

# Strategic Implementation of Nationally Determined Contributions for Waste-to-Energy Utilization in Indonesia: A Regulatory Review

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## Abstract

Municipal solid waste (MSW) stands out as a significant contributor to greenhouse gas emissions, with Indonesia ranking among the world's largest contributors. The Nationally Determined Contribution (NDC) commits Indonesia to minimize MSW emissions through renewable energy development, a central aspect of addressing the climate change crisis. In response, Presidential Regulation Number 35 of 2018 was introduced to vitalize these efforts. However, despite these initiatives, the existing legal framework has not adequately addressed the issue. This research aims to address two pivotal questions: How does Indonesian law regulate the conversion of waste into energy? To what extent do current regulations encompass Waste-to-Energy power plants? Employing a normative legal analysis, this study critically examines national legal instruments related to renewable energy, utilizing a statutory approach. Our findings underscore that current regulations concerning renewable energy lack effectiveness in ensuring availability, resilience, and national energy independence in a sustainable manner. Our study contributes to the existing body of research by delving into aspects of Waste-to-Energy regulation in Indonesia, an area that has not been extensively explored in previous studies.

## Keywords:

energy security, renewable energy, waste to energy, energy policy, sustainable development goals

## 1. Introduction

Indonesia, heavily reliant on oil, gas, and coal, faces a looming threat to its energy security due to the finite nature and eventual depletion of these resources (Dwiesta, 2017; Yulianto & Susanto, n.d.). The simultaneous rise in energy consumption, aligned with population growth, exacerbates this challenge (Aswadi et al., 2023). A sole dependence on nonrenewable energy sources would result in pronounced societal inequalities (Ministry of Energy and Mineral Resources Republic of Indonesia, n.d.). Beyond the jeopardy to energy security, fossil energy stands as a major contributor to global warming, emitting harmful greenhouse gases (Cevik, 2022; International Energy Agency, 2019). In response to these challenges, Indonesia implemented Government Regulation No. 79 of 2014 on National Energy Policy (KEN), referencing the Energy Law No. 30 of 2007. Article 9 (f) (1) of the KEN sets a target for Indonesia to achieve a minimum of 23% of the total energy supply in 2025 from new and renewable energy sources. In 2020, the Indonesian Government confirmed its commitment to using clean energy by increasing renewable energy projects and investment (Cabinet Secretary of The Republic of Indonesia, 2020; Government of Indonesia, 2016). This commitment aligns with Indonesia's obligations under the Nationally Determined Contribution (NDC) (Wongkar, 2021), specifically addressing technical solutions to combat climate change (Moriarty & Honnery, 2023). Climate change poses risks

such as temperature increases, disruption of natural resources, socioeconomic impacts, and heightened health risks, transitioning to clean energy emerges as a vital commitment in promoting renewable energy projects (Mikhaylov et al., 2020).

In response to the escalating waste volume and the need for renewable energy, the Indonesian Government has committed to developing a strategy aimed at reducing waste in landfills. This strategy involves promoting the transition of the waste management sector towards energy production through a process of waste-to-energy (WtE) (Lombardi & Castaldi, 2024). By harnessing the potential of WtE, Indonesia aims to simultaneously address waste management challenges while generating renewable energy resources. This method reduces the need for land for waste disposal, presenting a more efficient energy recovery system, aligned with the principle of 'zero waste' that emphasizes the recycling and reuse of municipal solid waste (MSW) (Mikhaylov et al., 2020). Amidst various options for renewable energy, WtE emerges as a fitting solution. This not only aligns with the concept of 'energy security' but also resonates with SDGS 12, emphasizing waste reduction through the principles of reduction, recycling, and reuse. Furthermore, this concept intertwines with SDGS 7, ensuring universal access to affordable, reliable, sustainable, and modern energy for all. Therefore, proper processing of waste has the potential to transform it into a viable source of renewable energy (Khan et al., 2022).

Indonesia's current policy regarding MSW management is articulated in the Presidential Regulation Number 35 of 2018 concerning the Acceleration of the Development of Thermal Generation Facilities for Converting Waste into Electrical Energy with Environmentally Friendly Technology (Government of Indonesia, 2021b, 2021a). Despite the enactment of this regulation, concerns have emerged regarding the implementation of WtE management. The Presidential Regulation mandates 12 Regions in Indonesia to operate WtE facilities, yet between 2018 and 2023, only WtE facilities in Bantar Gebang and Benowo have become operational. The operationalization of Bantar Gebang WtE facilities, for instance, requires approximately two years, involving the preparation of an Environmental Impact Assessment (AMDAL), and several other necessary documents (Qodriyatun, 2021). In contrast, developed countries like Sweden and Singapore have successfully implemented WtE management, showcasing its potential. Meanwhile, developing countries like Thailand and India have experienced limited adoption of waste power plants, partly attributable to inadequate regulations and technical standards in these regions. The divergence in implementation can be attributed to a combination of factors, including contextual variations, infrastructure disparities, and regulatory frameworks (Khan et al., 2022).

