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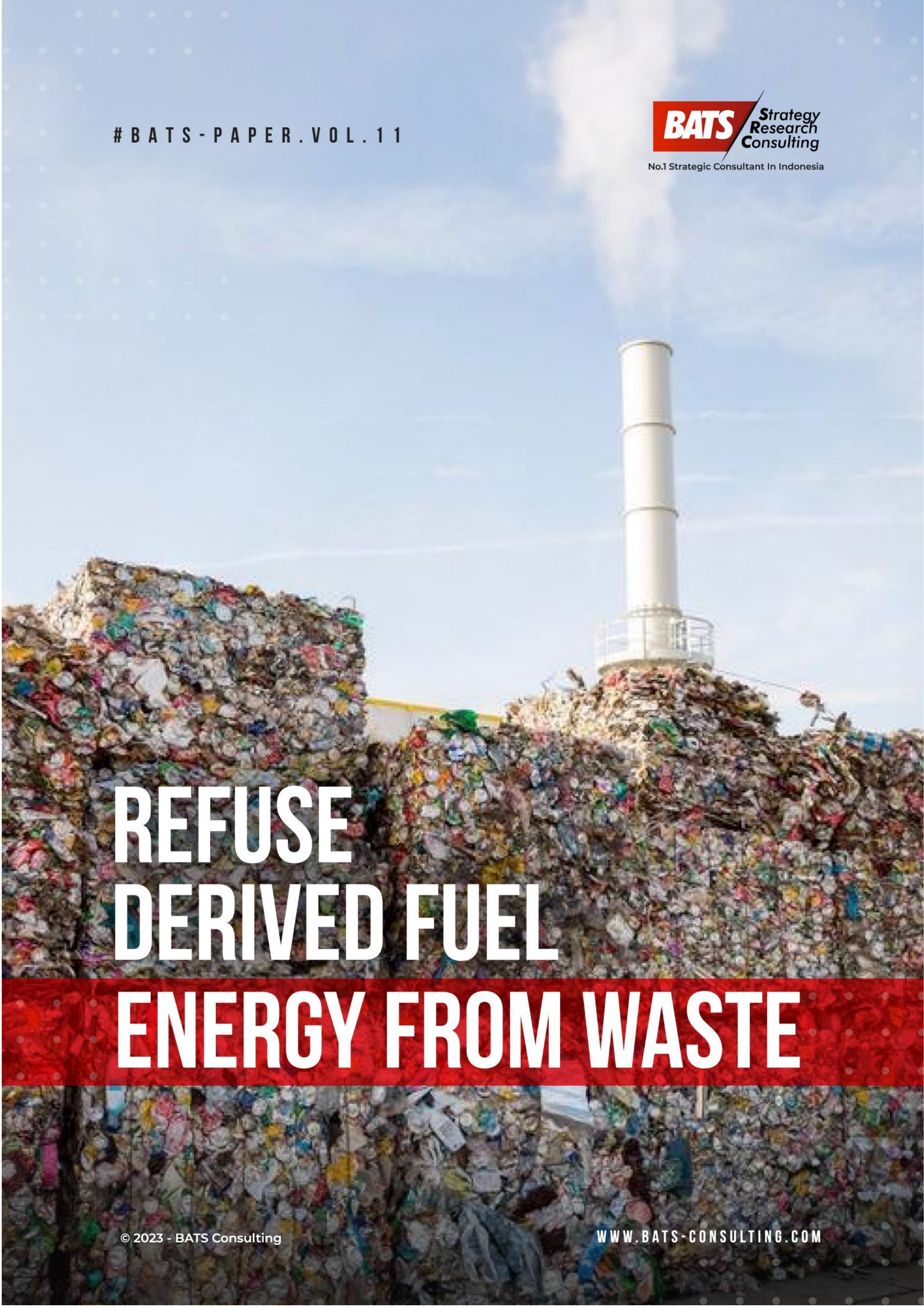

REFUSE DERIVED FUEL ENERGY FROM WASTE

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Refuse Derived Fuel: Energy from Waste

