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

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RESUME

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 Lombok and Batam.

The focus of this report is to assess barriers (financial, structural and regulatory) related to waste-to-energy (WtE) investments in Lombok 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 Lombok to increase private sector participation and support Lombok 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 Lombok.

As shown in Table 1, the business case returns an NPV of 14 million USD and an IRR of 10.6%. The gate fee, which returns a break-even business case in an all-things-equal scenario, is 19 USD/ton.

Results		
NPV	mUSD	14
IRR (%)	%	10.6%
Assumptions		
PPA	USD/MWh	117.7
Gate fee	USD/ton	32
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.

The assumed PPA price follows MEMR 04/2020, which determines the tariff level for renewable energy projects. The gate fee is derived based on input from private investors, who estimate that a gate fee of 32 USD/ton (500,000 IDR/ton) is required to make an investment financially viable. In comparison, the current gate fee paid to Kebon Kongok is only 3.2 USD/ton (50,000 IDR/ton). However, considering the financial constraints of the municipal budget and the lack of regulatory support from the national government, it is not deemed realistic that the local government is currently able to pay ~32 USD/ton in gate fee.

The business case gives some indications of the feasibility of WtE in Lombok, 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 Lombok.

- 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. PLN has little incentive and few financial resources to support PLTSa development	
2. Uncertainty on future regulation concerning subsidies for PLTSa in Lombok	
3. Ineffective government policies concerning waste handling and renewable energy development	
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. Low transparency and accountability of waste data	
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 when it comes to waste sector spending	

Table 2 – Barriers of WtE and advanced SWM in Lombok.

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	
1. Remove the price cap on PPA prices for PLTSa	Compensation for private sector risk
2. Introduce a “load” subsidy	
3. Revisit Perpres 35/2018 and larger roll-out	
Financial de-risking instruments	
1. Put-or-Pay guarantee	Risk reallocation - from private sector to the public sector
2. Off-take risk guarantee	
3. PPP guarantee through IIGF	
4. Grants and concessional financing	

Table 3 – Public instruments that may improve the risk/reward profile of investments

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)
BAPPEDA	Badan Perencanaan Pembangunan Daerah (Development 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 Agency at the provincial level)
DLH	Dinas Lingkungan Hidup (Environment office at the regency/city level)
DLHK	Dinas Lingkungan Hidup Kehutanan (Environment office at the provincial level)
DFI	Development Finance Institutions
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)
PERDA	Peraturan Provinsi (Provincial Regulation)
PLN	Perusahaan Listrik Negara (Indonesia's state-owned power company)
PLTSa	Pembangkit Listrik Berbasis Sampah Kota (power generated from municipal solid waste)
PP	Peraturan Pemerintah (Government Regulation)
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
RDF	Refuse-Derived Fuel
RUEN	Rencana Umum Keternagalistrikan Nasional (National Energy General Plan)
RUED	Rencana Umum Keternagalistrikan Provinsi (Regional General Plan for Electricity)
RUKN	Rencana Umum Keternagalistrikan Nasional (National General Plan for Electricity)
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik (Electricity Power Supply Business Plan)

SISPN	Sistem Informasi Pengelolaan Sampah Nasional (National Waste Management Information System
SSI	Sustainable Island Initiative
SWM	Solid Waste Management
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

Table of Content

1 Introduction

This chapter introduces the report and covers the motivation and scope of the study. It begins with an introduction to Lombok and explains why Lombok 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.

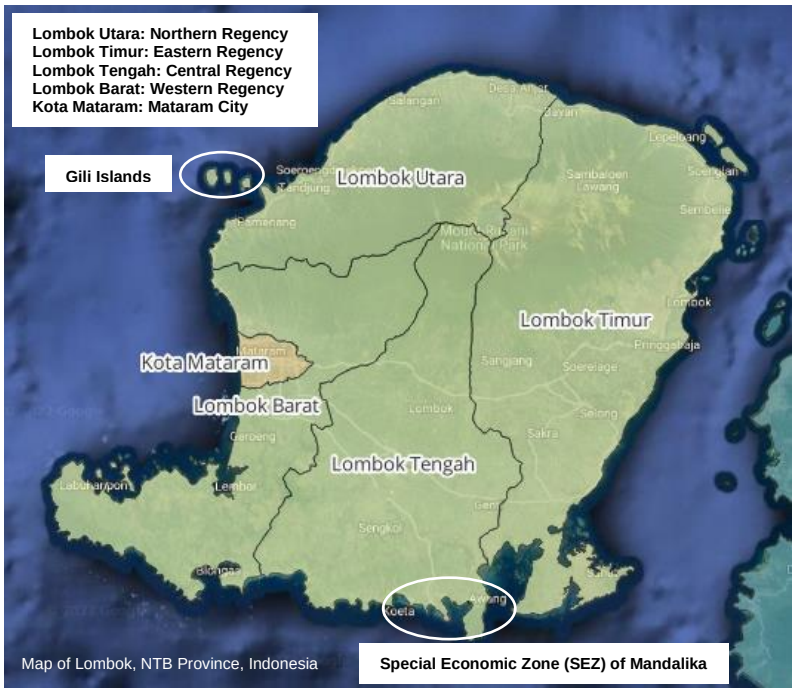
1.1 The sustainable island initiative (SSI)

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: Lombok and Batam. This study is the last study in the SSI program and focuses on the regulatory, structural, and financing barriers of WtE in Lombok.