Therefore, to maximize WtE management and align it with Indonesia's commitment under NDC, this research aims to scrutinize the implementation of legal instruments governing WtE in Indonesia. Our study also assesses Indonesia's commitment to NDC within the WtE sector, evaluates the effectiveness of WtE regulation implementation, and provides recommendations and solutions to stakeholders and authorities. Our study endeavors to bridge a gap in previous WtE research conducted in Indonesia, predominantly concentrating on technology, social, and economic issues (Aziz et al., 2022; Budihardjo et al., 2023; Mustafa et al., 2022). By addressing this gap, we aspire to contribute valuable insights to the existing body of knowledge and foster a more holistic understanding of the intricacies associated with WtE regulations in the Indonesian context.

## **2. Methods and Materials**

The research methodology used is normative legal research, employing a statutory review approach to analyze sources related to WtE. Primary and secondary sources constitute the data utilized in this study. Primary sources encompass relevant regulations or public policies in Indonesia, including the Energy Laws, Renewable Energy Policy, WtE regulations, National Energy Policy, Waste Management law, and other pertinent domestic laws. Additionally, international treaties that Indonesia is a party to, such as the United Nations Framework Convention on Climate Change, contribute to the primary data. We also conducted a comparative analysis of WtE policies in developed and developing countries. The findings indicate that the contextual backdrop of the state significantly influences the continuity of Waste-to-Energy policies.

In addition to primary sources, secondary sources for this research were acquired through comprehensive reviews of pertinent academic publications and scientific articles published within the last five years. To interpret the application of current regulations related to WtE, we harmonized factual data with regulatory frameworks. Given the intricate nature of WtE issues, an analytical approach was employed to identify challenges and offer recommendations for effective WtE management to meet Indonesia's NDC targets. We then utilized descriptive analysis to present and elucidate the issues outlined in this paper.

### **3. Results and Discussions**

#### ***3.1 Indonesia NDC Commitment***

Indonesia has set an ambitious target for 2025 to achieve its commitment to reach low-carbon and climate-resilient targets. This involves a significant reduction in emissions in the energy sector, focusing on a substantial increase in renewable energy to at least 23% by 2025, and a concurrent decrease in the reliance on fuel oil, coal, and gas energy. This goal target is based on Indonesia's NDC report (Government of Indonesia, 2021b, 2021a). The mitigation policy extends beyond the NDC and finds articulation in the National Energy General Plan (RUEN), consisting of policies to ensure national energy security and sustainable development. Energy security, characterized by the availability of ample resources at an affordable price without detrimental environmental impacts, is a central tenet of these policies (Rahman et al., 2021). Affordability of renewable energy represents a tangible manifestation of this commitment, serving as a practical response to Indonesia's challenges in attaining sustainable and secure energy security (Government of Indonesia, 2021b, 2021a).

In alignment with the NDC mandate, parties are urged to reevaluate their targets in 2022 to fortify and realign their commitments. Accordingly, on September 23, 2022, as a party of United Nations Framework Convention on Climate Change (UNFCCC), Indonesia submitted an enhanced NDC to the UNFCCC Secretariat, as per the stipulations of Article 4 of UNFCCC, which requires states to determine measures for mitigating climate change. The report outlines ambitious programs, strategies, and mitigation measures with clear objectives. Specifically addressing each greenhouse gas (GHG) producing sector, Indonesia, from the waste sector, has committed to implementing waste power plants (PLT<sub>Sa</sub>) as a mitigation measure, aiming to process 4.6 million tons of MSW to avert 1.9 million tons of CO<sub>2e</sub>. This approach integrates not only WtE but also incorporates landfill gas (LFG) utilization, waste composting, and the principles of 3R (Reduce, Reuse, Recycle), ultimately working towards achieving zero landfills by 2060 (Government of Indonesia, 2021b, 2021a).

In addition, the Indonesia NDC report has set a target of using renewable energy for at least 23% in 2025 (Government of Indonesia, 2014). However, referring from the handbook of energy in 2022, the share of renewable energy in Indonesia's energy supply only reaches 12.30% in 2022. Concurrently, the share of coal energy continues to escalate, rising from 37% in 2021 to 42% in 2022 despite Indonesia's commitment to reducing coal use by at least 30% in 2025 (Ministry of Energy and Mineral Resources Republic of Indonesia, 2022). This discrepancy underscores a significant gap between the current figures and the targeted renewable energy share outlined in Indonesia's NDC. Therefore, realizing the renewable energy target should harmonize all types of renewable energy. While WtE represents a noteworthy source of renewable energy, Indonesia should also optimally use other renewable energy to effectively realize the country's objectives in mitigating global climate change.

