Barriers of Waste-to-Energy and how to address them Batam – Indonesia

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Report:	**Barriers of Waste-to-Energy and how to address them Batam – Indonesia**
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Resumé

This report is part of the Sustainable Island Initiative (SSI), which is a government partnership between Denmark and Indonesia focused on advancing sustainable waste management in Batam and Lombok.

The focus of this report is to assess barriers (financial, structural and regulatory) related to waste-to-energy (WtE) investments in Batam and relevant derisking instruments and financial incentives that may improve the investment case.

The goal of the study is to identify pathways enhancing the framework conditions for WtE in Batam to increase private sector participation and support Batam in realizing a sustainable and future proof waste management system.

A preliminary business case of a waste incineration power plant (PLTSa) has been completed to assess the financial viability of WtE in Batam.

The assumptions underlying the business case calculations are also presented in Table 1.

Results		
NPV	mUSD	0
IRR (%)	%	8%
Assumptions		
Power price	USD/MWh	74.3
Gate fee	USD/ton	41
CAPEX	mUSD	60
O&M	mUSD/year	3.1
Net power capacity	MWe	6.3
Feedstock volume	tons/year	98,750

Table 1 – Summary of business case. More details are provided in Chapter 5.

PTLSa producers in Batam are not eligible for feed-in tariffs (FiT). The maximum power price is therefore derived by assuming the average generation cost in Batam, which is 74.3 USD/MWh. To realise an NPV of 0 (break-even), the gate fee must therefore be at least 41 USD/ton.

Considering the financial constraints of the municipal budget and the lack of regulatory support from the national government, it is not deemed realistic that PLTSa producers can obtain a gate fee in this range in Batam.

The business case gives some indications of the feasibility of WtE in Batam, however the business case is based on high level assumptions. It is therefore not intended for final investment decisions as this requires more detailed analysis and financial modelling.

The study identifies 11 barriers for WtE investments; these are categorized into regulatory, structural, and financial barriers (see Table 2). Each of the barriers is ranked according to how it impacts the investment case of WtE and advanced Solid Waste Management (SWM) in Batam.

- The most critical barriers, which are considered showstoppers for investment, are marked ( ).
- Barriers, which are considered critical but can be mitigated through risk mitigation, are marked ( ).
- Barriers, which are considered less critical for the investment case, but still demand awareness, are marked ( ).

Regulatory barriers	
1. PT PLN Batam has no legal obligation nor incentive to support WtE generation	
2. Government subsidies are not available for PLTSa in Batam	
3. Lack of policy support for renewable (incl. WtE) energy generation	
Structural barriers	
4. Lack of basic infrastructure for collection and transfer of waste	
5. Communities bear a large responsibility for waste collection from households but lack resources and incentives	
6. Ineffective system for collection of retributions from waste	
7. The regulating authority of waste is split between two government agencies: BP Batam and DLH Batam	
Financial viability barriers	
8. The gate fee (tipping fee) level is not sufficient to cover advanced SWM and WtE	
9. The pecking order of local budgeting negatively impacts the operation of the waste sector	
10. Insufficient retribution fee level	
11. Limited autonomy to DLH Batam when it comes to waste sector spending	

Table 2 – Barriers of WtE and improved SWM in Batam

This report identifies public instruments which can improve the risk/reward profile of WtE and SWM investments. Three public instruments are analyzed: 1) policy de-risking instruments, 2) financial de-risking instruments and 3) direct financial incentives.

Policy de-risking instruments	
1. Landfill bans on combustible waste	Lowers the overall project risks
2. Landfill levies	
3. Emissions quota system and carbon taxes	
4. Reform of the waste retribution system	
Financial incentives	
5. Introduce a "load" subsidy	Compensation for private sector risk
6. Revisit Perpres 35/2018 and larger roll-out	
Financial de-risking instruments	
7. Put-or-Pay guarantee	Risk reallocation -Transfer of private sector risk to the public sector
8. Off-take risk guarantee	
9. PPP guarantee through IIGF	
10. Grants and concessional financing	

Table 3 – Public instruments that could enhance the risk/reward profile of WtE investments in Batam.

ABBREVIATIONS

APBD	Local government budget
APBN	National government budget
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BPP	Biaya Pokok Penyediaan Pembangkitan (Average costs of generation)
BSU	Bank Sampah Unit (Waste bank unit)
BSI	Bank Sampah Inuk (Waste bank)
BAPPELITBANGDA	Research, Development and Planning agency
CAPEX	Capital Expenditures
CSO	Community Sustainable Organisation
DAK	Specific Allocation Fund
DEA	Danish Energy Agency
DEPA	Danish Environmental Protection Agency
Dinas ESDM	Dinas Energi dan Sumber Daya Mineral (Energy office at the provincial level)
DLH	Dinas Lingkungan Hidup (Environment office at the city/regency level)
DFI	Development Finance Institutions
DPRD	Regional Legislative Representative
ECA	Export Credit Agency
FiT	Feed-In-Tariff
GHG	Greenhouse Gas
IRR	Internal Rate of Return
KEN	Kebijakan Energi Nasional (National Energy Policy)
MEMR	Ministry of Energy and Mineral Resources
MoF	Ministry of Finance
MoEF	Ministry of Environment and Forestry
MPWH	Ministry of Public Works and Housing
MSW	Municipal Solid Waste
NPV	Net Present Value
OJK	Otoritas Jasa Keuangan (Financial Services Authority)
OPEX	Operational Expenditures
PAD	Pendapatan Asli Daerah (locally generated income)
PERPRES	Peraturan Presiden (Presidential Regulation)
PLN	Perusahaan Listrik Negara (Indonesia's state-owned power company)
PLN Batam	A separate entity of PLN responsible for the power system in Batam
PLTSa	Pembangkit Listrik Berbasis Sampah Kota (power generated from municipal solid waste)
PP	Peraturan Pemerintah (Government Regulation)
PPA	Power Purchase Agreement
PPP	Public-Private Partnerships
RKUD	Regional Public Cash Account
RUED	Rencana Umum Keternagalistrikan Provinsi (Regional General Plan for Electricity)
RUEN	Rencana Umum Keternagalistrikan Nasional (National Energy General Plan)
RUKN	Rencana Umum Keternagalistrikan Nasional (National General Plan for Electricity)
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik (Electricity Power Supply Business Plan)

SIPSN	Sistem Informasi Pengelolaan Sampah Nasional (National Waste Management Information System
SSI	Sustainable Island Initiative
SWM	Solid Waste Management
WtE	Waste-to-Energy
TKDD	Transfer ke Daerah dan Dana Desa (Transfer to Regions and Village Funds)
TPA	Tempat Pemrosesan Akhir (final disposal site, landfill)
TPS	Tempat Penampungan Sementara (temporary waste collection site)
TPS 3R	Tempat Pengelolaan Sampah – Reuse, Reduce & Recycle (waste processing facility
TSTS	Tempat Pengolahan Sampah terpadu (integrated waste processing site)
UU	Undang-Undang (Constitutional Law)
WACC	Weighted Average Cost of Capital
WtE	Waste-to-Energy

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1 Introduction

This chapter introduces the report and covers the motivation and scope of the study. It begins with an introduction to Batam and explains why Batam urgently needs to address barriers related to improved waste management and implementation of waste-to-energy solutions.

An overview of data used for the research is presented towards the end of the chapter.

1.1 The sustainable island initiative (SSI)

This study is a contribution to the Sustainable Island Initiative (SSI), which is a government partnership program between Indonesian Authorities and the Danish Energy and Environmental Protection Agencies (DEA and DEPA).

The aim of SSI is to enhance local capacities for developing sustainable solutions within integrated solid waste management (SWM) and waste-to-energy (WtE) in two islands in Indonesia: Batam and Lombok. This study marks the end of the SSI program and focuses on the regulatory, structural and financial barriers of WtE in Batam.

1.2 Batam

Batam is located only 20 km south of Singapore. Batam Island, Rempang Island and Galang Island and several small islands collectively called *Barelang* comprise Batam City's administrative area. Batam island is divided into 12 subdistricts. The total land area of Batam island (*Pulau Batam*) is 415 sq.km. With a population of ~1.2 million in 2021, Kota Batam (Batam City) is the largest City in the Kepulauan Riau (Riau Islands) province (BP Batam, 2022).

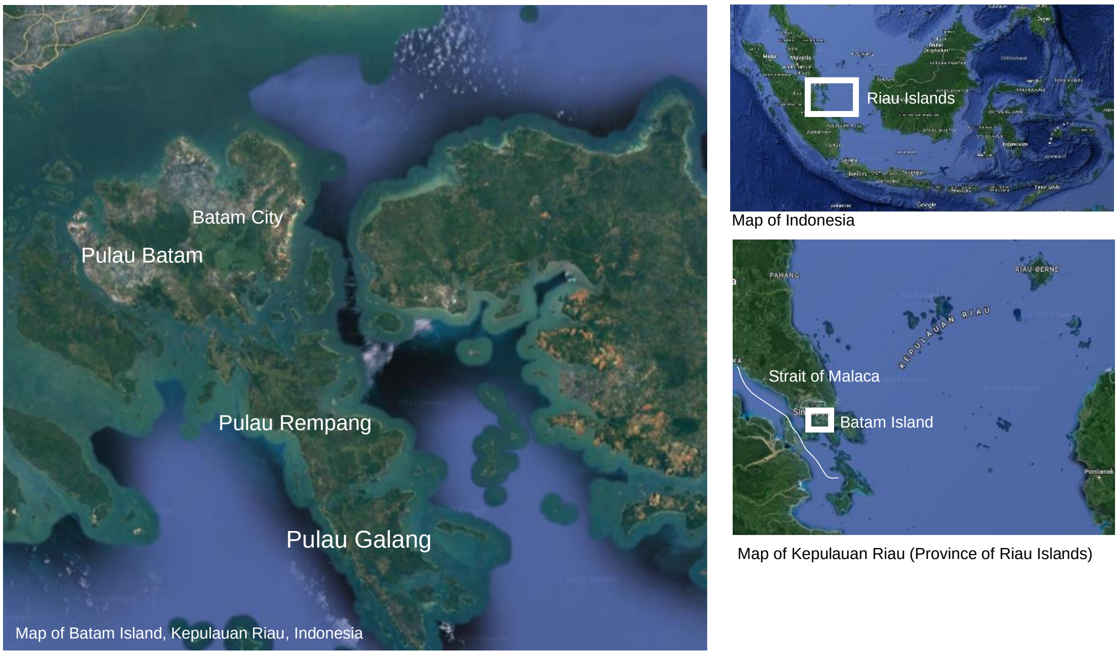

Illustration 1 – Map of Batam Island and Riau Islands (Google Maps).

Batam is located in the Strait of Malacca where more than 60,000 ships cross annually. Like the Panama Canal and the Suez Canal, the Strait of Malaca is one of the most strategic and economically important ship connections in the world.

Recognizing the strategic location of Batam, the industrial development of Batam has been a national priority since 1973. Several policy changes and regulations were made from 1973 up until today to attract foreign investment to Batam. Today, Batam is one of Indonesia's four Free Trade and Free Port Zones (FTZPZ). FTZPZ are separated custom areas, where certain exemptions on import taxes, sales taxes and other taxes apply.

Batam has four special economic zones (SEZ) on the island. SEZs are geographically restricted zones where selected industries enjoy several economic benefits and regulatory exemptions (BKPM, 2021). One of the SEZs in Batam is Nongsa Digital Park. Nongsa Digital Park is a 166-ha integrated digital park in the Northeastern part of Batam. Nongsa is developed with the purpose of attracting digital businesses and data centers, which can blend in with existing residential facilities, such as resorts and hotels. As of April 2021, Nongsa Digital Park employed more than 800 workers, expecting to grow to 16,500 in the future. The estimated total investment value of Nongsa Digital Park is 960 million USD. Batam Airo Technic (BAT) is another SEZ in Batam, which is dedicated to aircraft repair and maintenance industries. Future initiatives include an international health and medical SEZ in Sekupang and a SEZ dedicated to airport logistics and aviation activities near Hang Nadim Airport in Northern Batam (BP Batam Interview, 2022).

With an economic growth rate of 4.75% in 2021 (compared to the national economic growth rate of 3.69%), Batam is the fastest growing city in Indonesia according to BP Batam.

1.3 Status of Batam's waste sector

According to Batam's Medium-Term Development Plan (RPJD), the population of Batam is increasing and it is projected to reach 1,281,903 in 2037.

Population growth affects waste generation in the future. According to Batam City Environmental Agency (DLH Batam), Batam is expected to reach a daily waste generation of 2,000 tons in 2025. Of that ~60% is expected to come from households.

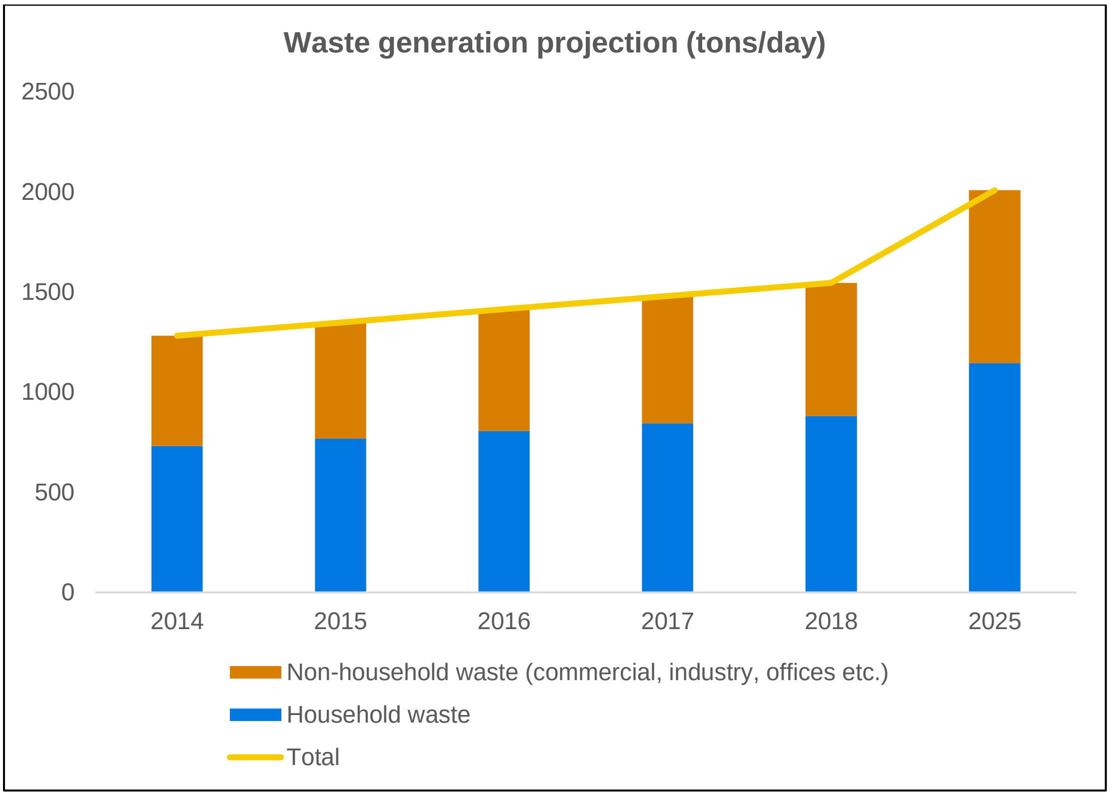

Figure 1 – Waste generation projection in Batam (DLH Batam Interview, 2022)

A large amount of the waste, which is generated in Batam, is currently not handled by the system. According to the local development plan (RKPD) of Batam City government, 13.8% of waste ends in the sea, rivers, and lakes, while 13.5% of waste is burned in open dumps around the island (Bapetlitbangda Kota Batam, 2022). This happens even though open dumping is illegal and subject to economic penalties.

Batam's only landfill (TPA Telaga Punggur) is soon reaching maximum capacity, but expansion plans are put on hold due to budgetary constraints.

Like other regions in Indonesia, Batam's system for solid waste management is dominated by landfilling. Telaga Punggur landfill is Batam's only landfill and it handles a daily volume of 800-1,100 tons of waste. The landfill area is 20 ha, and the landfill is soon reaching maximum capacity (TPA Telaga Punggur Interview, 2022).

The landfill is therefore planning to expand the operating area, but expansion plans are put on hold due to budgetary constraints. However, even if the planned expansion becomes operational, the landfill is still expected to be full within five years.

Considering the social and environmental consequences of landfills, including higher frequency of landslides and uncontrolled explosions, Batam City urgently needs to expand the landfill or invest in alternative technologies.

1.3.1 The status of attracting WtE in Batam

Batam City government has worked to attract investments into advanced SWM and WtE since 2012. To guide investors the environmental office of Batam (DLH Batam) formulated a document outlining five criteria upon which technologies will be selected.

According to the five criteria, the technology must:

1. be able to reduce 1,050 tons of waste per day,
2. be environmentally friendly,
3. not require a large land area,
4. extend the life of the landfill, and
5. be a proven technology.

The document further ranks technologies on a scale from 1 to 10 where 1 is the most desirable and 10 is the least desirable. As shown in Table 4, RDF and landfilling ranks highest while the status quo, which is "landfill only" ranks lowest.

Technology options	Ranking
RDF and landfill	1
WtE with biodrying and residue+ash landfill	2
Sanitary landfill	3
Waste incineration with composting and landfill	4
Waste incineration with wet waste and landfill	5
Composting and landfill	6
Landfill with with gas capture and utilization	7
Advanced WtE with biodrying and residue+charcoal+ash landfill	8
Anaerobic digestion (AD) and landfill	9
Landfill only	10

Table 4 – Ranking of WtE technologies according to the Outline of business case document from 2012.

Since 2012, several feasibility studies for WtE have been completed in Batam; however, none of the business cases have proved financial feasibility under current framework conditions. One feasibility study for a waste incinerator carried out by PT SMI (Sarana Multi Infrastruktur) showed that a gate fee of 350-500,000 IDR/ton of waste was required to make the investment financially attractive. However, the project was dismissed since the city government of Batam was unable to meet the gate fee required by the investor (DLH Batam Interview, 2022).

In 2018, a draft regulation on gate fee compensation was developed with the intention to create a legal framework, which included provisions concerning the obligation of the government in providing gate fees, principles of gate fee calculations and provisions for increasing/decreasing gate fee compensations. However, after three failed attempts to pass the legislation, it was eventually dismissed in 2019 (Batampos, 2018; JPNN, 2018; IndependenNEWS, 2019). Until a legal framework on gate fee compensations is in place, the City government is not expected to increase the gate fee level in Batam.

Although waste incineration is costly, it is the most efficient technology when it comes to the removal of waste. According to DLH Batam, implementation of waste incineration could extend the operating lifetime of Telaga Punggur landfill by 20 years. Meanwhile, advanced solid waste management such as waste-incineration is subject to high costs and thus require financial support through gate fees or other funding mechanism to be financially viable.

> According to DLH Batam, implementation of waste incineration could extend the operating lifetime of Telaga Punggur landfill by **20 years.**

1.4 Focus of this study

In response to the current discrepancy between the urgent need for more advanced SWM and WtE and the actual track record of private investments into WtE, this study evaluates barriers of WtE in Batam and identifies public instruments, which could mitigate private sector risk and the costs of financing.

The study reviews the structural, regulatory/legal, and financing conditions related to solid waste management in Batam and evaluates the barriers within all three categories.

The aim of this study is to highlight barriers seen from the perspective of investors when it comes to investing in WtE in Batam and identify public de-risking instruments, which can mitigate private sector risks. Some of these are within control of the regional governments while others require changes in national policies and regulations.

1.4.1 Delimitation of scope: Waste incineration

In contrast to previous studies (DEA & Viegand Maagoe, 2022; DEA, DEPA & COWI, 2021) which focus on WtE technologies more broadly, covering both anaerobic digestion, pyrolysis, incineration and landfill power, this study restricts the focus to incineration, in the form of power generation from incineration of waste. The motivation for focusing on waste incineration is that this technology has the highest potential for removal of large volumes of mixed waste streams combined with the highest power generation potential. Accordingly, incineration is considered a relevant first step in developing WtE, and over time – as the waste handling system is developed – incineration can be complemented by other WtE technologies such as e.g., anaerobic digestion. Moreover, most barriers related to e.g., regulation and financing constraints will also apply to other WtE technologies. The conclusions made in this study will therefore to a large extent also be applicable to cases focusing on other WtE technologies.

1.5 Data

The report relies on a thorough data collection process, which took place in the fall of 2022. Data is retrieved from a series of interviews conducted with local stakeholders (see Table 5) and supplemented with desk top research of official documents and research papers. Most interviews were conducted in physical meetings during two mission trips to Batam in August and November 2022. Questions used for the interviews can be found in **APPENDIX 1**.

Overview of interviewed organizations		
Organization	**Date of interview**	**Location of interview**
TPA Telaga Punggur (DLH Batam)	9 August 2022	Telaga Punggur, Nongsa District, Batam City, Riau Islands
TPS 3R Tiban Lama (DLH Batam)	9 August 2022	Tiban Lama, Sekupang District, Batam City, Riau Islands
BP Batam	10 August 2022	Office of BP Batam, Batam City, Riau Islands
DLH Batam and Bapelitbangda Batam	10 August 2022	Office of DLH Batam, Batam City, Riau Islands
PLN Batam	10 August 2022	Office of PLN Batam, Batam City, Riau Islands
Dinas ESDM Riau Islands	11 August 2022	Office of Dinas ESDM Riau Islands, Tanjung Pinang City, Riau Islands
TSPT Bantar Gebang (Dinas LHK, Special Capital Region of Jakarta)	12 August 2022	Bekasi City, West Java
Oligo Infrastructure Group	12 August 2022	Jakarta, Special Capital Region of Jakarta
Indonesia Solid Waste Association (INSWA)	14 October 2022	Online meeting
DLH Batam	24 November 2022	Office of DLH Batam, Batam City

Table 5 – List of organizations interviewed as part of the data collection process.