1.2 Lombok

Lombok is one of the two main islands in Nusa Tenggara Barat (NTB) province, Indonesia. Administratively, Lombok is divided into 4 regencies and Mataram City, the capital of NTB province. In 2020, the population of NTB province was 5.3 and the majority (~3.7 million) of the population resides in Lombok (Badan Pusat Statistik). The total land area of Lombok is 4,725 km^2. Mataram City has the highest population density, while Northern, Eastern, and Central Lombok are dominated by a large rural population.



Map of Indonesia

Map of Nusa Tengarra Barat (NTB) Province

Illustration 1 – Map of Lombok and Nusa Tengarra Barat (Google Maps).

Lombok is known for its beaches, tropical forrests, waterfalls and its impressive 3,726-meter high volcano Rinjani. From Lombok, it is possible to get to the Gili Islands within 1 hour by boat, and Indonesia's most visited tourist attraction, Bali, is merely a 6-hour boat ride away. Although Bali receives many more tourists than Lombok, Lombok is endowed with similar attractions. In an effort to increase tourism and spur economic growth in Lombok, the government is developing the Special Economic Zone (SEZ) of Mandalika in the Central Lombok Regency. SEZs are geographically restricted zones where selected industries enjoy several economic benefits and regulatory exemptions (BKPM, 2021). Mandalika is one of 10 national strategic projects aimed at developing new "Bali like" tourist destinations in Indonesia. The total area of the SEZ of Mandalika

is 1,175 ha. Like Bali, Mandalika is designed for eco-tourism with a special focus on sustainability and living in harmony with the environment (ITDC, 2022).

While Lombok is increasing investments in tourism, agriculture, forestry, and fisheries remain the largest economic sectors. In 2019, agriculture, forestry, and fisheries contributed with ~25% of GDP in Western, Central and Eastern Lombok Regencies and 34% in Northern Lombok Regency.

Western Lombok and Mataram City had the highest GDP per capita in 2019 (see Table 4).

Economic growth rates in Lombok				
City/Regency	**Year**	**GDP per capita (mill IDR)**	**Year**	**Growth rate**
Mataram City	2019	40.03	2019	5.58%
Western Lombok	2019	56	2019	5.20%
Central Lombok	2017	17	2017	4.07%
Eastern Lombok	2019	16.9	2019	4.68%
North Lombok	2019	22.08	2019	5.92%

Table 4 – Economic growth in Lombok (DEPA, DEA & Rambøll, 2022).

1.3 Status of Lombok's waste sector

Like the rest of Indonesia, Lombok's waste infrastructure is dominated by landfilling. In 2022, Lombok had four operative landfills, however, the current handling system, especially in the Western part of Lombok, is under pressure. According to (DEPA, DEA & Rambøll), Lombok's largest landfill, Kebon Kongok, was expected to reach a hight of 40 metres in March 2022, unless significant actions were taken. Reaching 40 metres is considered dangeorus due to an increased risk of landslides and uncontrolled explosions. One of the measures taken by the government has been to expand the landfill with 2 ha and apply for funding from the Ministry of Public Works to expand the existing Refuse-Derived Fuel (RDF) production from 100 kg/day to 15 tons/day (DEPA, DEA & Rambøll, 2022).

Lombok's waste management system is already insufficient with a share of unmanaged waste of 59-69%. This has implications for households with no or little access to waste services as they have to handle waste on their own, resulting in dispoal of waste in open dumps and rivers and untrolled burning of waste. This malfunction of Lombok's waste sector is difficult to ignore, discouraging some tourists from visiting the island.

Lombok's waste management system is already insufficient with a share of unmanaged waste of 59-69%.

Lombok needs to find long-term sustainable solutions for the management of waste, considering the environmental and social consequences of poor waste management and the ambitions to accelerate economic activity from tourism.

The local governments of the NTB province (covering both the provincial and local governments of Lombok) have investigated WtE technologies and invited private sector participation and financing. Several feasibility studies have been completed to prepare for investment in WtE solutions. However, up to this date, no business case has shown attractive returns on investment. As a result, the interest in investing in WtE technologies in Lombok remains low.