#### ***3.2 Indonesia Regulation pertaining Waste to Energy***

Recognizing the necessity for strengthened regulations to assist the establishment of WtE facilities, the Ministry of Energy and Mineral Resources published a "Waste to Energy Handbook" in 2015. The book serves as a reference for all stakeholders involved in WtE developments. This book divides the project stages into five clusters, starting with landfill management, WtE technology selection, project preparation, contract procurement, and concluding with the operational phase of the WtE project. In the project preparation cluster, a crucial requirement involves establishing a robust legal basis for the

operation of a WtE project. The aim is to ensure that WtE project developers have a comprehensive understanding of the relevant regulations (Directorate General for New and Renewable Energy and Energy Conservation, 2015).

In 2008, Indonesia established a legal basis for effective waste management through the enactment of Law Number 18 of 2008 concerning waste management. This Law stipulates a general framework for waste management by carrying out waste reductions covering three activities: (a) limiting waste generation, (b) recycling of waste, and (c) reusing waste (Government of Indonesia, 2008; Kamaruddin et al., 2022). To provide detailed guidance and operationalize the law, a derivative regulation was subsequently introduced—Presidential Regulation Number 35 of 2018. This regulation specifically focuses on accelerating the development of thermal generation facilities for converting waste into electrical energy using environmentally friendly technology. As per this regulation, the government is mandated to promote the development of WtE technology in 12 regions across Indonesia (Government of Indonesia, 2018). Local governments have to execute a full independent assessment of the proposed WtE technology while considering existing and planned waste management infrastructure within their jurisdictions (Directorate General for New and Renewable Energy and Energy Conservation, 2015). Given the variation in landfill sizes, available budgets, and technical capacities among regions, the development of WtE facilities is feasible only in several cities.

Apart from encouraging the construction of WtE facilities in several cities, Act No. 18/2008 mandates the central government to provide incentives to selected local governments in the form of a tipping fee. This fee, set at USD 33.78 (IDR 500,000) per ton of waste processed at the factory, serves as a financial encouragement. Furthermore, this regulation compels WtE developers or independent power producers (IPPs) to sign an electrical purchase contract with the State-owned Electricity Company (PLN) as the buyer of electricity. The following regulation mandated the regional governments to cooperate and collaborate with business entities managing WtE facilities (Azis et al., 2021; Government of Indonesia, 2018).

Initially, Indonesia did not plan for any WtE projects. In 2016, Indonesia introduced Presidential Regulation Number 18 of 2016, focusing on expediting the development of waste-based power plants. However, this regulation faced legal challenges, resulting in its annulment due to allegations from civic groups asserting its violation of higher laws and regulations in Indonesia. Despite this setback, the government has consistently demonstrated its commitment to the WtE initiative since 2017 by revising and introducing new regulations to support accelerated development. Table 1 provides a detailed breakdown of waste-to-energy regulations and approaches. The continuous efforts to navigate legal aspects related to WtE are evident in the replacement of the repealed regulations with Presidential Regulations No. 35/2018 (Luthfia et al., 2020).

As previously explained, during the five years since the Regulation of WtE came into force, only two WtE facilities have been successfully developed. Additionally, Presidential Regulation No. 35 of 2018 does not provide a time limit for the construction of WtE facilities in each mandated region. Therefore, how is it that the implementation of WtE does not take place optimally?

Firstly, considering that WtE addresses two problems that use one solution, there is an unequal synergy between office holders, such as the Ministry of Energy and Mineral Resources, the Ministry of Environment and Maritime Affairs, the Sanitation Service for each region, the City and Regional Planning Office. The regulation provided by The Regional Government is also a reason behind the delays in the implementation of Presidential Decree Number 35 of 2018 (Luthfia et al., 2020). If the scope of WtE is only limited to waste processing, then the cost of waste management compared to without WtE clearly has a significant discrepancy. However, if you consider the use-value for WtE development as a power plant, then WtE development will clearly be very profitable because the electricity can be sold to PLN in accordance with the agreed-upon agreement.