Initial findings were presented and discussed with key decision makers during a workshop in Batam 24 November 2022.

Participating agencies in the workshop are listed in Table 6.

Participating agencies in the workshop			
Name	**Abbreviation**	**Service area**	**Agency**
Badan Pengusahaan Batam	BP Batam	Batam City	Batam Free Trade Area and Free Port Concession Agency
Dinas Lingkungan Hidup	DLH	Batam City	Environmental Agency
Dinas Bina Marga dan Sumber Daya Air	BMSDA	Batam City	Highways and Water Resources Services Agency
Badan Perencanaan dan Penelitian Pengembangan Pembangunan Daerah	Bapelitbangda	Batam City	Regional Development Planning and Research Agency
Dinas Energi dan Sumber Daya Mineral	DESDM	Riau Islands	Department of Energy and Mineral Resources

Table 6 – Agencies participating in the workshop, November 2022.

2 Regulatory and policy framework for WtE

This chapter reviews current policy and regulatory framework conditions impacting the potential for WtE generation in Batam. This includes Indonesia's national climate policy, and policies and regulations related to the support for renewable energy and improved solid waste management at the national and sub-national level. The chapter aims to highlight regulatory and policy barriers for development of WtE in Batam.

2.1 Supporting policies for Waste-to-Energy

Waste-to-Energy (WtE) is a crosscutting policy and regulatory issue, which addresses multiple objectives including generation of renewable energy, waste management and climate mitigation. To understand and identify barriers in relation to the development of WtE, it is necessary to look at the current framework conditions and supporting policies related to all three objectives.

Indonesia has set policy targets on issues supporting development of WtE. This includes a commitment to reduce CO_{2eq} emissions with 43.2% in 2030 compared to the business-as-usual scenario (BAU). This is supported by specific policy targets on renewable energy and solid waste management at the national and sub-national level.

WtE supporting policies			
Objective	**National Policy**	**Provincial policies (Riau Islands)**	**Local policies (Batam City)**
Climate mitigation	43.2% abatement of CO_{2eq} emissions by 2030 compared to BAU	N/A	N/A
Renewable energy	23% RE share in 2025; 31% RE share in 2050 Net Zero emissions in 2060	15% renewable share in 2030	N/A
Solid waste management	30% waste reduction in 2025; 70% waste handling in 2025	N/A	30% waste reduction in 2025; 70% waste handling in 2025

Table 7 – Waste-to-energy supporting policies (national and regional).

The following sections review policies and supporting regulation for WtE at the national and sub-national level and discuss how they impact the potential for WtE development in Batam.

2.2 National Climate Targets

In line with the Paris Agreement from 2015, Indonesia has set nationally determined contributions on CO_{2eq} emissions reductions towards 2030 compared to the BAU scenario.

In September 2022, Indonesia submitted enhanced nationally determined contributions (ENDCs) to the UNFCC raising the unconditional target from 29% to 31.89%. The conditional target was raised from 41% to 43.20% (UNFCC, 2022). The unconditional target is an expression of what a country aims to achieve with own resources and capabilities, while conditional targets are subject to international means of support and fulfilment of other conditions (Climate Action Tracker, 2022).

GHG reductions in the waste and energy sectors constitute 3% and 36% respectively. WtE has the potential to support green transition measures in both sectors.

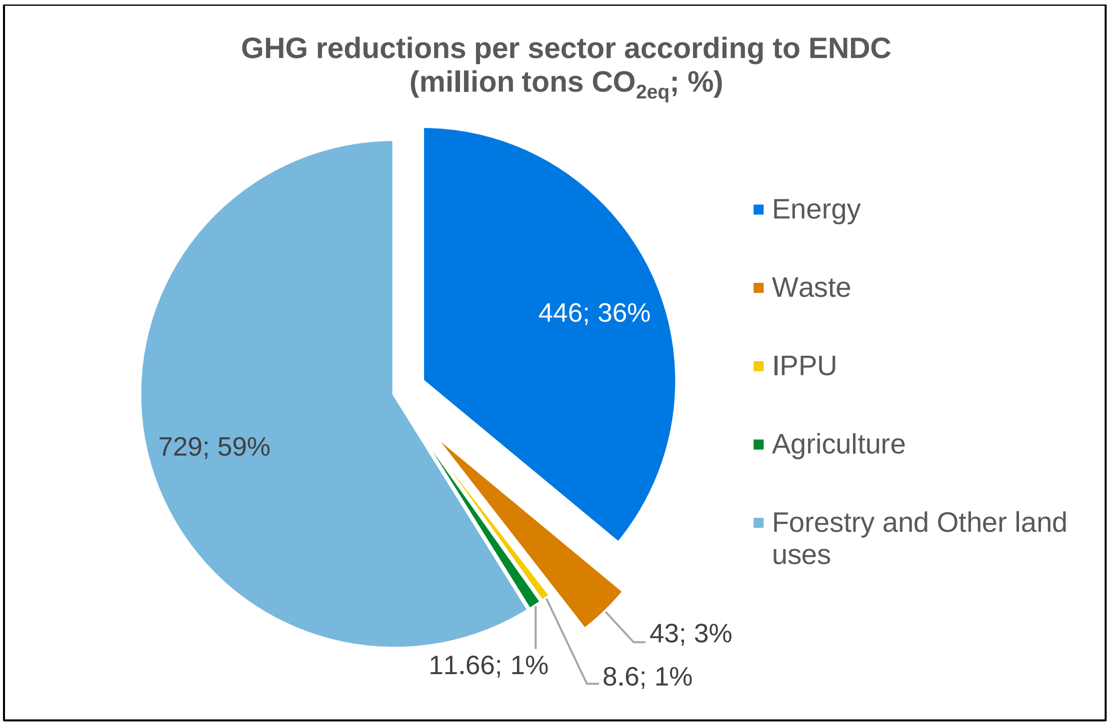

Figure 2 – Sector specific contributions to reduction targets according to Indonesia's Enhanced Nationally Determined Contributions (ENDC) submitted to the UNFCC in September 2022. Values are reported conditional commitments (UNFCC, 2022).

As part of Indonesia's climate mitigation activities aimed at the waste sector, Indonesia is working with 5 sub-sector initiatives:

1. Waste to energy and production of RDF for co-generation
2. Additional WtE generation
3. Utilization of landfill gas for power generation and conversion to sanitary landfills
4. Reusing, reducing, and recycling ("3R") in the form of composting and other waste recycling technologies
5. Industrial waste management incl. treatment of wastewater sludge and solid waste from industrial production (e.g., palm oil production)

Waste sector initiatives are altogether expected to abate 43 million tons CO_{2eq} in 2030.

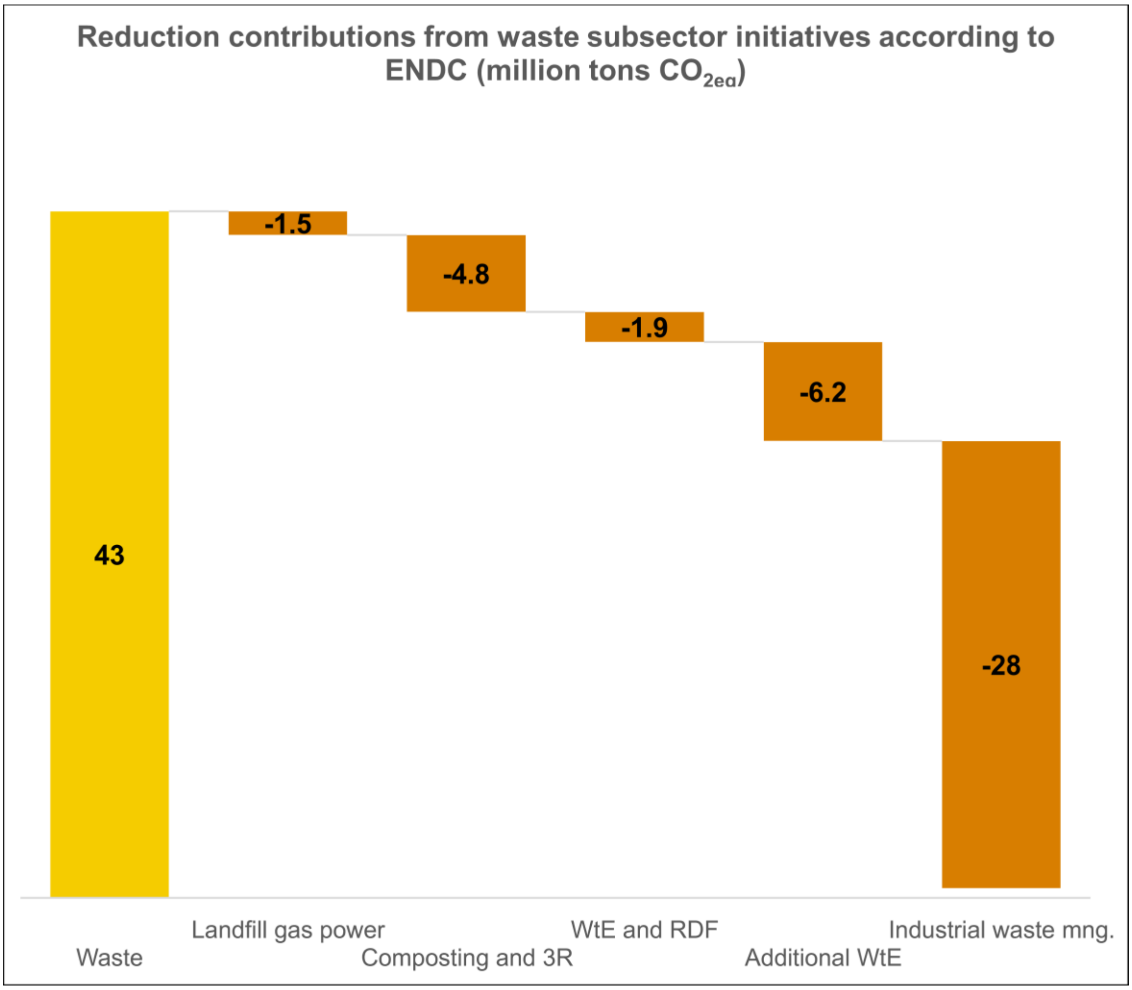

Figure 3 – GHG reduction targets for Indonesia's waste sector according to Indonesia's Enhanced Nationally Determined Contributions (ENDC) submitted to the UNFCC in September 2022. Values are reported as conditional commitments (UNFCC, 2022).

2.3 Regulatory framework conditions related to solid waste

Indonesia has enacted a series of national regulations to advance waste management and reduce waste generation. Waste Management Law No. 18/2008 is the overarching legal framework on waste management policy and practice in Indonesia. This law is detailed in various governmental, presidential, and ministerial regulations (see Table 8).

UU No. 18/2008	National Law (UU) on *Waste Management*
PP No. 81/2012	Government Regulation (PP) on *Management of Household and Household-like Waste*
MoEF decree no. 13/2012	Guidelines for *Implementation of Reuse, Reduce and Recycle (3R) through Waste Banks* (Ministry of Environment and Forestry, MoEF)
Perpres No. 97/2017	Presidential Regulation (Perpres) on *National Policy and Management Strategy of Household Waste and Household-like Waste*
Perpres No. 35/2018	Presidential Regulation (Perpres) on *Acceleration of Development of Waste-to-Energy Installation using Environmentally sound Technology*
MoEF No. P.75/2019	Ministerial Regulation on *Roadmap to Waste Reduction by Producers* (Ministry of Environment and Forestry, MoEF)

Table 8 - National Waste Management Laws and Regulations in Indonesia (MoEF, 2020).

2.3.1 Waste policies and regulations

Laws and regulations, setting targets on waste handling, can increase the government support for WtE projects.

Since feedstock in the form of waste is the foundation of a WtE project, laws and regulations supporting the availability of waste are critical for an investor. To that end, Perpes No 97/2017, more commonly referred to as “Jakstranas”, and Government Regulation (PP) No. 18/2012 are important. Both regulations regulate the management of household waste and set a target of 30% waste reduction and 70% waste handling/treatment in 2025 compared to 2017.

Since waste is the foundation of a WtE project, laws and regulations supporting the availability of waste are critical for an investor.

According to the legal definition, waste reduction (“pengurangan”) is a measure of waste reduction at source, while *waste handling* (“penanganan”) is a measure of waste treated either via resource recovery (composting, recycling, biogas, thermal recovery, etc.) or safe disposal of waste at landfill.

Batam City has set two goals concerning management of household waste: 30% waste reduction and 70% waste handling by 2025 compared to 2017.

It follows from Law No. 18/2008 that waste management must be further regulated by the respective responsible authorities at the regional and/or local level to reflect the shared responsibility of waste management between all levels of government.

The local implementation of Law No. 18/2008 is stated in governmental regulation of 10/2019 of Batam City. This law is also referred to as Jakstrada. Like the national regulation PP No. 18/2012, Batam City government has set two goals for management of household waste: 30% waste reduction and 70% waste handling by 2025.

2.3.2 Regulation of the acceleration of WtE

Outside Batam, the most important regulation for investors of WtE is Presidential Regulation (Perpres) 35/2018, which regulates the acceleration of WtE installations in 12 strategic cities appointed by the government. One of the benefits of Perpres 35/2018 is the opportunity to obtain a renewable energy tariff corresponding to a PPA price of 13.35 cUSD/kWh for plants with a capacity up to 20 MW. For plants above 20 MW, the FiT is derived by the formula: 14.54 c/kWh – 0.0767 x MW (capacity). Hence, if the capacity of the PLTSa plant is 22 MW, the corresponding FiT under Perpres 35/2018 is 12.85 cUSD/kWh.

FiT for PLTSa according to Perpres 35/2018							
Capacity	MW	20	21	22	23	24	25
FiT (Perpres 35/2018)	cUSD/kWh	13.35	12.93	12.85	12.78	12.70	12.62

Table 9 – FiT tariffs for PLTSa covered by Perpres 35/2018.

Another critical element of Perpres 35/2018 is the opportunity for investors to obtain a gate fee of up to 500,000 IDR per ton of waste (32 USD/ton). Where the regional budget is not able to provide the full funding for the gate fee, investors can apply for national budget funding. Besides, projects covered by this regulation are entitled to simpler and faster license processes, support from local government for e.g., layout for spatial adjustment, and other fiscal and non-fiscal incentives such as exemptions on import duties.

Perpres 35/2018 supersedes the previous regulation (Perpres 18/2016), which provided benefits for installation of WtE in 7 cities (Ashurst, 2018). Since Bali withdrew from Perpres 35/2018, the regulation currently covers 11 strategic cities/governments, including Special Regional of Jakarta Province, Tangerang City, South Tangerang City, Bekasi City, Bandung City, Semarang City, Surakarta City, Surabaya, Makassar City, Palembang City and Manado City (Oligo Infrastructure Group , 2022).

While these cities are entitled to several benefits, implementation of WtE facilities is still low. One of the reasons being that local governments are required to match the gate fee of the national government 1:1. For instance, the national government can only approve a gate fee of e.g., 250,000 IDR/ton if the local government also offers a gate fee of 250,000 IDR/ton.

Currently, Batam is not covered by regulation 35/2018, and this regulation is therefore not relevant for investors looking to invest in WtE in Batam today. However, considering that this regulation has previously been expanded to cover more cities, there may be a possibility that Batam City could be covered by this regulation in the future.

> Batam City is not covered by Perpres 35/2018 and WtE investors in Batam are thus not entitled to gate fee compensations from the national government nor feed-in-tariffs (FiTs) for renewable energy generation.

2.4 Energy policy and status in Riau Islands and Batam

Indonesia's National Energy Policy (KEN) regulated in Government Regulation no. 79/2014, serves as a guideline for the direction of National Energy Management from 2014 to 2050. As stated in Article 5, this law aims to secure energy independence and national energy security to support national sustainable development in Indonesia. This is reflected in short and long-term targets for the energy mix where coal and natural gas still play a role in 2050.

The new renewable energy goal set for 2025 is relatively modest compared to some provinces in Indonesia. For instance, Nusa Tengarra province (NTB) has set a goal of 60% renewable energy in the power sector in 2030 compared to a national goal of 31% in 2050.

National Energy Targets	Goal	Year
New and renewable energy share	23%	2025
New and renewable energy share	31%	2050
Electrification ratio	85%	2015
Electrification ratio	100%	2020
Natural gas share	22%	2022
Natural gas share	24%	2050
Coal share	30%	2025
Coal share	25%	2050

Table 10 – National energy targets as stated in Article 9 of Indonesia's National Energy Law 79/2014.

The National Energy General Plan (RUEN) lays out the energy management plan and constitutes implementation of the KEN across sectors. RUEN thus serves as the basis for national and local planning documents including the National Electricity Plan (RUKN) and Electricity and Supply Business Plan (RUPTL).

According to the 2007 Energy Law, provincial governments have an obligation to implement Regional Electricity General Plans (RUEDs), which are in alignment with the national energy plans (RUEN) (OECD, 2021). However, only 28 out of 34 provinces have implemented RUEDs as of December 2022 (NEC, 2022).

The province of Riau Islands has so far not implemented a RUED (NEC, 2022). Based on discussions with Dinas ESDM of Riau Islands and PLN Batam, the province does not have the required renewable resources to fulfil national energy targets.

The reason is that the province does not have sufficient renewable resources to meet the national renewable energy goals. Meanwhile, the province has set its own target of 15% renewable energy share in 2025, aiming for a 5%-point increase compared to the energy mix in 2020 (Dinas ESDM Riau Islands, 2022).

Riau Islands Province's renewable energy target is 15% by 2025 compared to a national target of 23%.

Riau Islands plans to reduce the reliance on coal and oil and increase the share of natural gas in 2025 (see Figure 4) (Dinas ESDM Riau Islands, 2022). Subsequently, Riau Islands is dominated by fossil power generation.

Due to access to local natural gas resources, Riau Islands is expecting to phase out coal faster than stated in the national energy regulation. Riau Islands have set a goal of 18% coal in the energy mix in 2025 against a national target of 30% (Dinas ESDM Riau Islands, 2022).

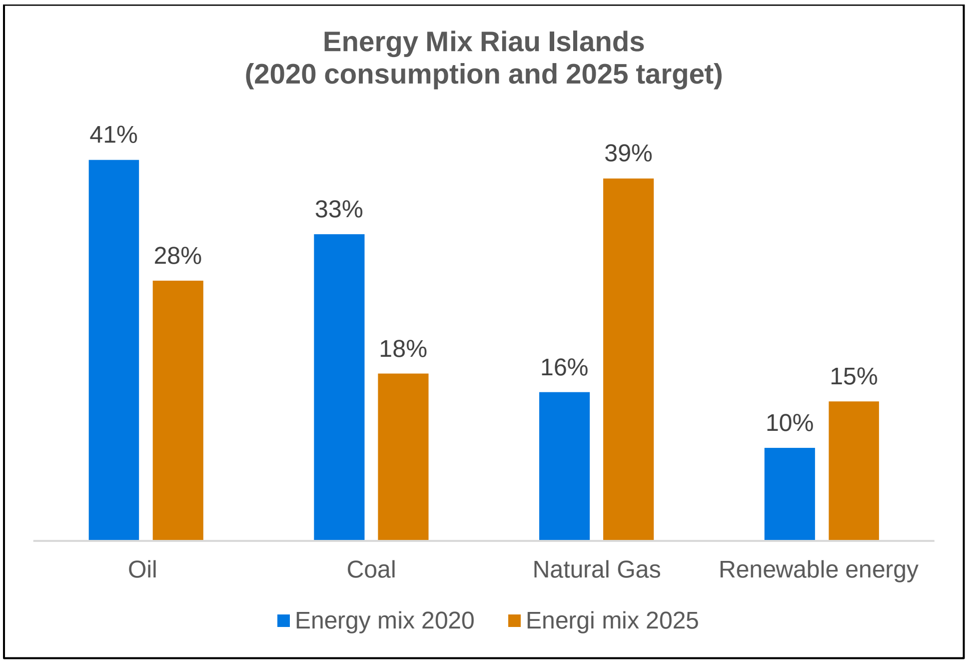

Figure 4 – 2020 energy mix and 2025 target in Riau Islands.

According to Law 79/2014 on Indonesia's National Energy Policy, Indonesia should reach 100% electrification ratio in 2020, however the provincial target of Riau Islands was slightly lower in 2022 (95.5%).

In 2022, Batam reached an electrification ratio of 94.4% according to Dinas ESDM, corresponding to a total of ~20,000 households with no access to electricity.

PLN Batam has a total installed capacity of 552 MW. Of that, 83.3 MW is exported to the neighboring island Bintan. With a peak load demand of 455.4 MW, Batam has a reserve margin of just 13.4 MW. Consequently, the power supply can only barely provide peak load and remains susceptible to grid instability during, for example, power plant failures.

