in Indonesia's NDC, leading to a significant reduction in coal reliance. Refuse-derived fuel (RDF) offers an important technological answer to these pressing issues. This Op-Ed limited the scope of Indonesia's current situation of RDF implementation to the challenges faced by the country. Additionally, it highlights two key urgent needs of RDF implementation and proposes potential actions that Indonesia can take.

Keywords: Refuse-derived fuel, Coal-Fired Power Plants, cement industries, waste, biomass, emissions

Introduction

Indonesia generated more than 30 million tonnes of waste in 2022, marking a significant increase of 35.53% from the amount recorded in 2019 (Ministry of Environmental and Forestry Republic of Indonesia/MoEF, 2023). Through Presidential Regulations No. 97 of 2017, it is anticipated that this number will reach 70.8 million tonnes by the year 2025. Despite this concerning situation, only about 60% of the country's urban population has convenient access to waste collection services, and roughly half (55%) of urban solid waste undergoes processing at transfer stations or facilities (World Bank, 2019). In response to this pressing concern, Indonesia has set a target to manage about 70% of household and similar waste by 2025 as part of its commitment outlined in Presidential Regulation No.97 of 2017.

The Institute for Essential Services Reform (IESR), in 2024, projected that Indonesia's energy demand will increase by 22.76% from 2022 to 2030. This rise in energy demand is leading to a corresponding rise in emissions. Meanwhile, Indonesia's NDC aims to unconditionally reduce greenhouse gases by 31.89% and 43.20% conditionally by 2030 across various sectors, including energy, waste, IPPU, agriculture, forestry, and other land use.

With an expected rise in both waste generation and energy demand, it is crucial for Indonesia to fast-track the implementation of Refuse-Derived Fuel (RDF) as a sustainable approach to both waste management and renewable energy production.

Refuse-Derived Fuel (RDF) in Indonesia

RDF offers a solution for municipal waste management by serving as a high-calorific-value alternative fuel when processed from residual or mixed waste (International Pollutants Elimination Network/IPEN, 2022). In Indonesia, at present, only Coal-Fired Power Plants (CFPP) and cement kilns can be regarded as dependable consumers and are already regulated. The utilisation of RDF as the substitute for fossil fuel in CFPP is governed by SNI 8966:2021 as the standard of co-firing operations in CFPP. Meanwhile, the government has not yet standardised RDF specifications for industrial use (Perusahaan Listrik Negara/PLN, 2023). However, the use is currently limited to the cement industry, as outlined in the "Guidelines for RDF Technical Specifications as Alternative Fuel in the Cement Industry" by the Ministry of Industry (MoI).

Furthermore, The MoEF has established emission standard regulations specific to the utilisation of RDF in the cement industry through the Regulation of the Minister of Environment and Forestry No.19 year 2017 on Emission Standard of Cement Industry. These regulations ensure that the utilisation of RDF in the CFPP and cement industry meets environmental quality standards, minimising the impact on greenhouse gas emissions, and promotes sustainable waste management practices in Indonesia.

There was no need to construct the new power plants through the co-firing process in the existing CFPP to utilise RDF in Indonesia. Co-firing is a technique to replace coal in CFPP with various combinations of alternative fuels (Soleh et al., 2019). To achieve the goal of reaching a 23% share of new and renewable energy sources by 2025, Indonesia's State Electricity Company, PT PLN, has created a strategic plan that includes initiatives to improve energy efficiency in self-consumption and co-firing as detailed in The National Electricity Plan 2019-2038 (Rencana Umum Ketenagalistrikan Nasional/RUKN 2019-2038) (Ministry of Energy and Mineral Resources Republic Indonesia/MEMR, 2020). Of 30 CFPP facilities that underwent co-firing trials from 2020 to 2021, only three CFPP facilities carried out experiments using RDF derived from household waste. CFPP Jeranjang NTB, CFPP Lontar Banten, and CFPP Ropa-Ende in East Nusa Tenggara (Nusa Tenggara Timur/NTT) are the specific facilities. The remaining CFPP facilities utilised biomass waste in their co-firing tests. For instance, the RDF used at CFPP Jeranjang was sourced from agricultural waste and trees left over after deforestation (Bappenas & GIZ, 2023), while the co-firing trial at CFPP Lontar involved RDF obtained from the Landfill (Tempat Pembuangan Akhir/TPA) located in Rawa Kucing (Tangerang Government, 2021).