A. Pendahuluan

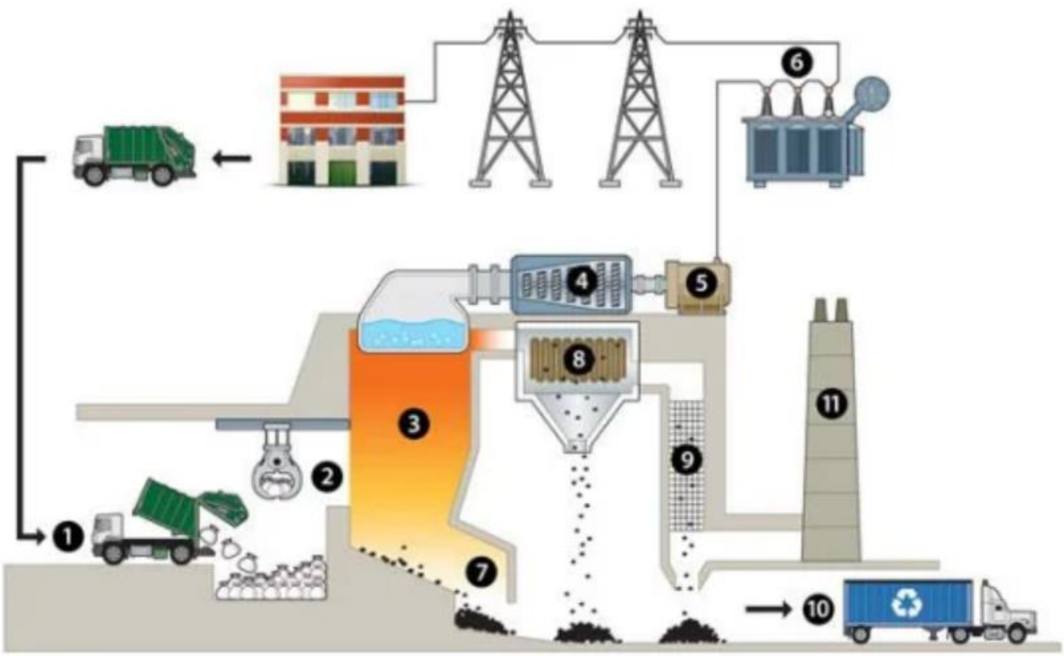
Dalam pengertian tradisional, sumber energi terbarukan adalah sumber energi yang dapat diisi ulang oleh alam, seperti tenaga air, tenaga angin, tenaga surya, dan biomassa. Sampah kota (*Municipal Solid Waste*/MSW) mengacu pada bahan-bahan yang dibuang di daerah perkotaan, termasuk sebagian besar sampah rumah tangga dengan tambahan sampah komersial, yang dikumpulkan dan dibuang oleh pemerintah kota.

Selain metode daur ulang tradisional, limbah komersial dapat digunakan untuk menciptakan sumber energi terbarukan yang dikenal sebagai bahan bakar yang berasal dari sampah (RDF). Hal ini memungkinkan sampah yang dihasilkan oleh bisnis Anda digunakan untuk menghasilkan listrik, panas, dan bentuk energi lainnya dan sering dikenal sebagai proses energi dari sampah (EFW).

A. Introduction

In the traditional sense, renewable sources of energy are those that can be replenished by nature, such as hydropower, wind power, solar power, and biomass. Municipal solid waste (MSW) refers to the materials discarded in urban areas, including predominantly household waste with sometimes the addition of commercial wastes, collected and disposed by the municipalities.

As well as traditional recycling methods, commercial waste can be used to create a renewable energy source known as refuse-derived fuel (RDF). This allows waste produced by your business to be used to generate electricity, heat and other forms of energy and is often known as the energy from waste (EFW) process.



Berbagai jenis limbah yang dapat digunakan dalam proses pengolahan sampah menjadi energi adalah sampah kota, sampah pertanian, dan sampah industri. Sampah kota adalah jenis sampah yang paling umum digunakan dalam proses ini. Sampah ini mencakup barang-barang sehari-hari seperti kertas, plastik, dan logam. Limbah pertanian mencakup hal-hal seperti pupuk kandang, jerami, dan serpihan kayu. Limbah industri meliputi terak, abu, dan debu ketel. Sampah kota adalah jenis sampah yang paling umum digunakan dalam pengolahan sampah menjadi energi.