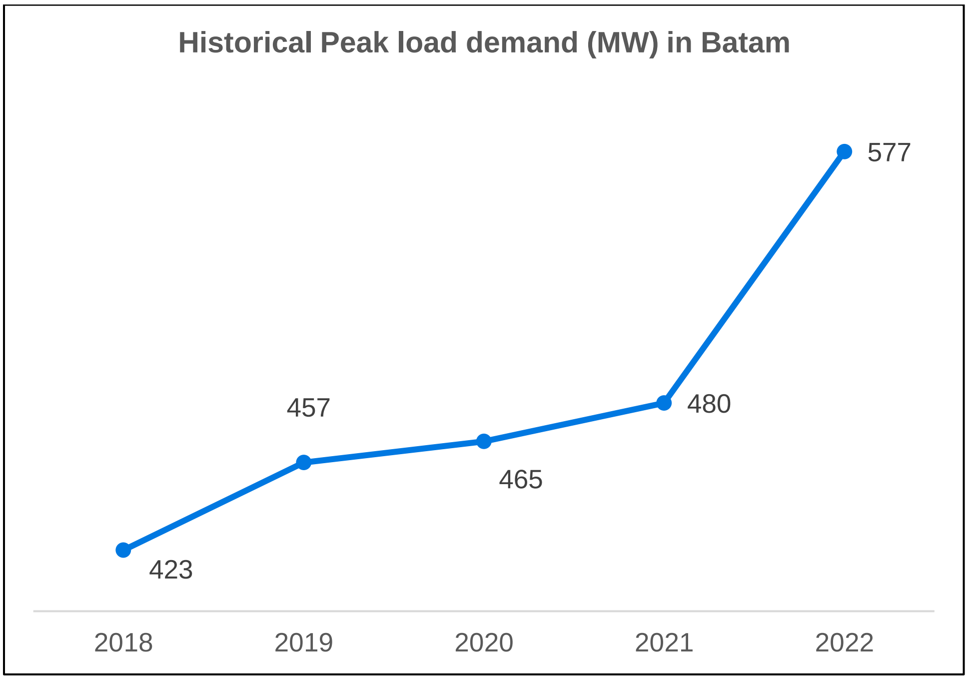

Figure 5 – Historical peak load demand, PLN Batam.

This challenge is expected to increase in the future unless Batam increases generation capacity significantly. By 2028, 11 new data centers are expected to be commissioned, and it is therefore critical that new capacity and infrastructure is built accordingly. As shown in Figure 5, PLN Batam is expecting a significant increase in peak load demand in 2022 compared to 2021. This significant increase is mainly a result of the increasing load on the grid from data centers.

Table 11 shows PLN Batam's expectations on grid load demand from data centers in Nongsa Digital Park in Batam between 2023 and 2030. Four data centers with a total grid load demand of 71 MW are coming online in 2023 and by 2030 the total grid load demand from data centers is expected to reach 449 MW corresponding to 81% of the current installed capacity of Batam. 83% of the cumulative demand (374 MW) is confirmed by investors (PLN Batam - Webinar, 2022).

Grid load demand from data centers 2023-2030 (MW)								
	2023	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
New grid load demand from data centers	71	88	70	54	51	40	46	29
Cumulative grid load demand	71	160	230	284	334	374	420	449

Table 11 – Grid load demand (MW) from data centers (PLN Batam - Webinar, 2022)

The increase in population growth, data centers and other business activities in Batam puts pressure on the power system. PLN Batam therefore urgently needs to add additional generation capacity to the system.

With a very small share of renewables in PLN Batam's system (<1%), PLN Batam indicates a willingness to support renewable energy technologies. Due to resource availability and production cost, solar PV is considered the most feasible option according to PLN Batam.

> The total power generation potential from solid waste incineration in Batam is estimated to be 30 MWe in 2023.

Power generated from solid waste has the potential to increase Batam's share of renewables while providing base load capacity to the power system. The total power generation potential of solid waste is estimated to be 30 MWe in 2023 if all solid waste in Batam is utilized for incineration.

Hence, the power generation potential of solid waste is relatively small compared to the future grid load demand from data centers in Batam. It should be noted that the estimated potential only considers availability of resources and disregards technical and economic barriers.

2.5 Regulation of power sales from WtE

Independent power producers in Batam have the option to sell electricity to PT PLN Batam, which has been responsible for the power system of Batam since 2000. PT PLN Batam is a subsidiary of PT PLN Persero, which is Indonesia's state-owned company responsible for distribution, generation, procurement, and sales of electricity.

PT PLN Persero owns 99.9% of PLN Batam, while the remaining is owned by YPK PLN. PLN Batam also has a subsidiary, namely PEB and 4 affiliates in the form of Independent Power Producers (IPP) that supply power to PLN Batam's power system. The overview of PT PLN Batam is shown in Figure 6.

Figure 6 – PLN Batam corporate structure.

While PT PLN must follow the national tariff scheme, PT PLN Batam, as a holder of a General Electricity Business License (PIUKU), is allowed to apply regional tariffs. Although PT PLN Batam has the option to pass on the costs of the system to customers, PT PLN Batam has a strong interest in keeping the costs of generation and hence the retail price level as low as possible (World Bank, 2015).

> FiT for renewables do not apply to producers in Batam. The highest attainable PPA price is thus equal to the BPP of Batam, which equaled 7.43 cUSD/kWh in 2022.

Opposite PT PLN, PT PLN Batam is not compensated for procurement of renewables from the national government. Feed-in-tariffs (FiTs) are thus not available for producers in Batam. The maximum PPA price an investor can expect to get is therefore equal to the average generation costs (BPP) of Batam, which reached 1,150 IDR/kWh (7.43 cUSD/kWh) in 2022 (PLN Batam, 2022).

To put this into perspective, the available PPA price for WtE developers in other Indonesian cities is almost twice as high as what developers can expect if they sell power to PLN Batam. This is possible through regulation 35/2018 concerning the Acceleration of WtE Technologies in 12 strategic cities in Indonesia.

PPA prices	IDR/kWh	cUSD/kWh
PPA price according to PP 35/2018 for WtE plants up to 20 MW	2,068	13.35
(Maximum) PPA price for WtE plants according to PLN Batam	1,150	7.43

Table 12 – PPA prices for WtE in Batam compared to the PPA prices offered to developers in cities/regions covered by regulation 35/2018.

The absence of national subsidies for power produced from solid waste is a significant barrier for WtE investments in Batam, particularly considering that Batam City government lacks the financial resources to provide gate fee compensations to investors.

2.6 Conclusion – regulatory barriers

This chapter has identified several regulatory barriers for successful development and implementation of WtE in Batam. Below is an overview of identified regulatory barriers and a high-level assessment of the impact on the investment case.

Each of the barriers is ranked according to how it impacts the investment case of WtE and advanced Solid Waste Management (SWM) in Batam.

- The most critical barriers, which are considered showstoppers for investment, are marked ().
- Barriers, which are considered critical but can be mitigated through risk mitigation, are marked ( ).
- Barriers, which are considered less critical for the investment case, but still demand awareness, are marked ().

Regulatory barriers	
1. PT PLN Batam has no legal obligation nor incentive to support WtE generation	
PT PLN Batam's main responsibility is to deliver stable and affordable power to customers in Batam. Since PT PLN Batam is a separate entity, PT PLN is not eligible for government subsidies to compensate for the additional costs of sourcing power from waste. Consequently, PT PLN Batam is not willing to internalize the costs since it would result in higher customer tariffs, thereby potentially jeopardizing its license to operate as a monopoly power company in Batam. As a result, PT PLN Batam will always choose the most competitive technologies. The social and environmental benefits of WtE will therefore not be factored in into PT PLN Batam's prioritization of technologies.	
2. Government subsidies are not available for PLTSa in Batam	
Batam is one of the few places in Indonesia not covered by national regulation in support of WtE. This means that there is no guaranteed FiT available for generation of power and no guaranteed gate fee for waste handling. Besides, the city government of Batam is not offering to finance gate fee compensations to private developers of WtE.	
3. Lack of policy support for renewable (incl. WtE) energy generation	
Investors need certainty for the future. With just 1% renewables in the energy mix, Batam is far from fulfilling the provincial target of 15% renewable energy in 2025. This suggests uncertainty regarding authorities' willingness to meet future goals, and for an investor this represents an uncertain and risky environment to enter. Besides, even if PT PLN Batam increases the share of renewables in its power mix, PT PLN Batam is likely to favor other less costly technologies than WtE, such as solar PV.	

3 Structural conditions of Batam's waste sector

This chapter reviews the structural conditions of Batam's waste sector and focuses on issues impacting investments into WtE. The chapter covers how data is collected and reported and addresses issues related to data accountability and transparency. Furthermore, waste infrastructure, administration, and governance issues are analyzed. The chapter concludes with a summary of barriers related to the structural conditions of the waste sector in Batam including how these barriers influence investor's risk when it comes to WtE development.

3.1 Data on waste generation and collection in Batam

Investors of WtE are concerned about the availability, transparency, and reliability of waste data since it forms the basis of investment decisions. Investors therefore need data on waste volumes, compositions, and calorific values to be able to make informed decisions on the location of the plant, designed capacity and other technological features needed to secure optimal output.

Investors are relying on the availability of sufficient infrastructure including waste trucks and collection facilities to assess the probability that waste is delivered as agreed upon in the feedstock contract. Data on the operational status and capacity of existing infrastructure is therefore important. In a situation where basic infrastructure is lacking, investors may decide to put resources into basic infrastructure. The derived costs will – all-things-equal – worsen the business case, which could potentially halt investment activity. Furthermore, where investors have low trust in publicly available data, they may be reluctant to invest.

> Investors of WtE are concerned about the availability, transparency, and reliability of waste data since it forms the basis of investment decisions.

From a local government perspective, data is important to measure progress on waste management and to provide the basis for political priorities and decision making. In the context of Batam, the availability of data is important in relation to realizing the targets of 70% waste handling and 30% waste reduction rate in 2025 compared to 2019, as stated in the waste management regulation.

Collection and management of waste data is administered by the environmental agencies of the national and sub-national governments. The national data system is also known as SIPSN (Sistem Informasi Pengelolaan Sampah Nasional). Regional data on Batam's waste sector can be retrieved directly through DLH of Batam City (the environmental agency of Batam City). Due to the delegation of autonomy when it comes to waste handling, the environmental agencies rely on support from villages and community organizations for submission of waste data.

3.2 Waste data

Batam generated 413,462 tons of waste in 2022. With a population of 1.196 million (2020 Census data), the average generated waste per capita per day was 0.95 kg in 2022. In comparison, the total waste volume of Batam was 486,322 in 2019, corresponding to a 15% reduction from 2019 to 2022. Batam is thus halfway in fulfilling the waste management target of 30% reduction by 2025.

As stated in the legal definition of waste handling, waste handling is equal to the amount of waste delivered to landfills and treatment/processing facilities. The waste handling rate is thus the share (in %) of waste handled compared to waste generated for a given year.

> Batam realized a 15% reduction of household waste between 2019 and 2022. To meet the government target, Batam needs to increase the waste reduction rate to 30% by 2025.

Batam City has one waste treatment facility (TPS 3R KSM Harapan Baru) and one landfill (TPA Telaga Punggur). According to the national information management system "SIPSN", TPA Telaga Punggur handled 310,277 tons of waste in 2019, while

TPS 3R KSM Harapan Baru treated 379 tons of waste in 2019. In 2022, Batam handled 75% of waste generated. This is 5 %-points more than the waste policy target of 70%.

Waste data – Batam City (2019-2022)			
Waste generated/handled	Indicator	Actual data (SIPSN)	Target (2025)
Waste generated (2019)	tons. p.a.	486,322	
Waste generated (2022)	tons. p.a.	413,462	
Waste reduced (2019-2022)	tons. p.a.	72,860	
Waste reduction rate	**%**	**15**	**30**
Waste handled, total (2022)	tons. p.a.	310,656	
- TPA	tons. p.a.	310,277	
- TPS 3R	tons. p.a.	379	
Waste handling rate	**%**	**75**	**70**

Table 13 – Waste data of Batam. Batam's population (1.196 million) is based on 2020 Census data.

The waste handling rate in Batam from 2011-2019 is shown in Figure 7.

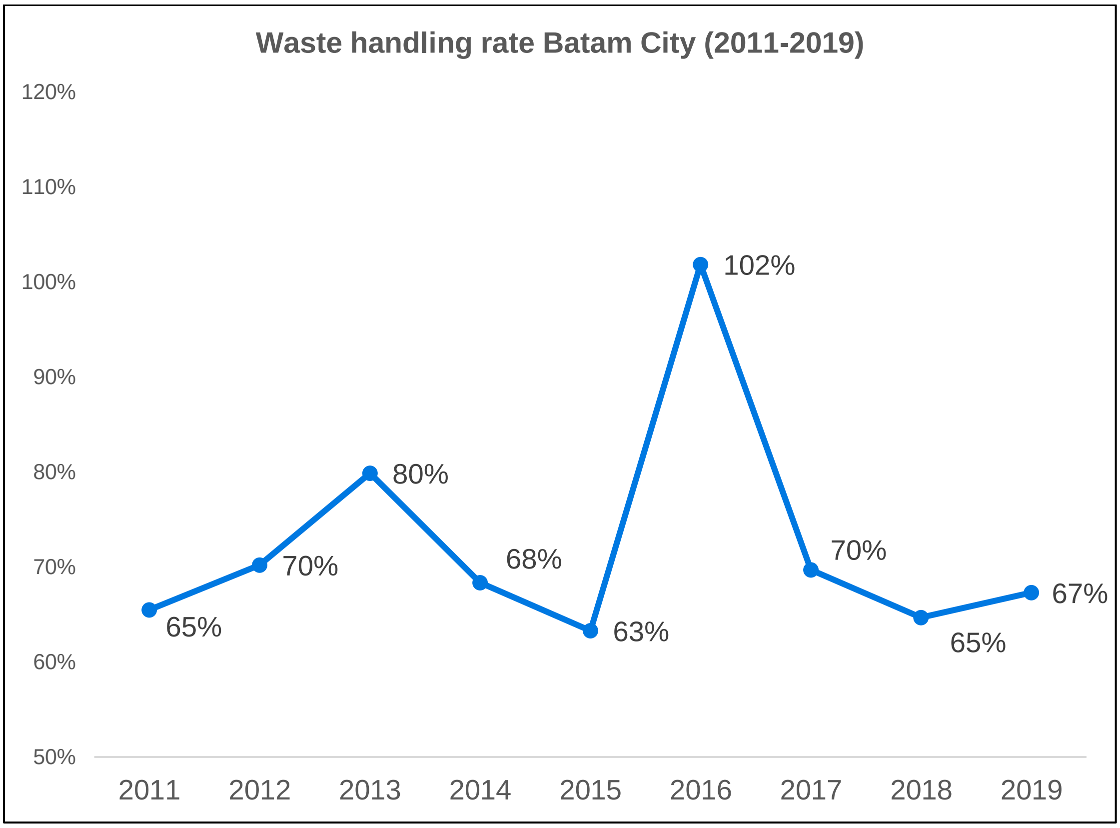

Figure 7 – Batam City waste handling rates in the years 2011-2019 (DLH Batam Interview, 2022).

The average waste handling rate over the 9-year period is 72% and there has only been a small increase from 2011 to 2019. The handling rate peaked in 2016 with 102%

but drops again in the following years. The explanation behind the peak is that the total waste collected in this year is both waste generated in 2016 and waste, which has accumulated from previous years (DLH Batam Interview, 2022).

Waste generation and waste handling are important indicators for whether it is attractive to invest in WtE in a specific location. While waste generation is a useful indicator of the total potential, waste handling data is even more important because this number is an indication of the current capacity of the waste sector. The share of waste not handled by the system ends up in open dumps, is burned or disposed of in rivers, in the sea, or on beaches. Since these waste streams are difficult to collect, it should not be included when estimating feedstock supply for a WtE plant.

A realistic capacity for a waste incineration plant in Batam ranges between 100,000-200,000 tons per year.

High development costs from e.g., permitting, feedstock contract negotiations and other aspects means that investors generally prefer large-scale projects above 0.5 million tons of waste per year. However, depending on the regulatory framework and potential subsidies, smaller plants may also be financially viable.

Due to the feedstock availability in Batam, investors would not be able to harvest significant economies of scale. A realistic plant capacity in Batam ranges between 100,000 and 200,000 tons per year.

3.3 Waste infrastructure in Batam

Formal waste management in Batam starts with primary waste collection from villages to temporary collection points (TPS), which are simple containers.

The transfer of waste from households to TPS containers is handled by community organizations (CSOs), while transfer of waste from TPS containers to the final disposal at the landfill (TPA), is handled by DLH of Batam City with support from the districts.

Some villages send source-separated household waste to waste banks. At the waste banks, recyclables are sorted and prepared for subsequent sale in the market. The revenue from the sale of waste is saved in deposit accounts managed by the waste bank. This account is accessible by households who have provided the waste and households can at any point withdraw the value from their savings accounts. In rare cases, local governments transfer a share of the mixed waste stream to more advanced recycling facilities (TP3R/TSTS), however the vast majority of collected waste ends up at the landfills (MoEF, 2020).

The typical waste management process of Indonesia is illustrated in Figure 8.

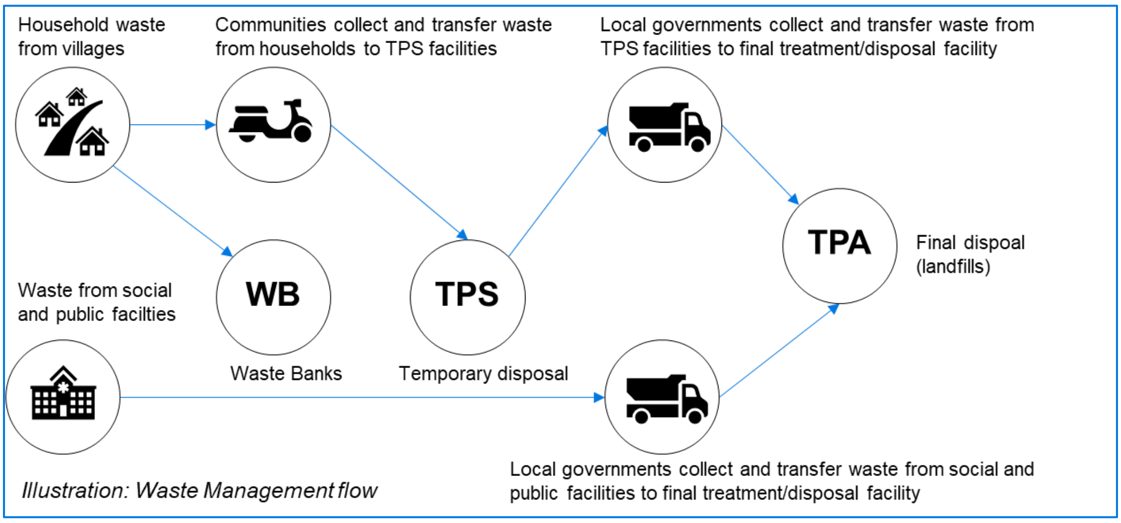

Figure 8 – Waste management flow in Indonesia. Viegand Maagøe Illustration.

Batam has 173 TPS facilities, 10 compactor trucks, 72 dump trucks, 41 arm roll trucks, 96 pickups and 26 rickshaws.

Distribution of waste transporters across Batam City's 12 districts						
District	**Compactor**	**Dump truck**	**Arm roll**	**Pickup**	**Rickshaw**	**TPS**
Belakang Padang	NA	NA	NA	NA	NA	NA
Bulang	NA	NA	NA	NA	NA	NA
Galang	NA	NA	NA	NA	NA	NA
Sungai Beduk	1	1	5	8	1	19
Sagulung	1	10	7	14	6	25
Nongsa	0	3	2	8	8	15
Batam Kota	5	11	5	10	1	27
Sekupang	1	6	6	14	5	24
Batu Aji	1	7	5	14	5	17
Lubuk Baja	1	24	4	7	0	15
Batu Ampar	0	4	1	8	0	13
Bengkoang	0	6	6	13	0	18
Total	**10**	**72**	**41**	**96**	**26**	**173**

Table 14 – Distribution of waste transporters across Batam City's 12 sub districts. Data is not available for the three isolated islands: Belakang, Bulang and Galang. (DLH Batam Interview, 2022)

Rickshaws and pickups are used by villages and CSOs to transfer waste from households to TPS containers. From the TPS containers waste is loaded to either a compactor, a dump truck or an arm roll truck and then transferred to the final disposal (TPA) or processing site (TPS 3R). Dump trucks, which are shown in Illustration 2, are the most common form of waste transporter in Batam.

Illustration 2 – Dump truck, Batam City. Photo credit: Viegand Maagøe

The capacities of the different waste transporters are listed in Table 15.

Design capacity per transporter (tons of waste)				
	Dump truck/compactor	**Arm roll**	**Pick up**	**Rickshaw**
Design capacity (tons of waste)	8	3	1.7	0.6

Table 15 – Volume capacity per transporter (tons) is based on: "Optimization of Municipal Solid Waste Transporter in Batam City using Genetic Algorithm" (Purnajaya & Hanggara, 2020).

The total transport capacity (shown in Table 16) is calculated by multiplying the designed capacities with the number of transporters in each category and the number of loads per day. Dump trucks, compactor trucks and arm rolls are assumed to take one load per day on average. As a result, the daily transport capacity of these three transporters is 779 tons/day.

Rickshaws and pickups have much lower designed capacities and therefore need to carry more loads per day to handle the same amount of waste. Assuming pickups carry 4 loads per day and rickshaws carry 6 loads per day, the daily transport capacity of armrolls and rickshaws is 746 tons/day.