Currently, not all cement plants in Indonesia use RDF, but some, like PT. SBI is able to transport RDF in fluff with a calorific value between 3,000 to 4,000 kcal/kg from the TPST Cilacap at a daily rate of 70 to 80 tonnes per day (Bappenas & GIZ, 2023). PT SBI also received 75 tonnes/day, while PT Indocement has received up to 625 tonnes/day (TPST Bantargebang 2024). The RDF produced by Bantargebang has a calorific value of 3,403 kcal/kg (Bappenas & GIZ, 2023). MEMR (2024) projected that 34 possible cement kilns across Indonesia could potentially serve as off-takers for RDF. Furthermore, Bappenas & GIZ (2023) have estimated that up to 3,424 tonnes of RDF per day can be utilised at cement kilns in Indonesia. This indicates substantial opportunities for using refuse-derived fuel in Indonesia's cement kiln plants.

The Urgent Need for Accelerating RDF Implementation in Indonesia

1. Minimising the Need for Landfill Space

Indonesia faces a waste emergency, as several landfills have reached their maximum capacity. Waste4Change (2022) has forecasted that 11 landfills in Indonesia will cease their operations before 2025 due to overcapacity issues. To address this problem, 8 out of 11 landfills have chosen to open new landfill sites. It shows that the increase in generated waste highlights the urgent need for additional landfill space as the growing volume of generated waste increases exponentially over time. Moreover, finding suitable landfill space has become increasingly challenging due to diminishing available land, often leading to conflicts with local communities over land use. As the demand for landfill space continues to rise at an alarming rate, it becomes imperative to explore alternative waste management methods to ease the pressure on existing landfill sites.

Three out of 11 landfills predicted for closure have committed to improving waste management, revitalising operations, and engaging the community in waste sorting efforts. As a result, TPST Bantargebang, previously predicted to close in 2021 (Waste4Change, 2022), continues to operate due to its optimisation of waste management methods, as efforts from DKI Jakarta Government, such as Waste-to-Energy Power Plant, composting facilities and RDF implementation. The RDF produced through the landfill mining and fresh waste process at Bantargebang will be used by two nearby cement factories, PT SBI Narogong Plant and PT Indocement Citeureup Plant. A co-process trial was conducted by PT Indocement involving around 600 tonnes of RDF. Additionally, the delivery of RDF products totalling 1,000 tonnes per month to PT SBI. The total amount of RDF sent to PT SBI has reached 4,580 tonnes (Bappenas & GIZ, 2023). In conclusion, it is evident that the implementation of RDF at TPST Bantargebang has proven to be a successful strategy in managing the increasing volume of waste and alleviating the pressure on existing landfill space in Indonesia. In moving forward, it is crucial for Indonesia to accelerate the implementation of RDF in other regions and landfills to address the challenge of landfill overcapacity.

2. Supporting Decarbonisation in CFPP and Cement Industries

Implementing RDF in CFPP can significantly contribute to decarbonisation efforts and help Indonesia meet its renewable energy targets. Currently, the government is developing a pilot project for co-firing with biomass, including RDF. By implementing co-firing in existing CFPP, Indonesia has managed to cut down CO2 emissions by 450,000 tonnes in 2023 (PLN, 2024). This initiative supports Indonesia's goal of achieving net zero emissions (NZE) by 2060 and decreasing the use of coal in order to achieve a renewable energy mix of 23% by 2025.

Figure 1 illustrates the biomass co-firing realisation and target for CFPP. According to a release by PLN in 2023, Indonesia's goal was to utilise 2.20 million tonnes of biomass for co-firing at CFPP in the same year. However, the actual utilisation in 2023 amounted to only 1 million tonnes across 43 CFPPs (PLN, 2024). Even with a significant increase of 71% from the previous year, there remains a need for Indonesia to boost its usage of biomass by ten times in order to achieve the target of utilising 10.2 million tonnes by 2025.