Secondly, involving the private sector in terms of investment will also greatly help accelerate development. Recently, for example, Jabar Clean Lestari Ltd., in collaboration with the West Java

Provincial Government and the City Government of South Tangerang, signed a cooperation agreement to develop new renewable energy through waste management. The utilization of WtE in this cooperation utilizes MSW to become renewable energy, where the energy produced is supplied to PLN and the rest is used as compost (Sekuritas Sinarmas, 2022). In Singapore, the application of WtE has also been implemented for several years by involving the private sector through shareholder and financing agreements (Tuan, 2016). This automatically will immediately save the financial problem, which is a problem as stated by the Corruption Eradication Commission regarding WtE, which is a burden on the state budget (Suparman, 2020).

**Table 1.** Primary legal Instrument inventory on WtE in Indonesia.

Law Instrument	Approaches
Law Number 18 of 2008 concerning waste management	The government is anticipated to guarantee effective waste management, aiming to shift from the traditional waste disposal paradigm in landfills to a new waste management approach with economic value and utility. This legislative emphasis underscores the importance of prevention, reuse, and recycling activities. Notably, these activities can extend to sectors such as energy and industrial raw materials, aligning with the objective of deriving economic benefits from waste management practices.
Presidential Regulation Number 35 of 2018 concerning the construction of installations to process waste into electricity based on environmentally friendly technology	It is mandated by Law 18/2018 and Law 30/2007. This regulation directs the government to advance technology capable of converting waste into electrical energy, ultimately aiming to diminish the overall volume of waste.
Law Number 30 of 2007 concerning Energy	It establishes a framework for increasing economic activity and national resilience through energy management by emphasizing four policies: (1) energy availability, (b) energy development priority, (3) utilization of national energy resources, and (4) national energy buffer reserves.
Minister of Energy and Mineral Resources of The of Republic of Indonesia Regulation Number 4 of 2020 concerning the use of renewable energy resources for the supply of electricity	It establishes a framework for purchasing electricity generated from renewable energy sources. It mandates that the procurement of electricity, including from WtE, will be conducted by PLN.

In addition, waste that ends up in landfills for years will have a sale value. If the government regulates electricity prices and supervises electricity production, even with the help of private sector investment, electricity prices will not soar high (Azis et al., 2021). Moreover, if there are regional regulations that authorize and mobilize the use of WtE with the right legal umbrella, it will have a positive impact on each of these regions, considering that waste has good management, as well as an increase in energy supply, which will have implications for the relatively low selling price of electricity.

Furthermore, the problem encountered in the operation of WtE is the high tipping fee caused by poor waste management before it accumulates in landfills. Thus, there is a need for pre-treatment to process the waste (Indonesian Center for Environmental Law [ICEL], 2018; ICEL, 2019; Mantovani, 2020; Wahana Lingkungan Hidup Indonesia [Walhi], 2018; Wibby, 2020). However, considering that the tipping fee is a cost incurred to the waste manager that will turn into energy, which is then worth selling again, the tipping fee should not be a problem that will hinder the rate of economic growth. Moreover, there is no reason that technology will be an obstacle in the implementation of WtE, considering that

solar panels, wind turbines, and electric vehicles also focus on technology. Therefore, efforts to facilitate the development of WtE technology by the government as an alternative energy source to meet the electricity needs of the community have the urgency to apply.

As a synthesis, our study thoroughly reviews Waste-to-Energy (WtE) regulations in Indonesia, making a contribution to complement previous studies on WtE in the country. Notably, our contribution complements prior studies, such as the work of Aziz et al. (2022), which focused on challenges in adopting WtE policies from developed nations to Indonesia. Additionally, Mustafa et al. (2022) concentrated on estimating emission reduction benefits arising from diverse WtE policy scenarios. Furthermore, Budiharjo et al. (2023) conducted a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis and utilized a quantitative strategic planning matrix (QSPM) to formulate WtE policies specifically in the city of Semarang. Our research adds depth to this scholarly discourse by concentrating on the regulatory framework, thereby enriching the understanding of the multifaceted landscape surrounding WtE in Indonesia.

#### 4. Conclusions

The clean energy is initiated to reduce the emissions and achieve the NDC targets set by Indonesia. The country has established high standards for attaining low-carbon and climate-resilient objectives, especially through the WtE program. However, there is an obvious contradiction between these goals and Indonesia's current utilization of renewable energy, underscoring the need for a more comprehensive and well-coordinated strategy.

To ensure successful implementation, it is necessary to tackle regulatory obstacles. If the legal umbrella for the operation of WtE is clear, the use-value generated by the construction of WtE as a new renewable energy source will maximize the implementation of Presidential Regulation No. 35 of 2018. Additionally, another effective implementation requires improved cooperation, leveraging private sector involvement, and ensuring financial sustainability. In order to achieve Indonesia's goals for sustainable and secure energy security, it will be essential to harmonize renewable energy sources and advance technologically.

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