Daily capacity if waste transporters in Batam (tons of waste/day)					
Subdistrict	**Compactor**	**Dump truck**	**Armroll**	**Pickup**	**Rickshaw**
Belakang Padang	NA	NA	NA	NA	NA
Bulang	NA	NA	NA	NA	NA
Galang	NA	NA	NA	NA	NA
Sungai Beduk	8	8	15	54	4
Sagulung	8	80	21	95	22
Nongsa	0	24	6	54	29
Batam Kota	40	88	15	68	4
Sekupang	8	48	18	95	18
Batu Aji	8	56	15	95	18
Lubuk Baja	8	192	12	48	0
Batu Ampar	0	32	3	54	0
Bengkoang	0	48	18	88	0
Total	**80**	**576**	**123**	**653**	**94**
Transport of waste from source to TPS (653+94)			**-**		**746**
Transport of waste fra TPS to TPA (80+576+123)			**779**		**-**

Table 16 – Daily capacity of waste transporters in Batam (ton of waste/day).

An overview of waste transported in % of waste generated is provided in Table 17. It is assumed that each transporter drives once a day. Besides, it is assumed that compactors, dump trucks and armrolls are used for transport of waste from TPS facilities to TPA and TPS 3R, while pick-ups and rickshaws are assumed to be used for transport of waste from source to TPS facilities. The transport percentage is thus derived using below formulas:

a) Waste transported from TPS facilities to final disposal (TPA) or processing plant (TPS 3R):

$$\frac{Daily\ capacity\ of\ compactor\ trucks + dump\ trucks + \ armrolls\ (tons)}{Waste\ generated\ (tons)}$$

b) Waste transported from source to TPS facilities:

$$\frac{Daily\ capacity\ of\ pick\ ups + rickshaws\ (tons)}{waste\ generated\ (tons)}$$

Following the above assumptions, the transport capacity from TPS facilities to TPAs/TPS 3Rs is estimated to be 69% on average, while the transport capacity from source to TPS facilities is estimated to be 66% on average. The 66% is considered optimistic since it would require that rickshaws and pick-ups carry 4-6 loads per day.

Waste transported in % of waste generated in Batam			
Sub-district	Waste generated per day (tons)	a) Waste transported to final disposal (TPA) or processing (TPS 3R) in % of waste generated	b) Waste transported from source to temporary collection point (TPS) in % of waste generated
Belakang Padang	16	NA	NA
Bulang	7	NA	NA
Galang	12	NA	NA
Sungai Beduk	91	34%	64%
Sagulung	198	55%	59%
Nongsa	77	39%	108%
Batam Kota	188	76%	38%
Sekupang	148	50%	77%
Batu Aji	132	60%	86%
Lubuk Baja	80	265%	59%
Batu Ampar	57	61%	95%
Bengkoang	113	58%	78%
Total	**1,133**	69%	66%

Table 17 – Waste transported in % of waste generated in Batam.

The calculated handling capacity is slightly lower than the waste handling rate of 75% reported by DLH Batam. One of the explanations could be that dump trucks carry more than one load per day.

To increase the waste handling rate of Batam, investments in transporters is expected to be required, especially transporters used to transfer waste from source to TPS facilities.

Considering the historic variation in waste handling rates in Batam City (see Figure 7), investors will be concerned about the availability of waste infrastructure for collection and transfer of waste to their facility. As a result, investors will most likely require a Put-or-Pay Agreement where the government commits to compensate the investors in case of waste supply scarcity.

3.3.1 TPA Telaga Punggur

Telaga Punggur, which is the only landfill in Batam, handles most of the solid waste in Batam. The landfill has been in operation since 1997 and is managed by a special environmental service unit of DLH Batam. The daily waste volume of Telaga Punggur is 850-1,100 tons/day, summing up to 310-401,000 tons waste per year (TPA Telaga Punggur Interview, 2022). According to SIPSN, TPA Telaga Punggur handled 310,276 tons waste in 2022 (SISPN, n.d.).

General information Telaga Punggur landfill		
Indicator	Unit	Amount
Total waste volume	tons/day	850-1,100
Industry waste volume	tons/day	20
Total landfill area (permitted)	ha	48
Landfill area in use	ha	20
Area for offices	ha	5
Area for planned expansion	ha	4
Staff	no. of employees	50
Active scavengers	no. of scavengers	400

Table 18 - General information, TPA Telaga Punggur (DLH Batam Interview, 2022)

The total land fill area is 48 ha, and 20 ha is currently in operation. The landfill is reaching capacity and has therefore started development of a 4-ha new cell. Including the 4-ha in the operating landfill area, TPA Telaga Punggur is expected to have reached full capacity within 5 years.

The landfill area currently in operation is shown in Illustration 3 and the 4-ha planned expansion area is shown in Illustration 4.

Illustration 3 – TPA Telaga Punggur – existing landfill area. Photo credit: Viegand Maagøe

Illustration 4 – TPA Telaga Punggur, reserved area for construction of new 4-ha cell. Photo credit: Viegand Maagøe.

The existing landfill area of Telaga Punggur is run as a controlled landfill and the 4-ha new cell will have status as sanitary landfill.

Indonesia's definition of controlled and sanitary engineered landfills is shown in Table 19.

Design criteria for controlled and sanitary landfills in Indonesia			
Design criteria		**Controlled landfill**	**Sanitary landfill**
Cell lining	Cell lining	x	x
Leachate control	Leachate collection – gravel liner with perforated pipes		x
	Leachate collection – gravel liner	x	
Leachate treatment	Active leachate treatment (recirculation, mixers, biological chemical treatment etc.)		x
	Passive leachate treatment	x	
LFG control	LFG control – recovery and collection		x
	LFG control – passive venting	x	
Waste cover	Daily waste cover		x
	Weekly waste cover	x	
Heavy equipment	Heavy equipment – required		x
	Heavy equipment – recommended	x	

Table 19 – Design criteria for controlled and sanitary landfills in Indonesia. Source: (MEMR, 2015)

Budgetary constraints are currently stalling the development process of the landfill. The estimated costs of constructing the new 4-ha cell that fulfils the criteria of a sanitary landfill is estimated to be 1.3 million USD (20 billion IDR). Besides from the higher up-front investment costs of constructing a sanitary landfill, compared to a controlled landfill, additional budget is also required for operation and maintenance due to stricter requirements concerning leachate control, waste covers and LFG recovery.

TPA Telaga Punggur landfill has an additional 12 ha, which is permitted for waste handling and treatment. This area could be used for waste incineration or other WtE technologies.

3.3.2 Waste banks and recycling centers

In addition to the landfill, Batam's waste management system comprises of waste banks. Waste banks receive pre-sorted inorganic waste from villages. When households deliver their waste, households are paid a small amount, which depends on the condition of the incoming waste and the corresponding market value. As the name indicates, these facilities operate as "banks" where households have the option to save their money in a deposits account and later withdraw money.

Waste banks in Batam are divided into two categories: 1) waste bank units (Bank Sampah Unit, "BSU") and 2) large waste banks (Bank Sampah Induk, "BSI"). The BSUs are smaller waste banks, which receive smaller volumes of waste per year (average: 475 kg waste/year). The large waste bank (BSI) receives 383,250 kg waste/year (SISPN, n.d.).

According to DLH Batam, Batam has 197 active waste bank units, most of which are managed by community groups as shown in Table 20.

Waste bank units in Batam		
Category	No.	Status
Community Group	171	Active
School	16	Active
Institution	9	Active
University	1	Active
Total	197	Active

Table 20 – Waste bank units in Batam (DLH Batam Interview, 2022).

Meanwhile, according to the SIPSN database (SISPN, n.d.), DLH Batam has one large waste bank handling 1,095 tons of waste per year and 10 waste bank units with an average capacity of 9 tons/year.

Batam has one composting facility/TPS 3R facility (Illustration 5), which processes separated organic waste into fertilizer. The facility has been in operation since 2017 and has a daily volume of 400 kg. organic waste. The compost is sold to various customers at 0.2 USD/kg (3,000 IDR/kg).

Illustration 5 – TPS 3R and composting facility in Tiban Lama, Batam. Photo credit: Viegand Maagøe.

3.3.3 The informal waste sector in Batam

The previous sections described Batam's formal waste management system. However, Batam has a large informal sector who play an active role in the management of waste. It is common practice that scavengers/aggregators collect valuable waste streams such as plastic and metals and sell it in the market. This takes place all over Batam where waste is dumped, however most scavengers operate on TPA Telaga Punggur.

> 800 scavengers are involved in waste collection at Telaga Punggur landfill and 400 are currently active.

According to the management team at TPA Telaga Punggur, a total of 800 scavengers are involved in waste collection at the landfill and 400 are currently active. The scavengers collect 300 tons of plastic waste per month, and the scavengers pay the landfill 25,000 IDR/ton of plastic waste they remove from the landfill. This sums up to 5,811 USD per year (TPA Telaga Punggur Interview, 2022).

Illustration 6 – Scavenger at TPA Telaga Punggur landfill. Photo credit: Viegand Maagøe.

As Batam continues to upgrade the waste sector and implement more waste recycling and waste recovery, the risk of social unrest from the informal sector increases. This is already seen in other places in Indonesia, such as Jakarta where scavengers are protesting waste incineration projects. Investors of WtE in Batam should be aware of this social risk and consider ways to mitigate it by e.g., involving the informal sector to the extent possible.

> Investors of WtE in Batam should consider ways of involving the informal sector to the extent possible to reduce the potential risk of delays and protests derived from social opposition to the project.

3.4 Administration of Batam's waste sector

DLH Batam has the implementation responsibility for Batam's solid waste policies and is responsible for the operational activities of the waste sector, including transport, collection, and disposal/processing of waste. The landfill in TPA Telaga Punggur is run by a waste management implementation unit (UPTD) under DLH Batam.

It is DLH Batam's responsibility to ensure that waste facilities fulfil regulatory requirements and safety standards. DLH Batam also holds the regulating authority when it comes to issuing environmental permits for solid waste infrastructure.

With support from DLH Batam and other specialized agencies, Bappelitbangda is leading the long-term development planning of Batam. Coordination of infrastructure investments with respect to fulfilment of government programs and policies is one of the tasks of Bappelitbangda. This also includes assuming a long-term view on the resiliency of waste infrastructure with respect to population growth and economic growth in Batam.

As it is stated in ministerial regulation on the implementation of waste facilities and infrastructure (MPWH 03/2013), the general planning of waste infrastructure and facilities includes a) Masterplan, b) feasibility study, and c) technical planning, and d) management of waste. It is required to conduct feasibility studies in relation to the planning of WtE facilities processing over 100 tons waste per day. The feasibility study, which covers the technical, economical, and financial feasibility, may be conducted by the government or private developer. And it follows that the study is deemed financially feasible if the retribution income is higher than the operating or capital recovery costs.

The regulatory responsibility for SWM is split between two authorities and this may result in delays in WtE projects.

While DLH Batam assumes responsibility for solid waste management, BP Batam is regulating and managing hazardous waste and wastewater in Batam. This division of responsibilities within the waste sector can pose a challenge for investors in WtE. Challenges may relate to potential delays in the permitting processes, since two different agencies sit on the regulating authority. The environmental approval process for WtE is relatively extensive partly due to the number of residues generated from the production process (flue gas, bottom ash etc.).

Another consequence of the split authority within the waste sector is that it becomes difficult to undertake holistic and coordinated planning of infrastructure and incentives structures as this requires collaboration between different authorities.

Sub-district heads and villages assume responsibility for waste handling in and around villages reflecting delegation of autonomy as stipulated in local regulations. Sub-districts and villages thus handle the collection and transfer of waste from households to TPS facilities. In exchange, DLH Batam provides infrastructure, such as TPS facilities and smaller waste transporters such as rickshaws. However, as mentioned earlier, the infrastructure provided to the collection and transfer in the districts is insufficient. For instance, only 16 rickshaws have been delivered to the 9 districts located on the main island of Batam.

Communities rely heavily on voluntary community groups (CSOs), NGOs and social enterprises to facilitate waste bank operations.

With support from DLH Batam, sub-districts and villages are also responsible for waste reduction at the source and recycling of organic and inorganic waste at local waste banks and TPS 3R facilities. Communities are responsible for running the waste banks and Batam's one TPS 3R facility in Tiban Lama. Communities rely heavily on voluntary community groups (CSOs), NGOs and social enterprises to facilitate waste bank operations.

The incentive for participation in waste collection and separation at the household level is the opportunity for earning an additional source of revenue in return of the recyclable waste delivered to waste banks. Whether households feel incentivized to source-separate will depend on their financial situation, educational level and whether they live adjacent to waste banks where organic waste can be sold and processed into compost and other products. Besides, villages with strong community groups are better positioned to support waste collection and waste bank operations than those with weaker community group structures.

3.5 Retribution fee collection

Households and other waste generators pay retribution fees, which is a monthly charge paid to the government for waste management services. The collection of retributions is handled by retributions officers, who are employed directly by DLH Batam. Retributions from households are paid in cash and collected manually and subsequently deposited in the bank account of the regional treasury of Batam (see

Figure 9). This manual collection process is ineffective, highly resource intensive and creates a risk of fraud.

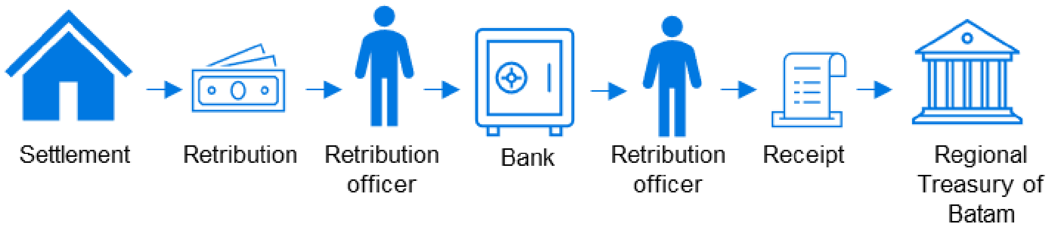

Figure 9 – Collection of retribution fees. Viegand Maagøe illustration.

Since 2018, DLH Batam environmental service unit has offered a digital retribution payment app called "E-retribusi" to three sub-districts in Batam (Lubuk Baja, Sekupang and Batam City). With this app, waste generators can pay retribution fees digitally, potentially lowering administration expenses of DLH Batam.

Illustration 7 – E-retribution app. Screen shot of a website article (DLH Kota Batam, 2018)

3.6 Conclusion – structural barriers

This chapter has identified several structural barriers for successful development and implementation of WtE in Batam. Below is an overview of identified structural barriers and a high-level assessment of the impact on the investment case.

Each of the barriers is ranked according to how it impacts the investment case of WtE and advanced Solid Waste Management (SWM) in Batam.

- The most critical barriers, which are considered showstoppers for investment, are marked ().
- Barriers, which are considered critical but can be mitigated through risk mitigation, are marked ( ).

- Barriers, which are considered less critical for the investment case, but still demand awareness, are marked ().

Structural barriers	
4. Lack of basic infrastructure for collection and transfer of waste at the local level	
The lack of basic infrastructure for transfer of waste from source to TPS facilities poses a risk for an investor who is heavily dependent on the availability of supporting infrastructure to ensure that waste is delivered to their facility.	
5. Communities bear a large responsibility for waste collection from households but lack resources and incentives	
Communities bear a significant responsibility for collection and separation of waste at the household level; however, they lack capacities, resources, and incentives to undertake this task. Since communities are responsible for transfer of waste from households to TPS facilities, low community participation has a direct impact on the waste handling rate and the availability of waste for e.g., advanced SWM or WtE.	
6. Ineffective system for collection of retributions from waste	
The current system of manual collection of retribution fees is ineffective and there is little transparency of the money transfer and usage. It has at least two implications for an investor 1) it increases the risk of corruption 2) it lowers the incentive for payment for waste handling services. Both implications pose a risk to the investors, since they jeopardize the revenue stream, which is needed to maintain the waste management sector. Meanwhile, Batam has already taken the first steps to roll-out a digital app for retribution payments.	
7. The regulating authority of waste is split between two government agencies: BP Batam and DLH Batam	
BP Batam is responsible for wastewater and hazardous waste while DLH Batam is responsible for solid waste management. The division of authority poses at least two risks: 1) it could prolong permitting and approval processes of a WtE facility 2) it lowers the possibility for holistic and coordinated planning of infrastructure and incentives structures across the waste sector.	

4 Financing of Batam's waste sector

This chapter analyses the financing of the waste sector in Batam. It reviews the financing arrangement between different levels of government and reviews the local/city government waste budgets. The chapter also reviews sources of funding for the waste sector, including locally sourced revenue (PAD) and fiscal transfers from the national budget. The chapter concludes with a summary of barriers related to budgetary constraints and the institutional structure of waste sector financing followed by an assessment of how these barriers impact WtE investments in Batam.

4.1 Local government financing in Batam

Local budgeting in Batam follows the financing arrangement of the rest of Indonesia. Batam City's budget is a combination of fiscal transfers from the national government budget to regions and village funds (TKDD), locally sourced revenue (PAD) and other revenue sources.

Fiscal transfers from the National Government budget (TKDD) associated with the waste sector include Specific Allocation Fund (DAK) and Village Fund (Dana Desa). DAK funds are used to cover capital expenditures related to physical and non-physical infrastructure, which support Batam in the realization of national priorities and waste goals. Examples are financial support for the development of waste facilities such as waste bank units, composting facilities, TPS 3R facilities, and investments in waste transport vehicles.

DAK funds are sourced from two different ministries: the Ministry of Public Works (MoPWH) and the Ministry of Forestry and Environmental Resources (MoEF). Dana Desa funds are used to finance waste infrastructure in and around villages including segregated bins, temporary collection points (TPS facilities), waste carts, transport vehicles, waste banks and treatment facilities in villages. As such, Dana Desa funds are aimed at empowering communities and providing financial support for the maintaining and developing of the waste sector at the village level. The village funds, which originally comes from the national budget are channeled and eventually allocated to the village budgets based on a set of predefined criteria such as poverty rate, village populations etc. (Vidyaningrum, 2020).

This financing arrangement is a result of the delegation of autonomy to local governments and the shared responsibility of the sector between all levels of government.

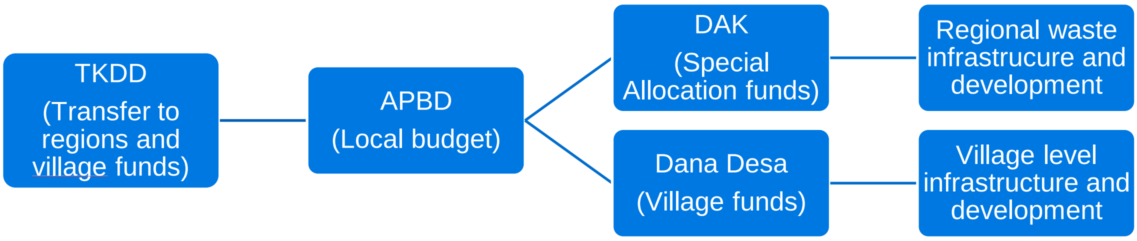

Figure 10 – Budget flow for capital expenditures in the waste sector

The total budget (APBD) for Batam City government in 2021 was 184.7 million USD. More than half is assumed to come from locally sourced revenue such as taxes and retributions.

APBD budget of Batam City government – fiscal year 2021		
	Budget [billion IDR]	**Budget [mill. USD]**
1. PAD (Local Own-Source Revenue)	1,433	92.5
Local Tax	1,156	74.7
Local Retribution	146	9.4
Local Own-Source Assets	12	0.8
Other Lawful Local Revenue	119	7.7
2. TKDD (Transfer to Regions and Village Funds)	1,087	70.2
Central Government Transfer Revenue	1,087	70.2
3. Other Revenue	341	22.0
Local Government Transfer Revenue	232	15.0
Other Income in accordance with the Provisions of Laws and Regulations	109	7.0
Total APBD budget	**2,861**	**184.7**

Table 21 – APBD budget of Batam City government. Fiscal year 2021.

4.2 Batam's waste budget

The waste budget of Batam City is handled by DLH Batam. DLH Batam submits a proposed budget to Batam City DRPD (the regional legislative representative of Batam City) for approval. If the budget of DLH is approved, it will be included in the APBD (local budget) of Batam City and stipulated in the Decree of the Mayor. In 2021, DRPD approved a budget of 69.8 bn. IDR corresponding to 4.5 mill. USD for waste management (See Table 22). Of that, 90% (4.09 mill. USD) is earmarked for operational expenditures related to the collection, transport, and disposal of waste, whereas 10% (0.42 mill. USD) is earmarked for CAPEX expenditures in new infrastructure or upgrades to the existing infrastructure.

To put this into perspective, TPA Telaga Punggur has estimated that to finance the expansion of the landfill, including installment of the legally required methane collection system, an investment of 1.29 mill. USD is needed (TPA Telaga Punggur Interview, 2022). This is over 3 times the budget allocated for CAPEX investments in DLH's budget for the fiscal year 2021.

Batam City waste budget – fiscal year 2021		
	Budget [billion IDR]	Budget [mill. USD]
Waste Reduction by Reducing, Recycling, and Reusing	1.3	0.086
Waste Handling (Sorting, Collecting, Transporting, Processing, and Final Processing of Waste at TPA/TPST/SPA)	62.0	4.004
Provision of Waste Management Facilities and Infrastructure at the Regency/Municipal TPA/TPST/SPA	6.4	0.416
Total waste budget	**69.8**	**4.506**

Table 22 - Batam City waste budget, Fiscal year 2021 (DLH Batam, 2022).

Comparing the waste budget to the total APBD budget of Batam, it is found that the waste budget constitutes only 2.5% of APBD. To understand why the APBD budget allocated for the waste sector is so low, it is necessary to look at the institutional structure around budget allocations for local governments in Indonesia.

The waste budget constitutes **2.5%** of the local budget of Batam City.