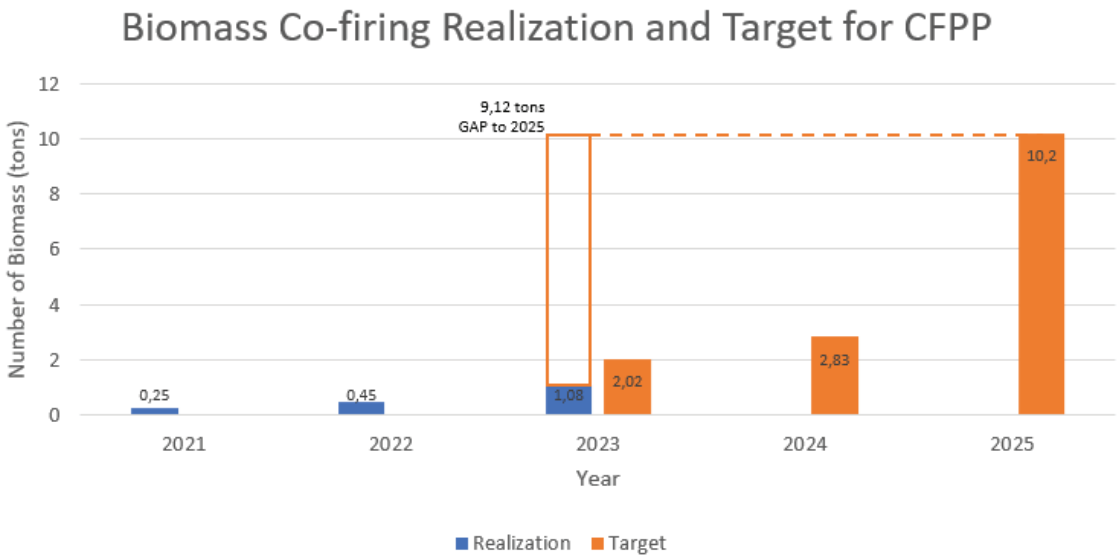

Figure 1. Biomass Co-firing Realisation and Target for CFPP
Source: Author, 2024 (adapted from PLN, 2023)

Reducing CO2 emissions through co-firing at existing CFPP is a positive step toward the target 23% renewable energy mix. However, there is a long way to go in increasing biomass utilisation, including RDF, for co-firing at CFPP.

The utilisation of RDF also presents a significant opportunity to reduce carbon emissions in the cement industry. Research from Nakajima and Matsuyuki (as cited in the MoI Republic of Indonesia, 2017) outlines that RDF with a moisture content below 15% has the potential to decrease emissions by up to 0.4 million tonnes of CO_2 per ton of coal used. In 2022, alternative fuels in cement kilns reached a 7.8% Thermal Substitution Rate (TSR). However, due to supply limitations, RDF could only meet 1% of the coal heat demand in cement industries (Bappenas & GIZ, 2023). According to The Ministry of Energy and Mineral Resources, with a TSR of about 5% RDF consumption, the cement industries could potentially rise to 3,425 tonnes per day. Assuming a 5% TSR for RDF, the estimated annual demand for RDF would be about 938,182 tonnes or 3,127 tonnes per day. This is expected to rise as several cement plants in Indonesia target a TSR of over 10% by 2030. However, the three existing RDF plants that supply the cement industry have varying production levels, as shown in **Table 1**, estimated at around 823 tonnes per day or approximately 300,395 tonnes annually. To meet the RDF demand target by 2030, Indonesia needs to increase its production by more than 67.98% from current levels.It shows that there is significant untapped potential for RDF utilisation in the cement industry. Hence, cement industries need to enhance the utilisation of RDF as an alternative fuel, aiming to reduce coal consumption and lower emissions to align with decarbonisation objectives.

Table 1. RDF Production for Cement Industries

Project RDF	Offtaker	Capacity (tonnes/day)
Cilacap	SBI	65
Bantargebang, DKI Jakarta	SI	700
Banyumas	SBI	58
Total		**823**

Source: Cilacap Regency Government (2024), TPST Bantargebang (2024), Banyumas Regency Environmental Agency (2024)

Challenges and Actions for Indonesia

As previously stated, RDF Implementation has two main urgent needs in Indonesia: reducing the demand for landfill space and aiding in decarbonisation within CFPP and cement industries. The government's commitment to enhancing biomass utilisation and engaging in co-firing pilot projects within CFPP, as well as co-processing initiatives within cement industries, makes RDF a significant opportunity. **Table 2** exhibits the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of implementing RDF in Indonesia.