Badan Perlindungan Lingkungan AS menganggap MSW sebagai sumber daya energi terbarukan karena limbah tersebut akan dikirim ke tempat pembuangan akhir (U.S. *Environmental Protection Agency*, 2006a). Departemen Energi AS memasukkan MSW ke dalam energi terbarukan hanya sejauh kandungan energi dari aliran sumber MSW bersifat biogenik (*Energy Information Administration*, 2007). Bagian MSW yang tidak terbarukan harus dipisahkan atau diterima sebagai bagian dari bahan bakar (Themelis dan Millrath, 2004), dan secara praktis semua limbah dalam MSW setelah pemulihan dan daur ulang material diperlakukan sebagai limbah terbarukan.

Proses *waste-to-energy* (WTE) memulihkan energi dari limbah melalui pembakaran langsung (misalnya, insinerasi, pirolisis, dan gasifikasi) atau produksi bahan bakar yang mudah terbakar dalam bentuk metana, hidrogen, dan bahan bakar sintetis lainnya (misalnya, pencernaan anaerobik, pengolahan biologis mekanis, dan bahan bakar yang berasal dari sampah).

Insinerasi dan gasifikasi adalah dua teknologi WTE utama yang telah berhasil digunakan di seluruh dunia. Diperkirakan sekitar 130 juta ton MSW dibakar setiap tahun di lebih dari 600 fasilitas WTE di seluruh dunia, menghasilkan listrik dan uap

The different types of waste that can be used in waste to energy are municipal solid waste, agricultural waste, and industrial waste. Municipal solid waste is the most common type of waste that is used in this process. It includes everyday items like paper, plastic, and metal. Agricultural waste includes things like manure, straw, and wood chips. Industrial waste includes things like slag, ash, and boiler dust. Municipal solid waste is the most common type of waste that is used in waste to energy.

The U.S. Environmental Protection Agency considers MSW a renewable energy resource because the waste would otherwise be sent to landfills (U.S. Environmental Protection Agency, 2006a). The U.S. Department of Energy includes MSW in renewable energy only to the extent that the energy content of the MSW source stream is biogenic (Energy Information Administration, 2007). The non-renewable portion of MSW has to be either separated or accepted as part of the fuel (Themelis and Millrath, 2004), and practically all the wastes in MSW after material recovery and recycling are treated as renewable.

Waste-to-energy (WTE) processes recover the energy from the waste through either direct combustion (e.g., incineration, pyrolysis, and gasification) or production of combustible fuels in the forms of methane, hydrogen, and other synthetic fuels (e.g., anaerobic digestion, mechanical biological treatment, and refuse-derived fuel).

Incineration and gasification are the two primary WTE technologies that have been used successfully throughout the world. It is estimated that about 130 million tonnes of MSW are combusted annually in over 600 WTE facilities worldwide, untuk pemanasan distrik dan logam yang dipulihkan untuk didaur ulang (Themelis, 2003). Insinerasi WTE telah lama diterima sebagai opsi pengelolaan limbah padat, melengkapi penimbunan dan pengomposan.

Insinerasi MSW di fasilitas WTE mencegah kemungkinan polusi air dan gas yang terkait dengan penimbunan dan menyediakan sumber energi terbarukan yang andal. Sebagai teknologi yang terbukti ramah lingkungan, WTE telah digunakan secara luas di Eropa dan negara-negara maju di Asia seperti Jepang dan Singapura (*American Society of Mechanical Engineers*, 2008).

producing electricity and steam for district heating and recovered metals for recycling (Themelis, 2003). WTE incineration has long been accepted as a solid waste management option, complementing landfilling and composting.

Incineration of MSW in WTE facilities prevents the possible aqueous and gaseous pollution associated with landfilling and provides a source of reliable, renewable energy. As a proven, environmentally sound technology, WTE has been used extensively in Europe and developed countries in Asia such as Japan and Singapore (American Society of Mechanical Engineers, 2008).