4.3 The budget hierarchy in Indonesia

Local budget (ABPD) allocation refers to the Minister of Home Affairs Reg. No. 90/2019 on Classification, Codification, and Nomenclature of Local Development Planning and Budgeting.

It follows from the regulation that ABPD funds should first and foremost prioritize 6 mandatory basic services including education, health, public works, housing, security, and social services. Furthermore, local governments are required to spend at least 20% on education and at least 10% on health. The next order of priority when it comes to distribution of ABPD funds is mandatory affairs, which comprises of +20 sectors. The environment sector is categorized as mandatory affairs and the waste budget is a subcategory of the environment sector. In contrast to health and education, there is no legal requirement for earmarking a minimum percentage for environmental affairs and waste.

There is no legal earmarking of waste sector expenditures in the public budgets.

The absence of a legal earmarking on waste sector expenditures and this hierarchical order in the budget allocation partly explains why the waste sector budget constitutes a relatively small share of APBD. On top of that, a large share of the budget is absorbed in administration and red tape (DLH Batam Interview, 2022; INSWA, 2022; Oligo Infrastructure Group , 2022).

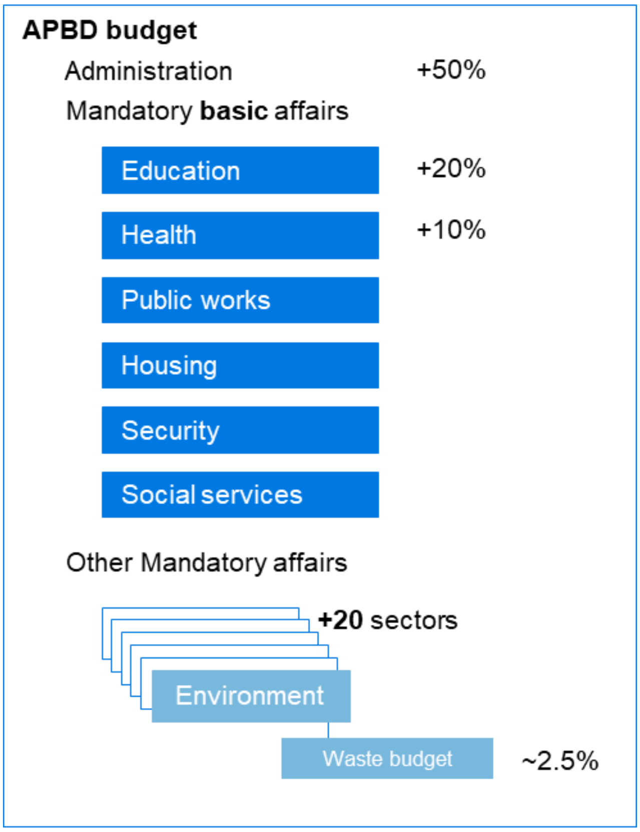

Figure 11 – The budget hierarchy of APBD. Viegand Maagøe illustration.

The lack of budget for waste management may also be explained by the fact that elected officials have an interest in prioritizing prestige projects, such as the construction of large hospitals over waste management services, since the latter may be less visible to the general public and therefore not as appealing for elected officials (Oligo Infrastructure Group , 2022).

The waste budget constraints have implications for investors of WtE who rely on supporting waste infrastructure and waste services to run efficient operations, which could impact the investor's ability to meet financial obligations. Besides, investors in advanced SWM and WtE require a higher gate fee than the current level, which would affect the local waste budgets. Increasing the waste budget will thus make WtE in Batam more attractive to investors. Meanwhile, raising financing for CAPEX investments in new transfer stations, roads or trucks will not be sufficient. The operational budget needs to follow to ensure that infrastructure is run efficiently and at the required rate.

4.4 Locally sourced revenue (PAD) for operational expenditures

Locally sourced revenue mainly constitutes of taxes, retained revenue from regional assets, retributions/levies, and other own sourced revenue. As a result of Indonesia's delegation of autonomy to local governments, all levels of government can collect taxes to finance government services (see Table 23).

Types of taxes in Indonesia		
Central Government	Provincial Government	Local Government
Income tax, Value-added tax, Sales Tax on Luxury Goods, Land and building tax on agriculture, forestry and mining, stamp (material)	Vehicle tax, Title Transfer Duty of vehicle, vehicle fuel tax, surface water tax, cigarette tax	Land and building tax, hotel tax, restaurant tax, entertainment tax, advertisement tax, non-metal and stone mineral tax, parking tax, groundwater tax, etc.

Table 23 – Taxes collected from central, provincial, and local governments.

The waste sector's contribution to PAD comes from retributions on waste through a monthly waste service charge paid by waste generators. Once collected, waste retributions are deposited in the General Regional Public Cash Account (RPCA) and subsequently used to cover government expenses. According to Article 161 of Act 28/2009 on *Retribution and Tax Regional Government Taxes & Service,* the sector contributing to a certain retribution category should also be prioritized in the allocation of the retribution revenue for government service. In other words, waste retribution should be channeled back to its sponsors through investments in waste management (collection, transfers, and final disposal). However, in practice retributions from waste do not go exclusively to investments related to waste management. As a result of weak governance, centralized decision making and competing interests, waste retribution revenue may instead be spent on administration or allocated to support other basic services within the local government. Lastly, the practice of saving waste retribution revenue into the regional public cash account (RKUD), provides very little transparency on how waste retributions are spent (Vidyaningrum, 2020). This increases the risk of budget misallocations and lowers the incentive for waste generators to pay if they find that the waste management service is not provided.

Formally, retribution rates are highly differentiated according to customer groups and income groups. The tariff of "luxury houses" is for instance 50,000 IDR/month (3.23 USD/month), while the tariff for a "simple house", which is smaller than 35 sqm, is 7,000 IDR/month (0.45 USD/month) (See APPENDIX 2). However, in practice, the system has proven highly difficult to manage, hence it is difficult to know what households really pay in retribution fees.

As part of the budgeting process, DLH sets a target for revenue derived from collection of retribution fees. As shown in Table 24, both targeted and realized retribution revenue has increased in the period 2017-2021. Over the years, there has been a small variation between targeted and realized retribution revenue.

Retribution revenue in Batam 2017-2021					
Year	Target [bn IDR]	Realization [bn IDR]	Target [mill. USD]	Realization [mill USD]	Realized/target [%]
2017	28	28.47	1.808	1.838	102%
2018	35	31.04	2.260	2.004	89%
2019	35	33.91	2.260	2.190	97%
2020	32.1	33.78	2.070	2.181	105%
2021	40	34.89	2.583	2.253	87%

Table 24 – Retribution revenue in Batam, 2017-2021 (DLH Batam, 2022).

In fiscal year 2021, realized retributions from the waste sector constituted approximately half of the total waste budget of Batam City. Retribution fees are thus an important source of revenue for the waste sector.

4.5 Financing of Telega Punggur landfill

The existing financing model of waste management facilities is often a benchmark for the level of financial support a WtE facility can expect to receive from the government. This section looks at the financial model of Telaga Punggur landfill in Batam.

Telaga Punggur landfill is funded by Batam City government and administered by a unit under Dinas LH of Batam City. The yearly costs of operating Telaga Punggur are 4.5 billion IDR. With an annual capacity of 233,627 tons in 2021, the cost per handled waste corresponded to 1.24 USD/ton. In fiscal year 2021, the total budget for waste management services in Batam was equal to 19.24 USD/ton of waste handled.

In addition to MSW from households, the landfill handles MSW from businesses. In 2021, Telaga Punggur received an average of 20 tons/day of industrial waste at a rate of 25,000 IDR/ton corresponding to 1.64 USD/ton.

As shown in Table 25, Batam City is well below the typical cost range for waste management in lower- and middle-income countries. Zooming in on the typical costs of running a controlled or sanitary landfill, typical international costs are 15-40 USD/ton.

Waste management costs – Lower-Middle income countries		
Service	USD/ton waste	IDR eq. /ton waste
Collection and transfer	30 - 75	500,000 – 1,200,000
Controlled landfill to sanitary landfill	15 - 40	200,000 – 600,000
Combined SWM costs	45 - 115	700,000 – 1,800,000
Batam City budget allocation per ton of waste handled (fiscal year 2021)		
Service	USD/ton waste	IDR eq./ton waste
Total (Collection, transfer, disposal)	19.29	119,089
OPEX, TPA Telaga Punggur	1.24	19,262

Table 25 - Typical International Waste Management Costs – Lower-Middle-Income Countries and Batam City waste management budget in USD/ton waste. (Kaza, Yao, Bhada-Tata, & Woerden, 2018; DLH Batam, 2022; TPA Telaga Punggur Interview, 2022).

4.6 Financing of advanced SWM and WtE

In the process of advancing solid waste management in Batam, a higher budget for waste handling will be needed. This includes a higher gate fee for waste handling and treatment.

In Chapter 5 of this report, a business case example of a WtE plant is presented to provide an indication of the financial viability of WtE in Batam under current framework conditions. The business case shows that a gate fee of at least 41 USD/ton is required to make a business case financially viable in Batam. The high gate fee is required because PLN Batam is not able to offer a PPA price above 7.43 cUSD/kWh.

Increasing the gate fee is challenging for several reasons. First, there is a general opposition towards subsidizing private companies who make profit out of handling waste. Second, as presented in this chapter, the local budgets are already under pressure and waste has little priority in the allocation of public finances. Lastly, increasing government budgets for gate fees requires changes in regulation.

Meanwhile, WtE projects are strongly dependent on a relatively high gate fee compensation. This is especially the case in regions like Batam where the only other major revenue stream is power sales. In regions/countries where WtE plants can monetize additional revenue streams, such as heat, the business case will be less dependent on gate fees. However, even in countries where it is possible to sign off-take agreements on both heat and power, gate fees are still an important parameter in the business case evaluation.

> WtE is not cost competitive with other renewable alternatives, hence gate fees are an inevitable and critical component of making WtE projects financially viable.

When weighing the contribution of revenue from power vs. gate fees in WtE projects, it is important to note that when it comes to power generation, WtE is not cost-competitive with other renewable alternatives. Public decision makers should therefore view waste handling as the primary driver of WtE and power generation as a positive side effect. Following this view on WtE, gate fees are an inevitable and critical component of making WtE projects financially viable.

4.7 Conclusion – financial viability barriers

This section summarizes the identified barriers which may impact the financial viability of WtE investments in Batam. Below is an overview of identified financial viability barriers and a high-level assessment of the impact on the investment case.

Each of the barriers is ranked according to how it impacts the investment case of WtE and advanced Solid Waste Management (SWM) in Batam.

- The most critical barriers, which are considered showstoppers for investment, are marked ().
- Barriers, which are considered critical but can be mitigated through risk mitigation, are marked ().
- Barriers, which are considered less critical for the investment case, but still demand awareness, are marked ().

Financial viability barriers	
8. The gate fee (tipping fee) level is not sufficient to cover advanced SWM and WtE	
To sustain a waste management system that is functioning and fulfils environmental standards and requirements, the gate fee must be higher than the current level in Batam, which is estimated to be 1-2 USD/ton. Due to the high CAPEX for WtE and the assumed PPA price of only 7.43 cUSD/kWh, a gate fee of around 41 USD/ton is required to realize a break-even (see also business case evaluation in Chapter 5). This is not realistic considering the budget constraints of the city government.	
9. The pecking order of local budgeting negatively impacts the operation of the waste sector	
The waste sector has very little power and influence over the APBD budget allocations due to the position of the waste sector in the budgeting hierarchy. As a result, the waste sector budget share is only around 2.5%.	
10. Insufficient retribution fee level	
With the current system of waste retribution, households have little incentive to pay their fees. Part of the explanation is the lack of budget for transfer and collection of waste, which means that there are some villages that don't get their waste picked up even if the households have paid retribution fees. Secondly, while waste retributions are supposed to be spent on waste management activities, in practice, waste retributions may also be spent on mandatory basic services (e.g., health sector) or government administration.	
11. Limited autonomy to DLH Batam when it comes to waste sector spending	
Although the responsibility of waste management is formally and legally delegated to local governments, Batam City government is strongly dependent on national government funds and is therefore obliged to follow national regulation on how funds are spent and distributed.	

5 Business case for WtE

This chapter presents a business case example of a potential WtE project in Batam. Starting with a description of a typical business model for a waste incineration plant (PLTSa) in Batam, costs, revenue, customers, resources, value propositions and channels are described. This leads to an analysis of key assumptions for the business case calculations. The chapter concludes with an economic evaluation of the business case and analyzes how a series of uncertainties may impact the case for the investor.

Viegand Maagøe

5.1 Business model for a WtE project

Applied to an investment prospect such as waste incineration, the Business Model Canvas (BMC) illustrates how a company plans to turn a profit from the investment. The model answers key questions such as who contributes and benefits from the investment, which activities are needed to create value to customers and profits to the company, and how value is created.

BMC is a simple and common approach to presenting a business model. In Figure 12, we have applied the BMC on a typical waste-to-energy project to highlight the primary considerations that lie ahead of an investment decision.

<table>
<tr>
<td rowspan="2">Key partners

Waste suppliers (local government and waste management companies)

Suppliers of technology and services (e.g., EPC companies)

Public agencies (permitting issues and approval of gate fees and potential grants)

PLN Batam (responsible for off-take agreements on electricity)</td>
<td>Key Activities

Environmentally sound treatment of municipal solid waste

Production of power from municipal solid waste

Installation, operation, and maintenance of WTE facilities</td>
<td rowspan="2">Value proposition
Securing environmentally safe disposal of Batam's municipal waste and clean electricity delivered to the regional grid.</td>
<td>Customer Relationships
Municipality (on behalf of waste generators)

PLN Batam (power offtake)</td>
<td rowspan="2">Customer Segments
Transmission grid operator, PLN Batam, on behalf of electricity users connected to PLN Batam's grid in

The local government responsible for waste management in Batam, on behalf of waste generators (DLH Batam)</td>
</tr>
<tr>
<td>Key Resources
Technology (furnace, pumps, piping, emission control etc.)

Knowhow (waste management and power generation)

Access to finance (e.g. grants, commercial bank loans)</td>
<td>Channels
Waste supply agreements with local government and/or waste management companies

Export of power to the local PLN grid in Batam</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Investment costs for piping, waste storage, furnace, engines, emission control/cleaning, SCADA system,
• Operational costs (O&M), technical management, insurance, taxes, transportation services
• Financing costs (debt and equity),
• Disposal and handling of residues/rejects</td>
<td colspan="2">Revenue Streams
• Power price agreement (PPA) with PLN Batam including feed-in tariff (FiT) for WtE.
• Gate fee for waste received under waste supply agreements.</td>
</tr>
</table>

Figure 12 – Business Model Canvas (BMC) applied to a waste incineration project

The business model is important for the subsequent financial analysis since the business model provides an overview of up- and downstream relations, customer segments and channels.

It should be noted that waste incineration projects with private financing will typically be structured as a Public Private Partnership where the private party (for which the business model is described above) is organized in a Special Purpose Vehicle (SPV), which is a limited liability company established solely for the purpose of designing, building, operating, and financing the waste incineration facility.

5.2 Technology description

The technology chosen for the business case calculation is a grate-fired incineration plant. With over 2,500 plants worldwide, grate incineration is a well-proven technology (DEA, DEPA & COWI, 2021).

In a grate-fired boiler, waste is typically burned unprocessed which means that no pretreatment is needed. The combustion occurs in the furnace on a grate and the flue gas passes through the internals of the boiler with water-cooled walls. It then passes the superheater and moves to the economizer. Like a conveyor belt, the grate ensures that incoming waste is transported from waste feed until it leaves the grate fully combusted. The grate can be controlled in terms of waste flow, grate movement, and combustion air injection below the grate.

Steam is produced and can be led to a turbine for production of electricity and/or heat/steam. The low-pressure steam from the turbine is cooled in an air-cooled condenser (ACC) if not utilized for industrial purposes like process steam/hot water and condensate is returned to the feed water system for the boiler. When the flue gas leaves the boiler, it leads to a flue gas treatment system typically using bag house filters purifying the flue gas for dust/particles, acid gases like SO_2 and HCl, and heavy metals. Dioxins/furans are captured by injecting activated carbon in the flue gas and NO_x by injecting either urea or ammonia water (NH_4OH) into the combustion chamber.

The process of generating electricity, steam, and/or heat (also called CHP - Combined Heat and Power if steam/heat is included) can be divided into five overall stages:

1. Reception, mixing, storing, and feeding of residual/general MSW/C&I waste - *(“Material processing”)*
2. Combustion in a grate fired boiler that produces high pressure superheated steam - *(“Combustion”)*
3. The steam turns the blades of a steam turbine that generates electricity (and potentially heat/steam for other purposes) - *(“Power generation”)*
4. An air pollution control system removes pollutants from the combustion gas before it is released through a stack - *(“Environmental controls”)*
5. Ashes are collected from the boiler (bottom ash) and the air pollution control system (fly ash) – *(“End products”)*

Figure 13 is a simple diagram that shows the process.

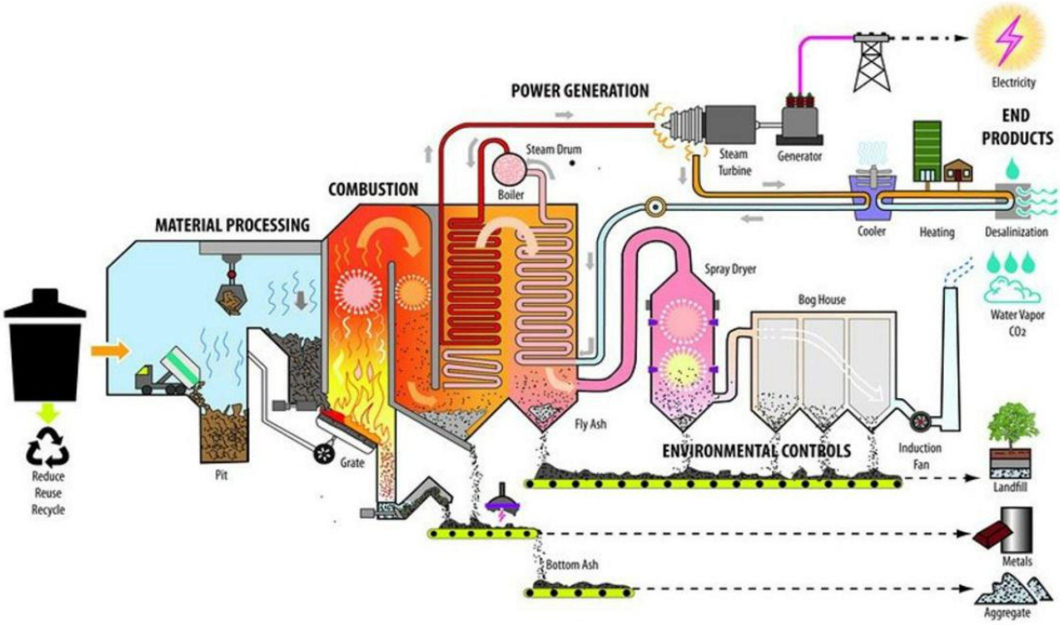

Figure 13 – Waste-to-energy process (IEA, n.d.)

5.3 Design capacity

The design capacity of a WtE facility should consider the availability and quality of municipal solid waste (MSW), which is the resource for the incineration process. In this respect, it should be assessed how MSW develops and varies (both in volume and quality) over time. Ideally, plants are designed for continuous full load hours to increase return of investment. As such, designing for overcapacity compared to available MSW should be avoided. However, if the designed capacity is too small, investors will not benefit from economies of scale.

The annual waste generation of Batam is ~486,000 tons in 2022. Of that, 75% of was handled by the system, corresponding to ~310,000 tons/year. Based on these assumptions it is deemed realistic to design a WtE plant with a capacity of 100,000 tons/per year.

The most feasible location for a WtE facility is the 12-ha available land area at TPA Telaga Punggur in the southeastern part of Batam.

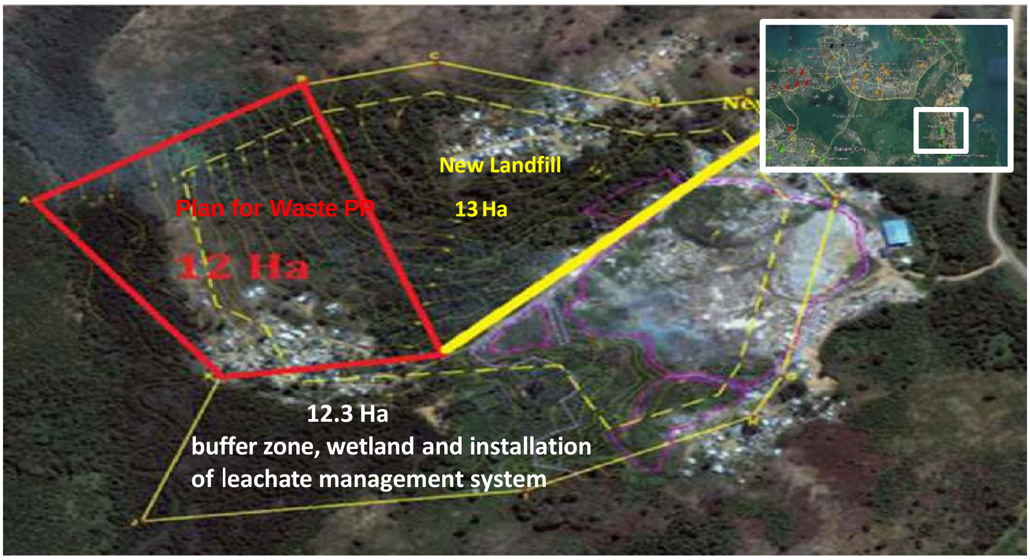

Illustration 8 – Telaga Punggur. Source: DLH Batam, 2021.