Table 2. SWOT Analysis of RDF Implementation in Indonesia

Strengths	• Minimising the need for landfill space • Decarbonisation in CFPP and Cement Industries
Weaknesses	• Low RDF quality resulting from a mixed household waste • High investment cost
Opportunities	• The government's commitment to enhancing biomass utilisation • Co-pilot project of biomass co-firing in CFPP and cement industries potential off-taker
Threats	• There are no specific RDF standards for the industry use yet • Need to ensure the net emission is negative to address the perception of greenwashing

Source: Author's analysis, 2024

Considerable challenges remain in the implementation of RDF, such as low RDF quality resulting from a mix of household waste, as well as substantial investment costs for establishing pre-processing, collection, and RDF transportation facilities (Bappenas & GIZ, 2023). Furthermore, there are no RDF standards for specific industrial use (PLN, 2023). In addition to these obstacles, industries sometimes perceive the use of RDF as greenwashing. However, as mentioned before, research by Nakajima and Matsuyuki (cited in the MoI Republic of Indonesia, 2017) has indicated that utilising RDF can reduce up to 0.4 million tonnes of CO_2 per tonne of coal used if we ensure high-quality RDF.

Successfully implementing RDF requires actively promoting waste sorting within the community to improve RDF quality from the source. Moreover, long-term benefits are feasible by investing in infrastructure and technology to reduce coal usage and contribute to decarbonisation efforts. Establishing standards for RDF and advocating for effective waste management policies will provide clear industry guidelines. Furthermore, collaborating with governments and cement industries will help ensure market demand and regulatory support for RDF, enabling Indonesia to accelerate its implementation of RDF while striving to minimise coal usage towards achieving net zero emissions.

Conclusion

In conclusion, fast-tracking the implementation of Refuse-Derived Fuel in Indonesia is crucial for addressing the urgent need to minimise landfill space and support decarbonisation in both CFPP and cement industries, despite the challenges of low RDF quality, high investment costs, the limitation of specific RDF standards for industry use, and greenwashing perception. Actionable steps can be taken to overcome these obstacles. By promoting waste sorting, investing in infrastructure and technology, establishing RDF standards, and collaborating with governments and industries, Indonesia has the potential to speed up the adoption of RDF and transition toward a waste management system and minimising coal consumption.

Resilience Development Initiative

Disclaimer

The views expressed in this op-ed are those of the author or authors of this article. They do not necessarily represent the views of RDI, its editorial committee, or the mentioned speakers' affiliation.

Author
Fitri Wulandari
Hasanuddin University

Supervisor
Baihaqi Muhammad
REER Research Officer
Resilience Development Initiative

References

Badan Standardisasi Nasional. (2021). SNI 8966. Retrieved April 26, 2024, from https://akses-sni.bsn.go.id/viewsni/baca/8693

Banyumas Regency Environmental Agency. (2024). RDF Skala Mikro dan Kecil di KSM Kedungrandu dan TPA BLE Banyumas.

Banyumas Regency Government Bappenas & GIZ. (2023). Analisis Potensi Off-taker Refuse Derived Fuel (RDF) untuk Mendukung Pengembangan Pengolahan Sampah Ramah Iklim yang Terintegrasi. https://lcdi-indonesia.id/wp-content/uploads/2024/01/Kajian-Analisis-Offtaker-RDF-BAPPENAS-GIZ.pdf

Cilacap Regency Government. (2024). Manajemen dan Operasionalisasi TPST RDF Cilacap. Capacity Building "Penilaian Teknoekonomi Implementasi RDF di Indonesia"RDI

Institute for Essential Services Reform. (2024). Indonesia Energy Transition Outlook. https://iesr.or.id/download/indonesia-energy-transition-outlook-ieto-2024