B. Perbandingan Opsi Teknologi Pengelolaan Sampah yang Utama: Penimbunan, Pengomposan, dan Pembakaran

B. Comparison of the Major MSW Management Technology Options: Landfilling, Composting, and Incineration.

Technology	Advantages	Disadvantages
Landfilling	• An universal solution that provides ultimate waste disposal; • Relatively low cost and easy to implement; • Complements with other technology options for handling the residual waste; • Can derive landfill gas as a byproduct for household and industrial uses; and • Costs incurred incrementally as landfill expands.	• Cost increases significantly with liner, leachate collection and removal system, and stricter regulations; • Requires large area of land; • Does not achieve the objectives of reducing volume of MSW and converting MSW into reusable resources; and • May result in secondary pollution problems, including groundwater pollution, air pollution, and soil contamination.
Composting	• Converts decomposable organic materials into an organic fertilizer; dan • Reduces the amount of waste to be landfilled and	• Takes up more space than some other waste management technologies; • Can be costly to implement and maintain, and has no

	integrates well with landfilling and materials recovery/recycling.	environmental or economic advantages compared to incineration; • Requires waste size reduction and some degree of waste separation/processing; and • Quality of the fertilizer produced is low and volume is disproportionately large, resulting in poor market demand.
Incineration	• Provides substantial reduction (by 90%) in the total volume of waste requiring disposal in landfill; • Requires minimal pre-processing of waste; • The bottom ash from incineration is biologically clean and stable, and can be used in road building and the construction industry; • A very stable process, and virtually all wastes can be burned and the burning process can be adequately controlled; • Heat from combustion can be used as energy source for generation of steam and/or electricity; and • Air emissions can be well controlled.	• High capital and operational and maintenance costs, compared to other, nonincineration options; • Significant operator expertise is required; • Air pollution control equipment is required to treat the flue gas, and the fly ash needs to be disposed in hazardous waste landfills; • More raw material have to be used to replace those that have been incinerated, and it does not save energy in the long run as resources are not recycled; • May some time discourage recycling and waste reduction; and • Public perception is sometimes negative, primarily with dioxins emission.

C. Perluasan Wilayah Perkotaan Indonesia dan Tantangan Pengelolaan MSW

Indonesia merupakan negara dengan jumlah penduduk terpadat di dunia dan sedang berkembang pesat. Meningkatnya jumlah penduduk, sistem ekonomi dan sosial yang berkembang pesat, percepatan urbanisasi, dan kebutuhan untuk meningkatkan standar hidup dan ekosistem di sekitarnya menimbulkan berbagai tantangan lingkungan di Indonesia, termasuk polusi udara, pencemaran air dan tanah, pembuangan sampah, kekurangan air, dan kebutuhan energi yang sangat besar.

Sementara itu, di Jakarta, jumlah sampah harian penduduk Jakarta telah meningkat sebesar 1.573 ton per hari dalam lima tahun terakhir. Seiring dengan peningkatan tersebut, Pemerintah Provinsi DKI Jakarta akan menambah dua pengolahan sampah menjadi bahan bakar alternatif hingga tahun 2024.

Dinas Lingkungan Hidup DKI Jakarta mencatat adanya peningkatan jumlah sampah harian berdasarkan data timbangan Tempat Pengolahan Sampah Terpadu (TPST) Bantargebang, Bekasi, Jawa Barat. Jumlah rata-rata sampah yang masuk sebesar 7.228 ton per hari pada tahun 2021, atau meningkat 27 persen dari rata-rata sampah yang masuk pada tahun 2015 sebesar 5.655 ton per hari.

Salah satu upaya untuk mengatasi peningkatan sampah tersebut adalah dengan menggunakan fasilitas *landfill mining* dan pengolahan sampah menjadi *refused-derived fuel* (RDF) di Bantargebang. Pabrik RDF dinilai lebih terjangkau dibandingkan dengan *intermediate treatment facility* (ITF).