5.4 Waste composition and calorific value

When it comes to the quality of the waste, MSW with low organic fractions is desired since organic waste is more wet and therefore results in lower calorific values.

The business case calculation assumes a calorific value of waste of 8 GJ/ton, which is in line with the technology catalogue conducted by DEA, DEPA & COWI (2021).

Over time, the 'quality' of waste (in terms of energy content per ton) in Batam is expected to change due to increased adoption of source separation of organic waste at the household level and increased recycling rates. While the former results in higher calorific values of available MSW, higher recycling of e.g., plastic waste will pull the calorific value in the opposite direction.

It is recommended to conduct a more thorough study of calorific value including annual variation (e.g., influence from rainy season) and an assessment of the increase in caloric value taking various future implementations into account (e.g., more thorough source separation of organic waste) since calorific value can have a significant impact on the financial viability of WtE projects.

5.5 Plant operation

It is assumed that the WtE plant is a base load unit handling incoming MSW on a 24-hour basis. Since there will be fluctuations in the delivery of waste, the plant must be equipped with a waste bunker with a storage capacity of up to 5 days.

A modern WtE plant is designed for continuous operation and an availability of approx. 8,000 hours. For the business case 7,900 equivalent full hours annually is assumed.

The electrical efficiency of a modern WtE plant depends on factors like steam parameters, cooling principles, outdoor temperatures and how optimized the steam cycle is. Thus, the electrical efficiency can vary between approx. 20% and 30%. In the business case, a conservative estimate of 26% electric efficiency is assumed.

The surplus energy (dissipated heat) can be used for production of low-pressure steam or hot water. In Europe, the surplus energy including the energy in the flue gas is used to produce district heating. As district heating is not available in Batam, utilization of surplus energy is not assumed in the business case. However, in theory, it may be possible to utilize surplus energy for cooling purposes in Batam (absorption cooling). Alternatively, if the plant is located near an industrial center, companies may want to off-take steam or hot water from the WtE plant, or it could be used for desalination of sea water if relevant.

5.6 CAPEX

Capital expenditures for a WtE facility have a very high impact on the project viability and it is thus important to put some effort into the estimation. Factors, which have an impact on the total project costs, include:

- **Authority requirements**. Stringent air emission limits may introduce extra equipment requirements, e.g., extra scrubber to purify ammonia slip from a SNCR plant for NO_x-purification.
- **Choice of technology**. Different technologies may have different needs for maintenance, e.g., refractory vs. Inconel 625 cladding in the boiler.
- **Steam data and thus electrical efficiency**. The higher the steam data, the higher the maintenance.
- **Procurement**. A competitive situation is necessary to lower the price as much as possible.

As shown in Table 26, The World Bank estimates capital expenditures of 190-400 USD/annual ton in China and 600-1,000 USD/annual ton in Europe.

World bank CAPEX estimates for waste incineration		
Country/Region	**Indicator**	**Value**
China	USD/annual ton	190-400
Europe	USD/annual ton	600-1000

Table 26 – CAPEX expenditures in China and Europe. (World Bank, 2018)

By comparison, the Cross-Sectorial Technology Catalogue for SWM and Energy for Batam and Kepri Islands (Batam) estimates CAPEX for a WtE plant to range between 450 and 770 USD/annual ton plus 10-40% for civil structures and logistics (DEA, DEPA & COWI, 2021).

The capital expenditures for a grate waste incineration plant in Batam are therefore assumed to be equal to 600 USD/annual ton (2022 prices). For a plant with a designed capacity of 100,000 tons/per year, the resulting CAPEX is 60 million USD.

It should however be emphasized that the current market is extremely volatile, and prices have increased substantially over the past 1-2 years. Thus, there is a high uncertainty related to the above CAPEX figure and it is recommended to obtain budgetary prices if more detailed business case calculation with less uncertainty should be requested.

5.7 OPEX

Operational expenditure (OPEX) consists of salaries for staff, costs for maintenance and residues disposal costs.

5.7.1 Fixed O&M: Salaries and other fixed costs

Fixed O&M costs include salaries, administration, insurances, and other costs that are necessary to run the facility.

Salaries depend on the level of education and management responsibility. Annual salary expenses in Batam are estimated to range between 4,000 and 17,000 USD/employee on average (see Table 27).

Estimated salary costs in Batam (USD/employee/year)			
Salary category	**Low cost**	**High cost**	**Average**
Manager	11,623	23,245	17,434
Skilled/educated workers	5,424	11,623	8,523
Staff admin, unskilled workers	3,254	5,424	4,339

Table 27 – Estimated salary costs (USD/year) in Batam

A greenfield WtE facility is estimated to require a staff of around 40 people consisting of 2 managers, 25 skilled workers and 13 unskilled/administrative workers. Applying the average salary costs from Table 28, the total costs for salaries for a WtE plant is around 300,000 USD/year.

Estimated annual costs allocated for salaries for a WtE facility in Batam		
Salary category	**No. of staff**	**Annual costs**
Plant manager	2	34,868
Skilled workers	25	213,082
Staff admin, unskilled workers	13	70,511
Total	40	318,461

Table 28 – Estimated annual costs for salaries for a WtE facility with a capacity of 100,000 tons of waste per day.

Staffing will depend on the possibility of outsourcing certain functions and whether production patterns allow for part-time hires. The number of shifts to cover a full year of operation is indicative as it strongly depends on local conditions concerning work hours regulation.

Additional fixed costs should be expected, such as insurance costs, administration costs and other costs.

For the business case, total annual fixed costs, including salaries and other costs, are estimated at 0.5 million USD.

5.7.2 Maintenance costs

Maintenance costs consist of costs related to undertaking daily maintenance and major annual maintenance jobs, which require a full stop of operation. Modern WtE plants typically require one annual maintenance as components are normally designed for one year of continuous operation.

Maintenance may be carried out by permanent staff, or it may be outsourced. It is common practice that daily maintenance is carried out by permanent staff while the annual maintenance is often outsourced to external maintenance contractors or the original equipment manufacturers. It is also possible to sign an operations and maintenance contract with a third party.

For the business case, annual maintenance cost is assumed to be 2% of CAPEX. The 2% is expected to cover the daily maintenance activities and as well as larger maintenance works like replacing the grate or the superheater bundle.

5.7.3 Bottom ash residues

The amount of bottom ash leaving the grate is highly dependent on the incoming waste. Bottom ash typically constitutes 15-25% of incoming waste on a weight basis and only 10% on a volume basis.

Bottom ash residues must be handled. Handling of bottom ash requires some degree of sorting, and sorting is often outsourced to a contractor. Bottom ash is normally landfilled or recovered for road construction purposes. The latter normally requires changes in regulation.

In very few places, valuable metals like gold and silver are separated. This requires a very sophisticated sorting plant.

For the business case a cost of 0 USD is assumed, since bottom ash is expected to be recycled for e.g., road construction purposes. It is assumed that the value of the bottom ash is offset by the costs and overhead of the bottom ash contractor.

5.7.4 Air Pollution Control (APC) residues

Residue from the flue gas cleaning system, also called APC residue, is a mixture of dust and particles, activated carbon, and lime, and it contains hazardous substances like heavy metals and dioxin/furans. Thus, it must be treated as hazardous waste.

The amount of APC residues is dependent on the type of incoming waste but also dependent on the air emission limits set by the authorities.

Typically, the amount constitutes between 3 and 5% of the incoming waste on a weight basis. For the business case an amount of 3.5% is assumed. A cost of 80 USD/ton for landfilling at a hazardous waste landfill is assumed.

5.7.5 Consumables for flue gas cleaning

The design principles and consumables of the flue gas cleaning system are highly dependent on the air emission regulation.

Typically, a dry system consisting of a baghouse filter with injection of quick lime/hydrated lime and activated carbon is sufficient. Quick lime/hydrated lime is used for removal of acid gases and heavy metals while activated carbon removes dioxin and furans as well as the gaseous part of mercury. Additionally, either urea or ammonia water is injected into the boiler combustion chamber to reduce NO_x.

For the business case approx. 100 kg of hydrated lime/hour is assumed.

It is assumed that an amount of 20 kg/h of ammonia water and 3-4 kg/h of activated carbon should be sufficient. Costs for urea/ammonia water and active carbon are, however, not included at this stage as the amount is small and expenses are expected to be low.

5.8 Financing costs

Infrastructure facilities such as a WtE facility will, depending on the stability of framework conditions, normally be able to obtain a significant share of debt financing at competitive commercial rates from third parties such as banks and pension funds. This provides project developers and equity investors with a leverage which means that their equity investment can obtain a significantly higher return than the debt capital (against a higher risk of loss if things go wrong as the equity is on the bottom of the capital structure).

In relation to framework conditions, the key requirements that lenders as well as equity investors will consider are:

- The ability to secure a long term PPA for sale of produced power at foreseeable (fixed or market based) energy prices.
- The ability to secure a Put-or-Pay arrangement on a Minimum Waste Volume at a foreseeable gate fee.
- Contract provisions which are compliant with international best practice; and
- The credibility of the legal system in case of disputes and contract breach.

Separately, the lenders providing the debt capital will demand that project budgets comply with a required minimum Debt Service Coverage Ratio (DSCR), which is the net operating income divided by total debt service (which includes the principal and interest payments on a loan).

For the business case calculation, it is assumed that a private investor will finance the WtE investment with a combination of debt (with an interest rate of 5%) and equity (with a required return on equity of 15%). Assuming a 70%-30% debt equity ratio the Weighted Average Cost of Capital (WACC) is 8%.

The model calculates in real 2022 USD prices, (without inflation) since it makes it easier to compare and interpret results. When calculating in real terms it is implicitly assumed that inflation in costs and energy prices are aligned. WACC is also calculated in real terms.

5.9 Revenue streams

The revenue streams for a WtE facility typically consist of two main sources: 1) the sales of power and 2) a gate fee per ton of waste received on site. Depending on the market, other revenue streams may be available, such as carbon credits and the sale of excess heat for industrial purposes. In this simple business case, it is only the PPA price and the gate fee compensation that are modelled.

If nearby industries or large infrastructure projects like malls, airports etc. could utilize excess heat in the form of process steam or hot water the business case could be improved. However, the challenge is to base the financial close on contracts with industries as this isn't necessarily a secure long-term revenue stream. Thus, the use of excess heat is not included in the business model.

5.9.1 PPA price

The PPA price reflects the price of electricity sold to PT PLN Batam excluding transmission costs. As described in section 2.5, PT PLN Batam is a separate entity and therefore not eligible for government subsidies for renewable energy technologies.

As a result, PT PLN Batam is expected to offer a PPA price, which is equal to or lower than the average generation costs (BPP) of Batam, which was 74.3 USD/MWh in 2021.

A PPA price of 74.3 USD/MWh is therefore assumed.

5.9.2 Gate fee

When a private developer assumes the responsibility to undertake a waste management service, it is normal practice that the party responsible for waste services provides compensation. In the case of household waste, the responsibility lies with the local government, hence it is assumed a government responsibility to compensate the private developer. The compensation is also called a “gate fee”. The gate fee is a price per ton of waste handled by a waste treatment or disposal facility. A WtE developer may decide to negotiate a separate contract for industrial waste, in which case the gate fee will be settled with the company responsible for industrial waste.

The gate fee in the business case calculation is determined according to what is required to obtain financial viability (break-even) if all other input assumptions follow the baseline scenario. The required gate fee to realize break-even is 41 USD/ton. By comparison, the gate fee paid by industrial customers to the TPA Telaga Punggur landfill is only 1.6 USD/ton (25,000 IDR/ton).

The required gate fee to realize break-even is 41 USD/ton. By comparison, the gate fee paid by industrial customers to the TPA Telaga Punggur landfill is only 1.6 USD/ton (25,000 IDR/ton).

Recognizing that it is challenging to negotiate a gate fee of 41 USD/ton with the local government of Batam, a sensitivity assessment is performed to analyze the impact on IRR in case of a lower gate fee.

5.10 Business case evaluation

The technical assumptions of the business case are summarized in Table 29.

Technical assumptions of the business case			
Parameter	**Unit**	**Input**	**Remarks**
Capacity	Ton/hour	12.5	Equivalent to 98,750 tons/year
Calorific value of MSW	GJ/ton	8.0	Assumed calorific value when source separating organics
Operation hours (full load)	Hours	7,900	Equivalent full load hours
Boiler efficiency	%	85	
Power production, gross	%	26	
Power, own consumption	kWh/ton	70	Power for fans, pumps, ACC, etc.
Heat production	MWh	0	Export of heat or steam
APC residues	%	3.5	Amount of air pollution control equipment residue in percentage of amount of MSW (weight)
Bottom ash	%	20	Amount of bottom ash in percentage of amount of MSW (weight)

Table 29 – Technical assumptions used in the business case calculation

Based on the above assumptions, the WtE plant will have the following performance data:

Performance data			
Parameter	**Unit**	**Value**	**Remarks**
Fired capacity	MW	27.8	Waste to energy input
Gross power capacity	MWe	7.2	
Power (own consumption)	MWe	0.9	
Net power capacity	MWe	6.3	
Annual power production	MWh	49,770	Full load assumed at all times

Table 30 – Performance data

Assumptions on project cash flows and financing costs are provided in the following tables.

Assumptions on project cash flows in the business case			
Parameter	**Unit**	**Input**	**Remarks**
CAPEX	USD/ton/year	600	Equivalent to a total CAPEX of 60 million USD
Planning period	years	25	Depreciation period
Maintenance	% of CAPEX	2	
Fixed costs	mUSD	0.5	Staff, admin, insurance, PCs etc.
Variable costs	mUSD	Approx. 3.2	Potential usage of urea or ammonia water for $DeNO_x$ and activated carbon not included
Power price	USD/MWh	74.3	Equal to 100% of BPP in Batam
Heat price	USD/MWh	0	
Gate fee	USD/ton	41	Gate fee required to obtain break-even/financial viability in the baseline scenario

Table 31 – Assumptions on project cash flows in the business case

Assumptions on financing costs in the business case			
Parameter	**Unit**	**Input**	**Remarks**
Debt share	%	70	Assumed share of debt
Cost of debt	%	5	Interest rate in real terms
Equity share	%	30	Assumed share of equity
Cost of equity	%	15	Required return on equity in real terms
Weighted average cost of capital (WACC)	%	8	$(70\% \; x \; 5\%) + (30\% \; x \; 15\%) = 8\%$

Table 32 – Assumptions on financing costs

When assessing the financial viability of a WtE facility for a private sector investor, a key criterion is whether the project Internal Rate of Return (IRR) is equal to or above the Weighted Average Cost of Capital (WACC) for the Investor. At IRR, the NPV of the negative cash flows equals the NPV of the positive cash flows, hence where IRR=WACC, the investment "breaks even".

Using the above assumptions, the business case returns an IRR of 8% and an NPV of 0.

Results of the business case calculation		
Parameter	**Indicator**	**Value**
Project net present value (NPV)	mUSD	0
Project internal rate of return (IRR)	%	8

Table 33 – Results of the business case calculation

5.11 Sensitivity assessment

In this section, a sensitivity assessment is performed with the purpose of analyzing how it affects IRR if key assumptions in the business case change. Sensitivity assessments have been performed on three variables: gate fee, PPA price and lifetime of the project.

The impact on IRR at different PPA prices and gate fees is shown in Table 34. The green cells in the table indicate combinations of the PPA price and the gate fee, which return a positive business case (IRR≥WACC). For instance, assuming a WACC of 8%-real (excluding inflation), if an investor is offered a gate fee of 40 USD/ton, the PPA price needs to be at least 80 USD/MWh to reach the break-even point of the business case. This demonstrates that the gate fee is very critical for the investment case in Batam.

IRR (%)		**PPA (USD/MWh)**					
		70	80	90	100	110	120
Gate fee (USD/ton)	10	0%	1%	3%	4%	5%	6%
	20	3%	4%	5%	6%	7%	8%
	30	5%	6%	7%	8%	9%	10%
	40	7%	8%	9%	10%	11%	12%
	50	9%	10%	11%	12%	13%	14%
	60	11%	12%	13%	14%	15%	16%

Table 34 – Overview of sensitivity of IRR against the PPA price and the gate fee.

Finally, an extension of the lifetime of the facility from the base case 25 years by an additional 10 years to a total of 35 years will have a positive impact on the business case. A 10-year lifetime increase is expected to require a reinvestment in 2025 of around 10% of the initial CAPEX. An extension from 25 to 35 years is normally seen on WtE plants in Europe and elsewhere as a lot of the equipment have a lifetime longer than 25 years.

Assuming a lifetime increase of 10 years to 35 years, the related reinvestment of 6 million USD in year 25, as well as a PPA price of 74.3 USD/MWh, the investor needs, in an all-things-equal-scenario, a gate fee of 37 USD/ton to realize break-even (IRR=8%) compared to 41 USD/ton for the base case with 25 years lifetime.

Extending the lifetime can be problematic from a financing perspective, since lenders/financiers will require documentation (PPA contract) that the project cash flow is secured throughout the financing period of 35 years. Meanwhile, the standard PPA contracts for WtE power plants with PLN Batam are 25 years and maximum 30 years from commercial operation date (COD).

Investors will furthermore require a municipal 'put or pay' guarantee to ensure high-capacity utilization of the facility. The municipality can reduce their exposure by defining the WtE facility as the 'designated waste treatment facility' in waste collection contracts and/or licenses for waste collection operators. This means that waste generators are legally required to handle waste at the WtE facility. If the ability of the municipality to provide an acceptable put or pay guarantee is limited it may be difficult to attract bidders who do not have a parallel interest in waste collection in the region and through this can guarantee the access to collected waste.

5.11.1 Tax incentives

Tax incentives may improve the financial viability of the business case. In Indonesia, renewable energy power plants are eligible for tax holidays under the conditions stated in MoF Regulation 130 (see Table 35).

A WtE facility processing 100,000 tons waste/year, for which the investment cost is estimated to be 60 million USD, will be eligible for 100% exemption from corporate income tax for at least the first 5 years and 50% exemption for the following 2 years. The Corporate Tax Rate in Indonesia is currently 22% (2022).

Tax incentives could be an instrument, which turns a marginal project into an attractive project for an investor. It will however not in itself save a fundamentally unprofitable project.

Tax holidays for new and renewable energy power plants			
Capital Investment (IDR)	Capital Investment (USD)	Tax holiday (100% tax exemption on corporate income tax), [years]	Additional corporate tax rebate, [%, years]
≥500,000	≥35 million	5-20 years depending on CAPEX size	50% for following 2 years
100,000-500,000	7-35 million	5 years	25% for following 2 years

Table 35 – Tax holidays for new renewable energy power plants as stated in MoF Regulation 130/PMK.010.2020 and BKPM Regulation No. 07/2020 (OECD, 2021).

6 Investors and ownership models of WtE

This chapter assesses sources of financing and investors' motivations and preferences when it comes to WtE. This is followed by an analysis of pros and cons of different ownership models. The chapter concludes with a recommendation of Public Private Partnership (PPP) as the most ideal ownership structure of WtE.

6.1 Investment decision factors

The previous chapters unveiled the underlying barriers of investment in WtE in Batam. These barriers translate into real or perceived risks for investors which can have a significant impact on the financing costs and the private sector's willingness to invest. The financing risk and hence the financing costs can thus be expressed as the sum of all project risks, including, but not limited to, information asymmetry risks, technology risks and regulatory risks.

> The financing risk and hence the financing costs can be expressed as the sum of all project risks, including, but not limited to, information asymmetry risks, technology risks and regulatory risks.

In principle, any investor will look for projects where the risk/return profile is balanced. In other words, in a situation where there is high regulatory uncertainty, financial incentives should be available to compensate for the higher risk profile.

Meanwhile, investors have different preferences when it comes to investment horizon, risk profile, financial return, technology choice and strategic considerations. Some investors will prefer low risk projects, whereas others have an appetite for high-risk projects with high returns.

Investors can be divided into three overall groups: RE producers,
RE consumers and financial investors. Each investor category will be described in the following sections.

6.1.1 Investor group: RE consumers

RE consumers include commercial and industrial end-users, public and private institutions such as hospitals and village/household cooperatives.

Highly energy intensive consumers of energy, such as data centers, will be motivated to have access to reliable, stable power supply, which can be provided by WtE, which is a base load energy source. In addition, data centers are often associated with global companies, like Amazon, who are exposed to public opinion. Investing in clean energy, such as WtE, is one way to enhance public opinion. Besides, it can function as a carbon offset mechanism, particularly in regions where the share of renewables in the energy mix is low. However, this requires that an offsetting system is in place.

> RE consumers generally prefer projects with longer investment horizons and lower risk profiles than purely financial investors.

Industrial end-users have similar motivations for investing in WtE. Moreover, industries typically generate large volumes of industrial waste which can be recovered for energy production as opposed to being dumped at a landfill. Thus, the strategic considerations for investing in WtE for industrial end-users are strongly linked to sustainability and climate mitigation considerations. Yet, financial return expectations associated with savings on energy expenses are expected to be the primary motivation.

RE consumers generally prefer projects with longer investment horizons and lower risk profiles than purely financial investors. RE consumers typically rely on a combination of financing, incl. own-sourced capital, debt, and leasing arrangements.

6.1.2 Investor group: RE producers

The second group of investors are known as RE producers. Their main business is within development, production, distribution, and sales of electricity based on renewables.