IPEN. (2022). Refuse-Derived Fuel in Indonesia. https://ipen.org/sites/default/files/documents/ipen-rdf-pef-indonesia-v1_5aw-en.pdf

Ministry of Environmental and Forestry,

Republic of Indonesia. (2017). Permen LHK No.19. Retrieved April 26, 2024, from https://ditppu.menlhk.go.id/portal/uploads/laporan/1593658448_Peraturan%20Menteri%20Nomor%20P%2019%20Tentang%20Baku%20Mutu%20Emisi%20Bagi%20Usaha%20dan%20atau%20Kegiatan%20Industri%20Semen.PDF

Waste4Change. (2022). TPA Penuh di Indonesia: Kabar Terkini. Retrieved May 13, 2024, from https://waste4change.com/blog/kondisi-tpa-penuh-indonesia/

Ministry of Environmental and Forestry, Republic of Indonesia. (2023). SIPSN. SIPSN - Sistem Informasi Pengelolaan Sampah Nasional. Retrieved April 23, 2024, from https://sipsn.menlhk.go.id/sipsn/public/data/timbulan

Ministry of Energy and Mineral Resources, Republic of Indonesia. (2020). Dukung Target Bauran EBT, PLN Lakukan Uji Coba Metode Co-Firing PLTU. Retrieved April 26, 2024, from https://ebtke.esdm.go.id/post/2020/02/25/2484/dukung.target.bauran.ebt.pln.lakukan.uji.coba.metode.co-firing.pltu

Ministry of Industry. (2017). Pedoman Spesifikasi Teknis RDF Sebagai Alternatif Bahan Bakar di Industri Semen.

PLN. (2022). Bioshare Series #9 : Kelola Sampah Menjadi Energi Berkelanjutan. Retrieved May 18, 2024, from https://www.youtube.com/watch?v=aNF9tqsBAa0&t=1659s

PLN. (2023, Juli). Bioshare Series #11 - Penyediaan Biomassa yang Berkelanjutan untuk Pengembangan Pembangkit Listrik. In Rencana dan Kriteria Pengembangan Biomassa untuk Pembangkit Listrik. Retrieved May 18, 2024, from https://www.youtube.com/watch?v=Jiyyt58XOoE

PLN. (2024, January). Sepanjang 2023, Terobosan Teknologi Co-Firing PLN Mampu Tekan 1,05 Juta Ton CO2 Emisi Karbon. Retrieved May 18, 2024, from https://web.pln.co.id/cms/media/siaran-pers/2024/01/sepanjang-2023-terobosan-teknologi-co-firing-pln-mampu-tekan-105-juta-ton-co2-emisi-karbon/

Republic of Indonesia. (2017). Presidential Regulation No.97 of 2017. Retrieved April 23, 2024, from https://peraturan.bpk.go.id/Details/73225/perpres-no-97-tahun-2017

Republic of Indonesia. (2022). Enhanced Nationally Determined Contribution of Republic Indonesia. UNFCCC. https://unfccc.int/sites/default/files/NDC/2022-09/ENDC%20Indonesia.pdf

Soleh, M., Hidayat, Y., & Abidin, Z. (2019). Co-firing RDF in CFB Boiler Power Plant. 2019 International Conference on Technologies and Policies in Electric Power & Energy. https://doi.org/10.1109/IEEECONF48524.2019.9102591

Tangerang Government. (2021). PLN Sambangi TPA Rawa Kucing Arief: sudah 800 kg RDF dikirim ke PLTU Lontar Banten 3. Retrieved May 14, 2024, from https://tangerangkota.go.id/berita/detail/26589/files/PENGUMUMAN%20TENTANG%20KEWAJIBAN%20PENYERAHAN%20PRASARANA%2C%20SARANA%20DAN%20UTILITAS%20PERUMAHAN.docx

The World Bank. (2019). Improvement of Solid Waste Management to Support Regional and Metropolitan Cities. The World Bank. https://documents1.worldbank.org/curated/en/608321575860426737/pdf/Indonesia-Improvement-of-Solid-Waste-Management-to-Support-Regional-and-Metropolitan-Cities-Project.pdf

TPST Bantargebang. (2024). RDF Plant Bantargebang. Dinas Lingkungan Hidup DKI Jakarta.