Pelaksana Tugas (Plt) Gubernur DKI Jakarta Heru Budi Hartono berencana menambah pabrik RDF di Rorotan, Jakarta Utara, dan Pegadungan, Jakarta Barat, pada

C. Indonesia’s Urban Expansion and MSW Management Challenge

Indonesia is the world’s most populous country and is developing rapidly. Increasing population, rapidly developing economic and social systems, accelerated urbanization, and need for improvements in both the standards of living and the surrounding ecosystems pose multiple environmental challenges in Indonesia, including air pollution, water and soil pollution, waste disposal, water shortage, and massive energy demand.

Meanwhile in Jakarta, the daily amount of waste for Jakarta residents has increased by 1,573 tons per day in the last five years. Along with this increase, the Provincial Government of DKI Jakarta will add two waste processing into alternative fuels until 2024.

The DKI Jakarta Environment Agency recorded an increase in the daily amount of waste based on data from the Bantargebang Integrated Waste Processing Site (TPST) scales, Bekasi, West Java. The average amount of incoming waste is 7,228 tons per day in 2021, or a 27 percent increase from the average incoming waste in 2015 of 5,655 tons per day.

One of the efforts to deal with the increase in waste is by using landfill mining facilities and processing waste into refused- derived fuel (RDF) in Bantargebang. The RDF factory is considered more affordable than the intermediate treatment facility (ITF).

Acting Governor of DKI Jakarta Heru Budi Hartono plans to add RDF factories in Rorotan, North Jakarta, and Pegadungan, West Jakarta, in 2024. Reflecting on the RDF tahun 2024. Berkaca dari pabrik RDF di Bantargebang, pemerintah daerah tidak akan lagi mengeluarkan *tipping fee* atau biaya untuk membayar pengolahan sampah. Anggaran *tipping fee* akan difokuskan untuk pengembangan fasilitas pabrik RDF.

Untuk tahap awal, sampah yang telah diolah menjadi RDF akan digunakan sebagai bahan bakar untuk dua pabrik semen, yaitu PT Indocement Tunggal Prakarsa Tbk di Citeureup, Jawa Barat, dan PT Solusi Bangun Indonesia Tbk di Narogong, Jawa Barat.

Pabrik RDF mengolah 2.000 ton sampah per hari. Sebanyak 1.000 ton sampah berasal dari tumpukan sampah lama yang telah berusia lebih dari enam tahun yang diperoleh melalui metode *landfill mining*. Sampah lama ini berasal dari zona nonaktif Bantargebang.

Sampah-sampah tersebut kemudian dicacah dan dihancurkan sehingga menjadi ukuran tertentu untuk digunakan sebagai bahan baku RDF. Sementara itu, sisa sampah lama yang tidak sesuai dengan standar RDF akan digunakan sebagai tanah humus yang dapat digunakan sebagai tempat menanam tanaman.

Komposisi hasil pengolahannya pun berbeda. Untuk 1.000 ton sampah baru akan menghasilkan 40 persen RDF, 15 persen residu, dan sisanya berupa limbah cair, sedangkan 1.000 ton sampah lama akan diolah menjadi 35 persen RDF, 40 persen tanah humus, dan sisanya menjadi limbah cair yang nantinya akan menguap.

factory in Bantargebang, the local government will no longer issue tipping fees or pay fees to pay for waste processing . The tipping fee budget will instead be focused on developing RDF factory facilities.

For the initial stage, waste that has been processed into RDF will be used as fuel for two cement factories, namely PT Indocement Tunggal Prakarsa Tbk in Citeureup, West Java, and PT Solusi Bangun Indonesia Tbk in Narogong, West Java.

The RDF factory processes 2,000 tons of waste per day. As much as 1,000 tons of waste came from piles of old waste that were more than six years old obtained through the landfill mining method . This old trash comes from the Bantargebang inactive zone.

The waste is then chopped and crushed so that it becomes a certain size to be used as raw material for RDF. Meanwhile, the remaining old waste that does not comply with RDF standards will be used as humus soil which can be used as a place to plant plants.

The composition of the processing results is also different. For 1,000 tons of new waste will produce 40 percent RDF, 15 percent residue, and the rest is liquid waste, while 1,000 tons of old waste will be processed into 35 percent RDF, 40 percent humus soil, and the rest into liquid waste which will evaporate later.