Independent power producers (IPPs) and utilities fall within this group, including investor-owned and municipally owned utilities. Both types of investors are active in the Indonesian clean power market. Assuming the utility's perspective, PLN may view investment in WtE as a mechanism for diversifying its energy supply to customers – both to ensure stable and reliable energy and to increase the share of renewables in the mix. However, the power generation potential of solid waste is limited compared to coal and gas due to differences in availability. Moreover, government subsidies for domestic coal power production and use deter PLN from actively seeking alternatives to coal. Finally, due to the complexity concerning feedstock supply agreements and operation of a WtE plant, PLN may not represent a likely investor, as the complexity tends to favor investors representing existing players in the solid waste management sector.

Private developers of WtE generally look for long investment horizons and an acceptable return. Meanwhile, the required return depends on the expected future cash flows of the investment and the financing mix.

> Private developers of WtE generally look for long investment horizons and an acceptable return.

Whereas municipal governments may have access to low-cost debt financing, private investors rely on a mix of debt and equity, which increases the costs of capital and the required return of the investment. The pecking order of creditors, which assumes that creditors with higher seniority or "rank" are paid first while creditors with lower seniority are paid second, explains why equity is more costly than debt. As shown in Figure 14, debt service is paid back before taxes, and before dividends to shareholders. This higher cost of equity is a way to compensate for this pecking order where shareholders – compared to debt holders - are more exposed in the case of insolvency or default.

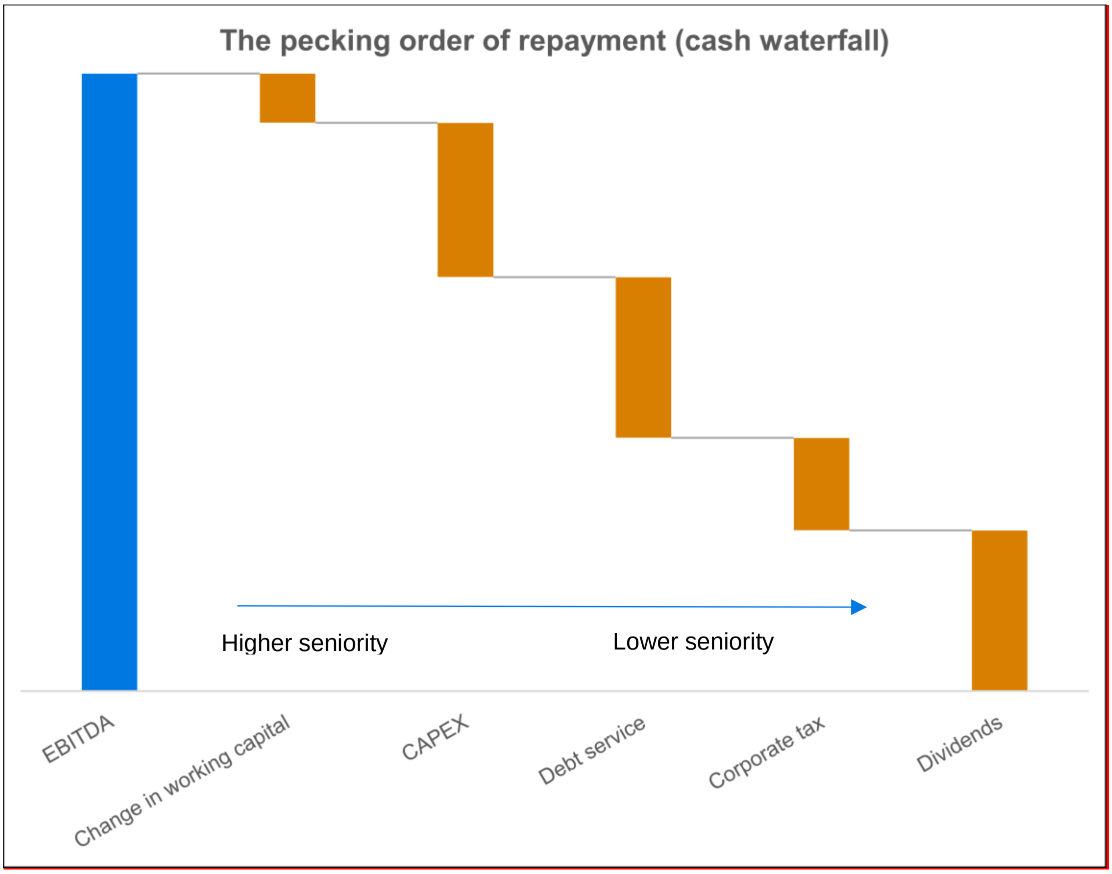

Figure 14 – The pecking order of financing repayment/cash waterfall.

6.1.3 Investor group: Financial and institutional investors

The third group of investors are financial investors such as banks or institutional investors.

Financial investors are neither consumers nor producers of energy but exclusively capital providers. The primary decision factor for financial investors is to obtain financial return on investment and to diversify their investment portfolios. However, sustainability is increasingly becoming a concern – even for financial investors.

Financial investors differ quite significantly from other types of investors when it comes to risk profile and required return; institutional investors, such as pension funds and insurance companies, are typically more risk averse and therefore also require lower return on investment. Investment banks have a higher risk appetite and therefore also require higher return on investments.

> Institutional investors are typically more risk averse and therefore also require lower return on investment.

6.1.4 Waste-to-energy investors' decision factors

As covered in the previous sections, the group of potential investors is large and diverse when it comes to preferences, investment horizons and strategic considerations. Common for all investor categories is that a project must be bankable and therefore must be able to document measurable and predictable revenue streams.

Typical investment decision factors of WtE investors are visualized in Figure 15 and described subsequently.

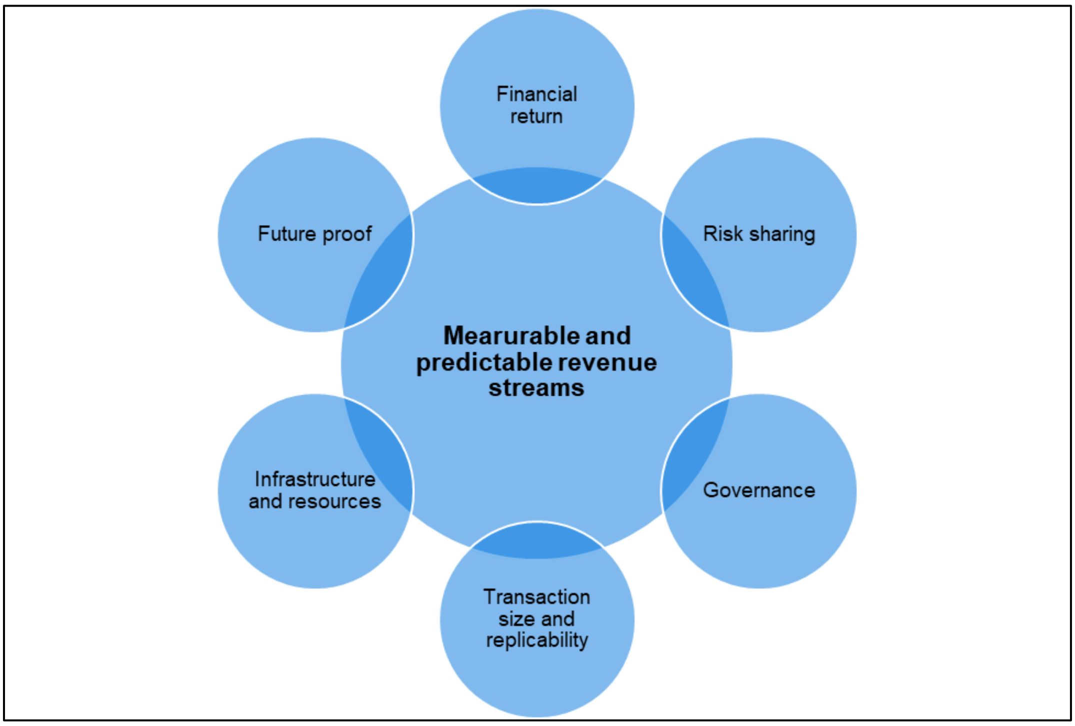

Figure 15 – Investment decision factors for waste-to-energy investors. Source: Macquire GIG, 2020.

Financial return is the primary decision factor when it comes to any investments, including WtE. As previously mentioned, the return requirement depends on the investor, its risk appetite, strategic considerations, and the costs of capital among other things.

Risk sharing between the public and private sector needs to be in place to attract private sector financing. Risk sharing entails e.g., that the local or national government provides construction permit guarantees and certainty on policy and regulation. The latter could involve regulations stating that certain waste streams must be transferred to the dedicated facility. In exchange the private sector assumes design, construction, financing, and operational risk of the facility.

Governance is another parameter, which is critical for the investor. Strong governance entails e.g., transparent and reliable procurement processes, clear definitions of roles and responsibilities between government institutions and the private sector. Strong governance improves investors' confidence since it lowers the risk of any disputes in relation to the investment.

Transaction size and replicability are important to most investors when it comes to WtE. Investors tend to prioritize large-scale projects due to the economies of scale. Moreover, where possible, investors often look for investments which are replicable. The reason being that the first project is often the costliest and it is often the case that learnings obtained in the first project, can be transferred to later projects, lowering the risks and costs of subsequent investments.

Infrastructure and resources are prerequisites for investing and therefore typically part of the initial due diligence undertaken by the investor. When it comes to WtE, resources include access to feedstock in sufficient volume and quality. An investor will typically require that the project developer document a binding long-term feedstock agreement at an acceptable price. When it comes to infrastructure, the investor will need to see a grid interconnection agreement, which guarantees off-take as well as a plan for delivery of waste, whether this is the responsibility of the private or public sector.

Future proof is the concept of assuring that the WtE plant is robust to changes in policies, waste compositions, and volumes throughout the economic lifetime of the plant. In this respect, it is critical that the developer can show to the investor that future waste flows and the power demand profile have been considered in the design of the plant to avoid that the plant is "over dimensioned".

6.2 WtE ownership structures

Three different ownership models/project setups exist each with their own sub-variants:

- Public sector ownership
- Private sector ownership (BOO)
- Public Private Partnerships (PPP)

6.2.1 Public ownership

Publicly owned and financed facilities are where the public sector engages with the private sector through a turn-key EPC (engineering, procurement, and construction) contract to build the facility, but retain responsibility over plant operation and maintenance, consumables, byproducts, power sales, etc. The public sector delivers the waste through its own collection.

A publicly owned and financed project will require heavy involvement from regional governments and a willingness to accept significant development risks, which potentially may result in higher waste treatment costs. This type of project is often seen in northern Europe as it gives the owner a high degree of influence on design and future operation. Operation and maintenance of the facility could potentially be outsourced to the private sector.

A publicly owned WtE plant is not realistic in most places in Indonesia – including Batam. The primary reason is budgetary constraints followed by weak governance and institutions to run efficient operations.

> Due to constraints in the government budget, a WtE plant based on 100% public ownership is not realistic in Batam.

6.2.2 Merchant plants (private ownership)

A privately owned facility or merchant facility is where the private sector would both finance and own the WtE facility and oversee the project development. This is also referred to as Build-Own-Operate (BOO). If a transfer of the assets after a certain period, e.g., 20 or 25 years is included, it is referred to as a BOOT.

The private party would be responsible for operation and maintenance as well as consumables, by-products, power sales, etc. The public sector potentially secures a site for the WtE facility.

Waste contracts are also under full responsibility of the private party, and this is a high risk for the private investor. The risk sharing feature of Public Private Partnerships (PPP) where long-term agreements are made between the public and the private sector is therefore often more attractive for the investor. PPP is described in the following section.

6.2.3 Public Private Partnership (PPP)

A Public Private Partnership (PPP) is a long-term contract-based cooperation where the public sector transfers the general responsibility for the delivery of a public service to a private company, while the public assumes political accountability.

Promoting the involvement of the private sector can take a variety of forms of cooperation between the private and the public sector depending on whether these are based on a short-term service contract, a concession, a joint venture etc. It is critical, however, to consider the length of contracts for successful private sector participation. For collection, relatively short contracts of 3-5 years are common in developed markets and 5-8 years when there is no good secondary market for vehicles. Contracts could potentially be renewable after 1-2 years upon satisfying performance. For disposal/treatment facilities, like WtE, long term contracts that match the lifetime of the asset (20-25 years) are appropriate.

It is important to establish a structure for measuring and ensuring future performance. On the part of the contractor, failure to meet contractual targets should trigger a meaningful level of payment abatements or financial penalties. These should be summarized in the supporting key performance indicators and detailed in the associated contract terms.

> It is important to establish a structure for measuring and ensuring future performance in PPP projects.

Well-run, transparent bidding processes ensure that bidders are comfortable with the proposed contract documentation structure. A pre-bid dialogue allows for amendments if requested by one or more bidders and accepted by the government. International experience suggests that extensive government-side project preparation helps attract committed bids from appropriately experienced and qualified companies and streamlines the bid award process. Furthermore, if the nature of the transaction is made clear to all parties from an early stage, implementation of projects becomes more efficient and predictable.

The key driving force for the application of PPP models (compared with traditional public procurement) should be that it offers overall better value for money for the government. This basically means that the project delivers better quality without additional cost or a lower price without lowering the quality. Summing up, the motivation for choosing PPP over public ownership includes:

1. Closing the public finance gap through mobilizing of financial resources from the private sector
2. Improving operational efficiency through performance incentive mechanisms

3. Optimizing lifecycle costs through design decisions that reduce O&M costs.[1]

International experience shows PPP can be optimized through mobilizing the measures described in the table below.

Measures that improve the condition of PPP as an ownership model for WtE	
1	Optimal allocation of risks (the party best able to control a risk should also be responsible)
2	Output based specifications (regulating service delivery rather than inputs)
3	Private sector management competences (enabling efficiency gains)
4	Performance based contracts (with payments being linked to actual service delivery)
5	Design Build Operate phase in one contract (allowing innovation and whole life costing)
6	Maintaining competition in the procurement process

Table 36 – Measures that can improve the conditions of PPP as an ownership model for WtE

Choosing a PPP model also has downsides. This includes high transaction costs and high complexity and length of contract negotiations resulting in a loss of future flexibility. For instance, the locked-in nature of contracts makes it difficult and costly to harvest opportunities that arise in the future. Furthermore, it is important to remember that ultimately, the money still must come from the users, the budget, or donors. Most governments therefore require detailed appraisal of PPP projects including:

- Assessment of Project Feasibility (is it technically feasible) and Economic Viability (does it make sense for society)
- Assessment of Commercial Viability (is it financially viable)
- Value for Money Assessment (is it better than traditional alternatives, if any public money or guarantee is involved)
- Assessment of fiscal Implications (if any public money or guarantee is involved).

Expanding private sector involvement in the delivery of SWM services through Public Private Partnerships (PPP) has been successfully adopted throughout developed and developing countries. In more established markets, a variety of landfill and WtE developments have successfully utilized private sector developers and operators under performance-based contracts.

[1] The optimization of lifecycle cost is through design decisions that reduce O&M costs – it is different from operational efficiency which is due to performance-based incentives

7 Public instruments supporting WtE

This chapter analyses available public instruments, which could be used to 1) reduce investor risk, 2) transfer risks from the private to the public sector or 3) compensate investors for the risks they take when they assume a public service obligation such as waste management.

7.1 Public instruments

Chapter 6 covered investors' motivation factors for engaging in WtE while Chapter 2-4 covered the underlying barriers, which constitute private sector risk. This Chapter zooms in on public instruments, which lower, transfer, or compensate for risks faced by the private investor.

Public instruments can be divided into policy and financial de-risking instruments and direct financial incentives.

- **Policy de-risking** is the concept of removing or lowering the underlying causes of the risks, e.g., inadequately developed framework conditions. Policy de-risking instruments related to WtE investments include, for instance, institutional capacity building and supporting energy and waste management policy designs. Since it is unlikely that policy instruments can remove all risks associated with WtE investments, efforts to improve the risk/rewards profile also involve financial de-risking instruments.

- **Financial de-risking** is the concept of partially transferring private sector financial risks to the public sector. An example of financial de-risking is the provision of political risk insurance or loan guarantees by development banks.

- **Direct financial incentives** can further improve the risk/reward profile through provision of price premiums, tax rebates or exemptions, or carbon off-sets. As such, direct financial incentives are economic compensations for the underlying risks reflected in a higher return on investment (Waissbein, Glemarec, Bayraktar, & Schmidt, 2013).

The impact of implementing a combination of a policy de-risking instrument, such as a landfill ban on combustible waste, and a direct financial incentive, such as a gate fee premium, is illustrated in Figure 13.

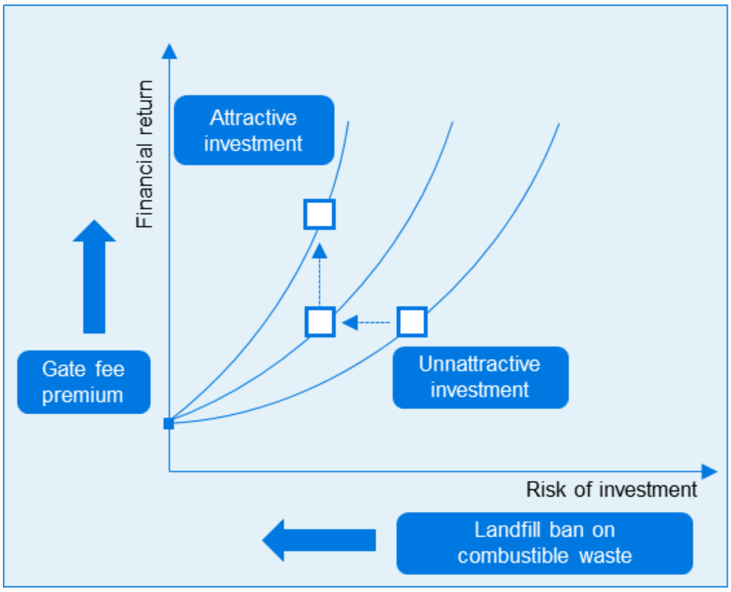

Figure 16 – Moving the risk-return profile of a WtE investment. Source: Glemarec (2011), modified.

As shown, a combination of public instruments may turn an unattractive investment into an attractive investment.

Several public instruments are available to address the financing and investment gap of WtE. The following section presents relevant public instruments, which have been deployed in other regions of the world.

Some public instruments can be deployed at a local level, while others require national intervention.

7.2 Policy de-risking instruments

Within the WtE sector, the most effective policy de-risking instruments are landfill diversion instruments, such as landfill bans and landfill levies. Landfill diversion instruments create a disincentive for landfilling, thereby lowering feedstock supply risks for investors of WtE. From the government's perspective, having supporting regulation that ban waste on landfills or direct waste to designated facilities lowers the government's risks in connection with a Put-or-Pay guarantee. A Put-or-Pay guarantee is typically signed between the government and the owner of the WtE plant and specifies that the government has a financial obligation to cover lost revenue in case of a waste supply scarcity.

7.2.1 Landfill bans

Landfill bans on waste can be an effective mechanism for directing waste away from landfill. A landfill ban is often phased in starting with the most hazardous forms of waste to eventually cover a range of waste streams and waste categories for which alternative use or disposal opportunities exist. The ban can relate to the potential end-use of waste or it can be attached to specific waste products, such as plastic waste. In the former case, the landfill ban could include combustible waste. Introducing this form of landfill ban would typically be driven by a political priority to utilize waste for power generation. Where the motivation is to spur investments into processing and treatment facilities, landfill bans on organic waste or yard waste can be an effective mechanism. As an example, the five states in the United States with the largest number of composting facilities also have landfill bans on yard waste (US EPA, 2022).

Landfills bans may also be linked to the volume of waste generated and can thereby target large generators of waste.

Landfill bans are common in developed countries and have increased the lifetime of landfills and resulted in higher recycling and recovery rates. In Denmark, all waste types, which are suitable for either incineration or recycling, have been banned on landfills since 1997. In combination with other incentives, the landfill bans have accelerated heat and power generation from incineration of municipal solid waste.

Instead of imposing a landfill ban on waste – or "certain" waste streams like combustible waste – the government may implement legislation, which specifies that waste must be directed to a waste recovery facility. To avoid the issue of imposing a law before the infrastructure is available, the regulation can be structured on a conditional basis. For instance, in parts of the United States, large food waste generators are required to recycle their food waste only if there is an organic waste facility (composting or anaerobic digestion) within a certain distance from the waste generation location (US EPA, 2022).

7.2.2 Landfill levies

As described in previous chapters, industries and households pay waste retribution to the local governments for handling of waste services. The retributions are directed to the landfills through waste service compensations also called tipping or gate fee allocations. Telaga Punggur landfill receives what corresponds to ~1.6 USD/ton in gate fees from industries. Meanwhile this gate fee is not sufficient to cover the costs of sanitary landfills or more advanced solutions, such as waste incineration as described in Chapter 4.

Introducing higher gate fees that are specific to landfills ("landfill levies"), creates a disincentive for landfilling, making investments into more advanced solutions such as waste incineration more attractive.

Landfill levies have been introduced in Australia – ranging between 40 and 100 UDS/tons (see Table 37). The landfill levies have been implemented with some variation across the different provinces. In Southern Australia the landfill levy is 50% lower for non-metropolitan areas. In Queensland, the landfill levies only apply to 38 of the 77 local government areas.

Landfill levies in selected provinces in Australia		
Province (Australia)	Indicator	Landfill levy
Queensland	USD/ton	50
New South Wales	USD/ton	100
Western Australia	USD/ton	40-60
Southern Australia	USD/ton	40-60
Australian Capital Territory	USD/ton	60-100

Table 37 – Landfill levies in selected provinces of Australia (Aph.gov, 2023) The numbers are proxies. An exchange rate of 0.7 USD/AUD is assumed.