D. Pengendalian Polusi Udara dan Pengurangan Gas Rumah Kaca dalam Insinerasi WTE

Pembuangan dan pengolahan MSW dapat menghasilkan emisi GRK dalam jumlah yang signifikan: karbon dioksida dan nitrat oksida dihasilkan melalui pembakaran, sementara metana (yang 21 kali lebih kuat daripada karbon dioksida selama 100 tahun) dihasilkan sebagai produk sampingan dari penguraian anaerobik MSW di TPA.

Metana yang dihasilkan di lokasi pembuangan limbah padat berkontribusi sekitar 3-4% dari emisi gas rumah kaca antropogenik *global* (*Intergovernmental Panel on Climate Change*, 2006). Dibandingkan dengan opsi penimbunan tanah, WTE dapat mengekang kontribusi MSW terhadap emisi GRK melalui penghindaran pelepasan metana dari tempat pembuangan sampah dan mengimbangi emisi dari pembangkit listrik berbahan bakar fosil.

Studi perbandingan WTE dan *landfilling* telah menunjukkan bahwa WTE dapat mengurangi hingga 1,3 ton setara karbon per ton MSW dengan menghindari pelepasan metana dari TPA dan mengimbangi emisi dari pembangkit listrik tenaga bahan bakar fosil (*American Society of Mechanical Engineers*, 2008). Data AS menunjukkan pengurangan emisi bersih sebesar 0,15 ton ekuivalen karbon dicapai untuk setiap ton MSW yang dikelola oleh WTE alih-alih ditimbun (dengan pemulihan metana rata-rata nasional) pada tahun 2003. WTE dapat menjadi langkah kecil untuk mengurangi total emisi gas rumah kaca Indonesia. Selain itu, WTE dapat mengurangi pengangkutan MSW ke TPA yang jauh serta emisi dan konsumsi bahan bakar yang terkait

D. Air Pollution Control and GHG Reduction in WTE Incineration

Disposal and treatment of MSW can produce significant amount of GHG emissions: carbon dioxide and nitrous oxide are produced by incineration, while methane (which is 21 times more potent than carbon dioxide over 100 years) is produced as a byproduct of the anaerobic decomposition of MSW in landfills.

Methane produced at solid waste disposal sites contributes approximately 3–4% of the global anthropogenic GHG emissions (Intergovernmental Panel on Climate Change, 2006). Compared to the option of landfilling, WTE can curb the contribution of MSW on GHG emissions through avoiding the release of methane from landfills and offsetting emissions from fossil fuel power plants.

Comparative studies of WTE and landfilling have shown that WTE can reduce up to 1.3 tonnes of carbon equivalent per ton of MSW through avoiding the release of methane from landfills and offsetting emissions from fossil fuel power plants (American Society of Mechanical Engineers, 2008). U.S. data indicate a net emission reduction of 0.15 ton of carbon equivalent was achieved for every ton of MSW managed by WTE instead of being landfilled (with the national average methane recovery) in 2003. WTE can be a small step towards reducing Indonesia's total GHG emissions. In addition, WTE can reduce the transport of MSW to distant landfills and the associated emissions and fuel consumption.

E. Masalah dan Prospek Insinerasi WTE di Indonesia

Seiring dengan pertumbuhan ekonomi yang pesat, Indonesia menghadapi kebutuhan yang mendesak akan teknologi pengelolaan limbah yang ramah lingkungan dan energi bersih. WTE memainkan, dan akan terus memainkan, peran yang semakin penting dalam pengelolaan MSW dalam waktu dekat. Meskipun demikian, pengembangan industri insinerasi WTE di Indonesia menghadapi beberapa tantangan besar.

1. **Biaya modal dan operasional**

   Dibandingkan dengan teknologi pengolahan MSW lainnya dan pembangkit listrik dari sumber daya terbarukan lainnya, WTE membutuhkan investasi modal dan biaya operasional yang tinggi. Peralatan insinerasi yang diimpor mahal dan memiliki biaya operasi dan pemeliharaan yang tinggi. Peralatan yang didasarkan pada teknologi dalam negeri harganya jauh lebih murah tetapi umumnya terbatas pada kapasitas yang relatif rendah. Namun, agar fasilitas WTE menjadi benar-benar mandiri, biaya tipping dan subsidi pemerintah perlu dinaikkan secara signifikan untuk menutupi biaya pembangkitan listrik yang lebih tinggi. Indonesia harus berinvestasi dalam penelitian dan pengembangan teknologi dan peralatan insinerasi dalam negeri, terutama insinerator berkapasitas besar, untuk membantu membuat insinerasi WTE lebih terjangkau oleh pemerintah kota di seluruh negeri.

2. **Korosi peralatan**

   Karena kurangnya pemilahan sampah dan pemisahan material, MSW di Indonesia mengandung kadar klorin dan sulfur yang relatif tinggi (Zhang dkk., 2008), yang membentuk gas asam (HCl

E. Problems and Prospects of WTE Incineration in Indonesia

Along with the rapid economic growth, Indonesia faces pressing needs for environmentally sound waste management technology and clean energy. WTE is playing, and will continue to play, an increasingly important role in MSW management in the near future. Nonetheless, development of WTE incineration industry in Indonesia faces several major challenges.

1. ***Capital and operating costs***

   Compared to other MSW treatment technologies and power generation from other renewable resources, WTE requires high capital investments and operational costs. Imported incineration equipments are expensive and have high operating and maintenance costs. Equipments based on domestic technologies cost much less but are generally limited to relatively low capacities. However, for WTE facilities to become truly self-sufficient, the tipping fee and the government subsidy need to be significantly raised to make up for the higher cost of electricity generation. Indonesia should invest in the research and development of domestic technologies and incineration equipment, especially the large capacity incinerators, to help make WTE incineration more affordable by municipalities across the country.

2. ***Equipment corrosion***

   Due to the lack of waste sorting and material separation, MSW in Indonesia contains relatively high levels of chlorine and sulfur (Zhang et al., 2008), which form acid gases (HCl and SO2) during dan SO2) selama pembakaran dan dapat menyebabkan korosi yang serius pada ketel uap.

Meskipun efisiensi yang lebih tinggi dapat dicapai dengan mengoperasikan boiler pemulihan panas pabrik WTE pada suhu yang lebih tinggi, laju korosi suhu tinggi juga akan meningkat. Sebagian besar karena pertimbangan biaya, baja karbon dan baja tahan karat 310 alih-alih bahan yang sangat tahan (misalnya, paduan berbasis Ni) biasanya digunakan untuk membuat tabung boiler di insinerator MSW, yang membutuhkan perbaikan dan penggantian superheater yang sering. Untuk mengatasi masalah korosi dan untuk meningkatkan efisiensi pembangkit listrik dari pabrik WTE, lebih banyak upaya harus dilakukan untuk meningkatkan kondisi proses di boiler dan mengembangkan paduan tahan korosi yang lebih murah.

3. **Emisi polutan udara**

Berbagai polutan udara, terutama dioksin, diproduksi dalam insinerasi MSW dan dapat dilepaskan ke atmosfer dalam jumlah yang signifikan jika insinerator dan sistem pembersihan gas buang tidak dirancang dan dioperasikan dengan benar. Meskipun demikian, fasilitas WTE perlu terus meningkatkan insinerator dan sistem pengolahan gas buang untuk mengurangi emisi polutan udara mereka.

Untuk perlindungan kesehatan masyarakat yang lebih baik, Indonesia harus memberlakukan batas yang lebih ketat pada emisi dioksin dan polutan udara lainnya dari fasilitas insinerasi (menuju standar Eropa dan Amerika Serikat), yang diharapkan dapat mengarah pada gelombang pengembangan dan implementasi teknologi pengendalian polusi udara baru.

combustion and can cause serious corrosion of the steam boilers.

Even though higher efficiencies can be achieved by operating WTE plant heat recovery boilers at higher temperatures, the rate of high temperature corrosion will also increase. Largely because of cost considerations, carbon steel and 310 stainless steel instead of highly resistant materials (e.g., Ni-base alloys) are typically used to make the boiler tubes in MSW incinerators, requiring frequent superheater repairs and replacements. To combat the corrosion problem and to improve the power generation efficiency of WTE plants, more efforts are to be spent on improving the process conditions in the boiler and on developing less expensive corrosion-resistant alloys.