Landfill levies have been the main driver for the acceleration of WtE projects in Australia.

Denmark has also had landfill levies since 1987, which, in combination with landfill bans and other public instruments, has reduced landfilling of waste significantly. According to DAKOFA (2022), Denmark has one of the lowest landfilling rates (5-6%) in Europe.

7.2.3 Emissions quota system

One of the major barriers of incineration in Batam is the continued support for domestic coal power production and sourcing, as it puts renewable alternatives, including WtE, at an unfavorable position. An example of a policy de-risking instrument, which could enhance the competitive position of WtE technologies and other renewables vis-à-vis fossil-based alternatives are quotas on emissions. An emissions quota system puts a cap on emissions and in the case where a polluter emits more than its allowance, the polluter (e.g., coal power plant) must purchase carbon offsets. A WtE plant benefits from this mechanism in two ways: On the one hand, they can participate in a market for quotas by selling carbon offsets from the saved CO_2 emissions generated. On the other hand, they receive an indirect competitive advantage vis-à-vis e.g., coal power plants, where production costs increase due to the requirements to purchase carbon offset to live up to its allowance (quotas).

Indonesia has already taken the initial steps in creating a national framework for a carbon trading system, which includes emissions trading. According to the regulation, an emissions trading system (ETS) is expected to be mandatory for the power sector in 2024. A carbon tax will be imposed on those who fail to live up to their obligations in the ETS. The carbon tax will be based on the domestic carbon market but with a minimum price threshold of 2 USD/ton of CO_2 (MoF, 2022).

7.2.4 Reform of the waste retribution system

The current waste retribution system is ineffective and complex to manage. Whereas legislation is in place concerning differentiated payments accounting for the economic level of households and the size of businesses, there are far too many categories, and the consequence is that most collection officers charge the same fees to all customer groups. As a result, waste retribution collection does not account for different economic levels.

Furthermore, there is no direct link between the services provided by DLH Batam and waste retributions. On the one hand, retribution fees may be collected even if waste is not collected. On the other hand, DLH Batam is obliged to collect waste even if retribution fees are not paid, creating a disincentive for both waste collection and payment of retribution fees.

A reform of the waste retribution system is needed. A reform should consider ways to improve incentive structures and lower expenses related to administration and collection of payment. Furthermore, effective models for differential payments should be considered to ensure waste services are affordable to all economic groups in Batam.

> A reform of the waste retribution system is needed.

Below is a list of possible initiatives that may be considered in relation to a reform of the waste retribution system in Batam.

1. **Incorporate payment of waste services into property taxes**
   Waste retribution fees can be paid via property taxes. This way, retribution fees account for the economic level of households while lowering administration costs related to collection of fees.

2. **Higher development and service taxes for tourists**
   Increasing development and service taxes for tourists could raise locally sourced revenue (PAD) available for public services without increasing costs for Batam's residents.

3. **Introduce a combined utility bill**
   Combining utility payments into one bill covering waste, water, and electricity, lowers administration costs in relation to collection of fees. It also enhances incentives for waste payment since electricity or water supply can be withheld in case of lacking payments.

4. **Digital waste retribution payment**
   Collection of waste retribution could be digitalized and automatized to lower administrations costs.

The above initiatives have the potential to enhance incentives for payment of waste retribution and lower administration costs while ensuring that waste services are affordable for all economic groups.

However, including the waste retribution into a collective utility tax has a downside, since it makes it more difficult to track revenue flows. This could generate negative spill-over effects, such as lower transparency of public spending. To address this risk, it is recommended to introduce a minimum spending requirement for waste services in the government budget to ensure that revenue collected from waste retribution is also spent on waste services.

7.3 Direct financial incentives

Direct financial incentives are often used to improve the level playing field of renewable investments vis-à-vis coal power production and other fossil-based alternatives. Examples of direct financial incentives are feed-in-tariffs on power produced with renewable sources.

7.3.1 Introduce a "load" subsidy

WtE is a base load thermal energy form. Any energy system needs baseload energy generation to ensure stability of supply. Today, Batam has sufficient baseload generation due to a high share of coal. However, in the future, Batam needs to phase out coal and other fossil fuels to align with national climate and renewable energy targets. Meanwhile Batam has few base load renewable energy sources available. A specific base-load subsidy for renewable thermal generation could foster investments into WtE, while lowering Batam's dependence on coal.

7.3.2 Revisit Perpres 35/2018 and larger roll-out

Perpres 35/2018 was enacted to create attractive conditions for WtE plants in 12 so-called "emergency cities" in Indonesia. The purpose of the legislation was to provide an alternative to landfilling in cities where landfills must close because of safety reasons (risk of landslides etc.).

While Perpres 35/2018 has spurred development of WtE in some cities, including Tangerang City and Sunter outside Jakarta, there is less traction in other parts of Indonesia. Barriers of Perpres 35/2018 is that the gate fee compensation (up to 32 USD/ton) is not guaranteed but requires application and that it requires a 50% co-investment from local governments. Where local governments have been unable to provide co-financing, private investments have stalled.

While Perpres 35/2018 has spurred development of WtE in some cities, including Tangerang City and Sunter outside Jakarta, there is less traction in other parts of Indonesia.

To spur investment into WtE, a proper framework needs to be in place. Amendments of Perpres 35/2018, which could accelerate investments into WtE in Batam include:

1) Expand Perpres 35/2018 to all large cities in Indonesia (e.g., cities with population above 1 million).
2) Remove the conditions on local budget contributions in regions/cities with strained budgets.

3) Introduce a FiT for PLTSa offered to projects developed in cities (e.g., Batam) currently not covered by government regulation concerning renewable energy support schemes.

7.4 Financial de-risking instruments

Private developers of WtE can choose to make use of financial de-risking instruments to lower the risk profile of an investment. Financial de-risking is the concept of transferring risk from the private to the public sector through financial market instruments. The instruments may address specific risks, such as off-taker supply risks, or general project risk associated with an investment.

Examples of financial de-risking instruments are concessional loans, grants and guarantees. The following sections present financial de-risking instruments relevant for the WtE sector.

National and multinational development finance institutions (DFIs) play an important role in facilitating and providing financial de-risking instruments in developing countries.

7.4.1 Concessional loans

Concessional loans from the public sector are loans with more attractive terms than can be achieved in the market. This includes longer tenors, lower cost of capital and longer grace periods. DFIs offer concessional loans to increase the supply of capital for renewable energy investments, incl. WtE. To be approved for concessional loans, the borrower must provide a guarantor. Thus, if a WtE developer wishes to a obtain a concessional loan for a share of the financing, it must be backed by a guarantee or partial guarantee, which assures that the Indonesian government steps in, in case the developer is unable to repay principals and interest to the DFI as agreed in the contract.

7.4.2 Guarantees

A guarantee is a contractual obligation between two parties, which states that certain conditions must be in place in a financial transaction, and if those criteria are not fulfilled, the obligating party pays compensation. Guarantees are important risk mitigation instruments in WtE projects.

A Put-or-Pay guarantee is central in WtE projects due to the risk associated with waste supply deliveries and waste quality. A Put-or-Pay agreement is a contract under which a government entity agrees to supply a predefined waste volume at a certain price during a specific period. In case the government party is unable to fulfil its obligation, the contract provides a financial compensation covering any costs incurred to the private investor.

> A Put-or-Pay guarantee is central in WtE projects due to the risk associated with waste supply deliveries and waste quality.

Typically, a Put-a-Pay contract also covers waste quality criteria since it can have a significant impact on the heating value and the yield of a WtE project.

Off-taker risk guarantees may be relevant in Indonesia to ensure that the cash flow is recovered in the event financial circumstances cause PLN to not fulfil the terms of the PPA contract.

Waste infrastructure projects that are structured as Public Private Partnerships (PPP) are eligible for guarantees from Indonesia Infrastructure Guarantee Fund (IIGF) conditioned that the projects fulfil the criteria stipulated in Presidential Regulation No. 38 Year 2015 on Cooperation between Government and Business Entities in Infrastructure Provision. The guarantee ensures that the private party is compensated in case a public contracting party is unable or unwilling to pay for the contracted public service, or if government action/inaction (change of law, expropriation etc.) causes early termination of project default (iisd.org, n.d.).

IIGF is a state-owned enterprise established in 2009 with the purpose of removing the barriers of private sector financing in public infrastructure projects (iisd.org, n.d.).

7.4.3 Grants

A grant is an award, usually financial, given by one entity (typically a company, foundation, or government) to a company (or individual) to support a goal or an agenda. Grants are financial instruments often used in combination with other instruments (e.g., guarantees or concessional loans) to address a financing gap.

Depending on the grant size, grants can help pay off debt faster thereby increasing the probability of attracting risk averse lenders with limited track record or ability for long-term finance. Grants are often conditioned on predefined results to reduce moral hazard risks related to inefficient use of funds. This form of result-based financing is typically based on future cash flows, but it may also be based on non-financial indicators. However, in many cases, the model is less attractive, since it does not address the large capital need in the initial project period. Therefore, even if grants are available, pre-financing is needed to cover initial investment costs.

> Grants are often conditioned on predefined results to reduce moral hazard risks related to inefficient use of funds.

Instead of distributing grants over the project lifetime, the total grant can be paid in the initial project phase, so-called frontloading. Frontloading of grants reduces the capital requirements of the project, which can result in more favorable loan financing. Meanwhile, frontloading is particularly exposed to moral hazards. It is therefore common to offer result-based frontloading, whereby the grant must be repaid if pre-defined conditions are not met.

7.5 Development finance institutions (DFI)

Development finance institutions (DFIs) are government-backed national/multinational banks investing in private sector projects in developing countries. Examples of development finance institutions active in Indonesia are, among others, World Bank Group (WBG), Asian Development Bank (ADB) and Indonesia Infrastructure Investment Fund (IIF).

As one of the founding members of Asian Development Bank (ADB), Indonesia is the sixth largest shareholder of ADB (5.43% of total shares). Over the years, ADB has provided 42 billion USD in public sector loans, grants, and technical assistance to Indonesia. In December 2021, ADB signed a 600 million USD loan to PLN earmarked for technical assistance concerning the strengthening and expanding of the power grid in Western and Central Java.

Over the years, ADB has provided 42 billion USD in public sector loans, grants, and technical assistance to Indonesia.

Within WtE, DFIs invest in a range of programs and projects, including government capacity building, technical assistance provision and financing, transaction advisory for developing PPP projects, sovereign financing, mobilizing commercial co-financing and knowledge sharing and promoting partnerships between international and local firms (Macquire GIG, 2020).

The International Finance Corporation (IFC), which is part of WBG, has advised on one of the first Public Private Partnership (PPP) projects based on MSW in Indonesia. IFC initially proposed a financing package of 94 million USD from IFC out of a total project sum of 224 million USD (MoF, 2022). However, the Sunter WtE project has been significantly delayed due to administration and funding issues.

The growth in power generation in Indonesia can partly be explained by a large inflow of development finance and financial support from Export Credit Agencies (ECA).

Between 2016-2019, 40% of financing of Indonesia's power generation came from DFI and ECA (OECD, 2021). Indonesia received 2.1 billion USD in WBG financing earmarked waste management programs, and activities where waste management is a component of a larger urban infrastructure project. The financing is either structured as loans, investment project financing or carbon finance transactions (grants).

Between 2016-2019, 40% of financing of Indonesia's power generation came from Development Finance Institutions and Export Credit Agencies

World Bank financing for waste management and related activities in Indonesia 1997-2022		
Project name	**Total IDA and IBRD Commitment (billion USD)**	**Lending instruments/Grants**
Pontianak - LFG Recovery Project	0.0039	Carbon finance transaction (Grant)
Improvement of Solid Waste Management to Support Regional and Metropolitan Cities	0.1000	Investment Project Financing
Bekasi Landfill Gas Flaring	0.0002	Carbon finance transaction
Makassar - TPA Tamangapa Landfill Methane Collection and Flaring	0.0077	Carbon finance transaction
Bali urban infrastructure project	0.2630	Specific Investment Loan
Western Java Environmental Management Project	0.0201	Adaptable Program Loan
Indonesia National Slum Upgrading Project	1.4202	Specific Investment Loan
Global Environment Facility Indonesia Sustainable Cities Impact Project	0.0159	Investment Project Financing
Replication and mainstreaming of rekompak (community-based settlement rehabilitation and reconstruction)	0.0016	Investment Project Financing
Regional Infrastructure Development Fund	0.4060	Investment Project Financing
Total	**2.1386**	

Table 38 – World Bank financing for waste management and related activities in Indonesia between 1997-2022 (World Bank, n.d.).

Project eligibility for development finance is conditioned on the respective DFIs' assessment of the project and country in question. Lower-income countries, which face high political and economic risks (e.g., inflation) are generally first in line when it comes to receiving development finance since these countries are more challenged when it comes to attracting traditional financing. Meanwhile, the global focus on climate change mitigation is driving more development finance to lower-middle income countries with high economic growth rates.

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Indonesia is facing significant challenges with regards to phasing out coal to fulfil its climate mitigation commitments towards the Paris Agreement. Indonesia has historically been and is – up until today – heavily reliant on coal for power generation. During COP26, Indonesia announced that the country will begin the transitioning away from coal and made a pledge to decommission a quarter of its coal capacity by 2030. Indonesia now needs to invest significantly in early retirement of coal power plants and in increasing renewable energy generation capacity. This transition requires large amounts of financing from both the public and private sector.

Indonesia is facing significant challenges with regards to phase out of coal to fulfil its climate mitigation commitments towards the Paris Agreement.

7.6 CIF-Act program

In March 2021, the Climate Investment Funds (CIF) established the Acceleration of Coal Transition (ACT) program to support developing countries heavily reliant on coal with the switch from coal to renewable power generation. Indonesia was selected – along with India, South Africa, and Philippines – as an ACT pilot country. Indonesia therefore recently submitted a proposed investment program to the CIF Trust Fund Committee for review and approval. The indicative financing plan concerning scaling up renewable energy and storage is found in Table 39.

Indonesia's indicative financing plan submitted to the CIF Trust Fund Committee related to "Scaling up Renewable Energy & Storage"			
Program	Lending terms	ACT-Co- funding (mUSD)	Total investment (mUSD)
Dispatchable Renewables Program	IFC private	70	560
PT SMI ETMCP – Facilities 2 & 3 (Standby Facility and RE Loan facility)	ADB public	100	500

Table 39 – Indicative financing plan submitted to the CIF Trust Fund Committee by Indonesia with focus on component no. 3: "Scaling Up Renewable Energy & Storage".

A total investment sum of 1,060 million USD is estimated for two programs: a) Dispatchable Renewables Program and b) Energy Transition Mechanism Country Platform (PT SMI ETMCP) focused on standby facilities and RE loan facilities. The dispatchable renewables program aims to use CIF-ACT funds to attract private sector financing for project finance structures and sustainability linked loans. The other program (PT SMI ETMCP – Facilities 2 & 3) concerns scaling up renewable financing through fiscal incentives such as concessional loans.

Combined, the two programs aim to replace the thermal capacity of coal with >300 MW of dispatchable renewable power and up to 90 MW of energy storage capacity. According to the investment plan, WtE has been identified as one of potential projects under this program (MoF, 2022).

Development finance institutions (DFI) can play a key role in lowering the private sector risk when it comes to investing in WtE solutions in Batam and Indonesia. So far, the waste sector has been underrepresented in DFI activities compared to other forms of clean energy.

Development finance institutions (DFI) can play a key role in lowering the private sector risk when it comes to investing in WtE solutions in Batam and Indonesia.

Meanwhile, improved waste infrastructure is well aligned with the typical DFI objectives, such as climate change mitigation. Furthermore, new financial de-risking instruments are expected to be unlocked under the CIF-ACT program.

7.7 Conclusion on public instruments

This chapter has looked at how a series of public de-risking instruments may be used to improve the risk/reward profile of WtE investments. The instruments described in this chapter are listed in Table 40.

Some policy/financial de-risking instruments require changes in national legislation (e.g., introducing a subsidy for base load renewable power), whereas others are aimed at improving local framework conditions.

When it comes to financial de-risking instruments, the potential upside of transferring risks to a public entity must be higher than the transaction costs associated with investing in these instruments. A more detailed financial modelling exercise is required to conclude on the impact of financial de-risking instruments.

Policy de-risking instruments	
1. Landfill bans on combustible waste	Lowers the overall project risk
2. Landfill levies	
3. Emissions quota system and carbon taxes	
4. Reform of the waste retribution system	
Financial incentives	
5. Introduce a “load” subsidy	Public compensation for private sector risk
6. Revisit Perpres 35/2018 and larger roll-out	
Financial de-risking instruments	
7. Put-or-Pay guarantee	Transfer of private sector risk to the public sector
8. Off-take risk guarantee	
9. PPP guarantee through IIGF	
10. Grants and concessional financing	

Table 40– Public instruments that could enhance the risk/reward profile of WtE investments in Batam.

This report does not offer an exclusive list of instruments available for WtE but has focused on highlighting some of the possibilities for public and private sector intervention in financial market dynamics and policy implementation, which can accelerate development activity related to WtE in Batam.

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APPENDIX 1

Interview questions used for data collection.

Topic	Specific questions
Regulatory framework conditions for WtE	• What are the most significant barriers for WtE from your point of view? • In your opinion, what do you think need to change (from a regulatory standpoint) to advance WtE? • Are you aware of/ are you working on changes to the regulatory framework that would advance waste reduction/waste handling and WtE?
Roles and responsibilities	• What is your organization's role in the SWM and WtE value chain and how do you work to advance WtE? • What is your organization's interest in WtE and how does WtE support your organization's goals? • Which other organizations (whether private or public) do you have close collaboration on this specific topic?
Attracting private investments and barriers	• Generally, what is your view on the ability of your region to attract private investments for WtE? • Are you aware of concrete initiatives or funding mechanism which have been successful in attracting private investments into WtE? And are you aware of/are you working on future initiatives? • How do you assess private investors' appetite for investing in WtE and are you aware of private investors actively working on WtE projects in Batam?
Public private partnerships and project financing	• What do you consider to be the most critical criteria in securing a financially sound business case for WtE? • Do you have experience with public-private partnerships and what is your view on it as a solution for securing more financing into WtE?
Institutional barriers	• In your opinion, what are some of the most prominent institutional barriers for WtE? Institutional barriers could be waste collection, lack of coordination or cooperation between agencies/private waste companies, conflicting interests, infrastructure challenges, lack of skilled/trained labor, public opposition towards large infrastructure projects
Power generation	• On the power generation side, what is your view on the role of WtE in your region? • What would it take to increase the share of WtE
Open questions	• What is your view on WtE more broadly? (could be from an environmental, social or economic perspective..)

	• What do you believe it would take to accelerate WtE in your region? • In your opinion, what are the most significant challenges concerning development of WtE (financial, regulatory, social, environmental or technological?) • Status of the landfill, projects in pipeline etc.?

APPENDIX 2

Retribution rates in Batam City (No.11/2011). The table covers most customer groups.

Customer group	Tariff [IDR/month]	Tariff [USD/month]
House		
Very Simple House (36 m2)	7,000	0.45
Simple House (36-45 m2)	9,000	0.58
Middle House (54-120 m (>120 m2)	15,000	0.97
Luxury House	50,000	3.23
Others	5,000	0.32
Apartment		
Small (≤ 100 unit)	1,500,000	96.86
Medium (101 to 200 unit)	3,000,000	193.71
Large (≥ 201 unit)	4,500,000	290.57
Home Office		
One level	42,500	2.74
Two level	60,000	3.87
Three level	85,000	5.49
Four level	110,500	7.14
>4 level	165,000	10.65
Boarding school		
Small	175,000	11.30
Medium	350,000	22.60
Large	700,000	45.20
Dormitory		
<500 people	875,000	56.50
500 – 5,000 people	7,875,000	508.49
5,000 – 15,000 people	35,000,000	2259.96
15,000 – 30,000 people	78,750,000	5084.91
30,000 – 50,000 people	140,000,000	9039.84
>50,000 people	175,000,000	11299.80
Office		
≤ 15 people	25,000	1.61
16-30 people	37,000	2.39
31-50 people	65,000	4.20
50-100 people	120,000	7.75
101-200 people	250,000	16.14
201-300 people	400,000	25.83
310-400 people	560,000	36.16
401-500 people	720,000	46.49
501-1,000 people	1,200,000	77.48
>1,000 people	1,600,000	103.31
Restaurant		
≤60 m2	100,000	6.46
61-500 m2	497,000	32.09
561-1,060 m2	1,297,000	83.75
1,061-2,060 m2	2,497,000	161.23
2,061-3,060 m2	4,097,000	264.54

3,061-4,060 m2	5,697,000	367.86
4,061 – 5,560 m2	7,697,000	497.00
5,561-7,060 m2	10,097,000	651.97
>7,061 m2	13,649,000	881.32
Hospital/Health facilities		
	15,000-3,200,000	0.97-206.62
Mall/Plaza		
	3,500/module	0.23/module
Hotel		
	60,000 – 3,200,000	3.87-206.62
Bar/Pub/Disco		
	425,000 – 2,500,000	27.44-161.43

Waste Disposal at Telaga Punggur		
	Tariff [IDR/ton]	Tariff [USD/ton]
Waste from industrial production process of non-hazardous and toxic materials waste	25,000	1.61
Industrial waste with special treatment	75,000	4.84
Waste of building debris	25,000	1.61
Waste of expired food	75,000	4.84
Trash extermination from collateral confiscation	40,000	2.58
Cattle extermination waste	80,000	5.17
Sorted waste sent out of the landfill	25,000	1.61