3. ***Air pollutant emissions***

A range of air pollutants, particularly dioxins, are produced in MSW incineration and can be released into the atmosphere in significant quantities if the incinerator and the flue gas cleaning system are not properly designed and operated. Nonetheless, it is necessary for WTE facilities to continue improve the incinerators and flue gas treatment systems to further reduce their air pollutant emissions.

For better protection of public health, Indonesia should impose tighter limits on emissions of dioxins and other air pollutants from incineration facilities (towards the European and U.S. standards), which is expected to lead to a wave of development and implementation of new air pollution control technologies.

4. Pengelolaan abu terbang

Pengelolaan abu terbang dari insinerasi MSW belum mendapat perhatian yang memadai di Indonesia, sementara pembuangan yang tidak tepat berpotensi menyebabkan pencemaran lingkungan sekunder dari abu terbang. Meskipun terjadi pengurangan volume sampah yang signifikan, sejumlah besar residu padat (yaitu abu dasar, abu terbang, dan residu pengendali polusi udara) dihasilkan pada titik-titik yang berbeda dalam proses insinerasi MSW.

Setelah perlakuan stabilisasi yang tepat, abu dasar sering digunakan sebagai bahan konstruksi. Sebaliknya, abu terbang merupakan limbah berbahaya karena pengayaan dioksin dan logam berat, dan harus dibuang sebagaimana mestinya (Li dkk., 2004; Yan dkk., 2006). Meskipun abu terbang diharuskan untuk dibuang di tempat pembuangan limbah berbahaya.

4. Fly ash management

Management of fly ash from MSW incineration has not received adequate attention in Indonesia, while improper disposal can potentially cause secondary environmental pollution from the fly ash. Despite the significant waste volume reduction, considerable amount of solid residues (i.e., bottom ash, fly ash, and air pollution control residue) are generated at different points in the process of MSW incineration.

After appropriate stabilization treatment, the bottom ash is often used as a construction material. In contrast, fly ash is a hazardous waste due to the enrichment of dioxins and heavy metals, and must be disposed accordingly (Li et al., 2004; Yan et al., 2006). Although fly ash is required to be disposed of in hazardous waste landfills.

F. Simpulan

Waste To Energy (WTE) memecahkan masalah pembuangan MSW sambil memulihkan energi dari bahan limbah, dan emisi polutan dapat dikontrol ke tingkat yang rendah. Dengan manfaat yang signifikan terhadap kualitas lingkungan dan pengurangan emisi gas rumah kaca, MSW semakin diterima sebagai sumber energi yang bersih di seluruh dunia dan sebagian besar di Eropa.

Kebijakan dan peraturan pemerintah, insentif keuangan, teknologi baru, dan operasi yang lebih baik akan memperkuat posisi WTE di pasar energi terbarukan di Indonesia. Penelitian dan pengembangan teknologi yang berfokus pada fenomena korosi, pengendalian gas buang, pengelolaan abu terbang, dan penggunaan kembali residu yang bermanfaat akan semakin mendorong pertumbuhan industri WTE. Insinerasi WTE diharapkan dapat memberikan kontribusi yang lebih besar dalam memasok energi terbarukan di China, sekaligus membantu menyelesaikan pengelolaan MSW di negara tersebut.

F. Conclusion

Waste To Energy (WTE) solves the problem of MSW disposal while recovering the energy from the waste materials, and the pollutant emissions can be controlled to low levels. With the significant benefits of environmental quality and reduction of GHG emissions, MSW is increasingly accepted as a clean source of energy around the world and mostly Europe.

Government polices and regulations, financial incentives, new technologies, and improved operations will strengthen the position of WTE in the renewable energy market in Indonesia. Research and technology development focusing on corrosion phenomena, flue gas control, fly ash management and beneficial reuse of residues will further drive the growth of WTE industry. WTE incineration is expected to make increasingly greater contribution to supplying renewable energy in China, while helping solving the country's MSW management.

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