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 Lombok 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 Lombok 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 Lombok 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

In contrast to previous studies (DEA, DEPA & COWI, 2021; DEA & Viegand Maagoe, 2022) 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 to a large extent also be applicable to cases involving 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 Lombok in August and December 2022. Questions used for the interviews can be found in APPENDIX 1.

Overview of interviewed organizations		
Organization	**Date of interview**	**Location of interview**
TSPT Bantar Gebang (DLHK, DKIJ)	12 August 2022	Jakarta, DKIJ, Indonesia
Oligo Infrastructure Group	12 August 2022	Jakarta, DKIJ, Indonesia
International Tourism Development Corporation (ITDC)	15 August 2022	Office of ITDC in Mandalika, Central Lombok, NTB, Indonesia
TPA Pengengat (DLH, Central Lombok)	15 August 2022	Landfill site of Pengengat, Central Lombok, NTB, Indonesia
Bintang Sejahtera Social Enterprise	15 August 2022	Bintang Sejahtera Waste Bank, Central Lombok, NTB, Indonesia
Dinas ESDM, NTB Province (Provincial Energy Agency)	16 August 2022	Office of Dinas ESDM, Mataram City, NTB, Indonesia
Dinas LHK, NTB Province (Provincial Environmental Agency)	16 August 2022	Office of Dinas LHK, Mataram City, NTB, Indonesia
PLN UIW, NTB province	16 August 2022	Office of PT PLN Unit Induk, Mataram City, NTB, Indonesia
Bappeda, NTB province (Provincial Development and Planning Agency)	18 August 2022	Office of BAPPEDA, Mataram City, NTB, Indonesia
BRIDA, NTB province (Regional Science and Innovation Agency)	18 August 2022	Office of BRIDA, Western Lombok, NTB, Indonesia
Indonesia Solid Waste Association (INSWA)	14 October 2022	Online meeting
Dinas LH Mataram City (Environmental agency of Mataram city)	30 November 2022	Office of DLH Mataram City, NTB, Indonesia
Dinas LH Western Lombok Regency (Environmental Agency of Western Lombok Regency)	30 November 2022	Office of DLH Western Lombok Regency, NTB, Indonesia
TPA Kebon Kongok (DLH, NTB province)	28 November 2022	Landfill site of Kebon Kongok, Western Lombok, NTB, Indonesia

Table 5 – Interviews completed as part of the data collection process.

Initial findings were presented and discussed with key decision makers during a workshop in Lombok, 29 November 2022.

Participating agencies in the workshop are listed in Table 6.

Participating agencies in the workshop			
Name	**Abbreviation**	**Service area**	**Agency**
Badan Perencanaan Pembangunan Daerah	BAPPEDA	NTB Province	Provincial Development Planning Agency
Badan Perencanaan Pembangunan Daerah	BAPPEDA	Mataram City	Regional Development Planning Agency
Dinas Energi dan Sumber Daya Mineral	DESDM	NTB Province	Department of Energy and Mineral Resources
Dinas Lingkungan Hidup Kabupaten	DLHK	NTB Province	Department of Environment and Forestry
Dinas Lingkungan Hidup	DLH	Mataram City	Environmental Agency
Dinas Lingkungan Hidup	DLH	Western Lombok	Environmental Agency
Perusahaan Listrik Negara	PLN	NTB Province	State-owned power company

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

2 Regulatory and policy framework for WtE

This chapter reviews current policy and regulatory framework conditions impacting the potential for WtE generation in Lombok. 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 concludes with a summary of the regulatory and policy barriers for development of WtE in Lombok.

2.1 Supporting policies for Waste-to-Energy

Waste-to-Energy (WtE) is a crosscutting policy and regulatory issue, which services 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 therefore necessary to look at the current framework conditions and supporting policies related to all three purposes.

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

As shown in Table 7, the provincial government of Nusa Tenggara Barat (NTB) has much more ambitious targets than the national government. For instance, NTB aims for a 30% waste reduction and 70% waste handling rate by 2023. The national timeframe for realizing the same targets is 2025. The NTB government also aims for net zero emissions by 2050. This is 10 years earlier than stipulated in the national policy.

The ambitious target setting of subnational governments is not exclusive for Indonesia, but a tendency also seen in many other countries.

WtE supporting policies		
Objective	**National Policy**	**Sub-national Policy (NTB province)**
Climate mitigation	43.2% abatement of CO_{2eq} emissions by 2030 compared to BAU scenario; Net Zero emissions in 2060	Net zero emissions by 2050
Renewable energy	23% RE share in 2025; 31% RE share in 2050	60% RE share in power generation by 2030; 100% RE in power generation in 2040
Solid waste management	30% waste reduction in 2025; 70% waste handling in 2025	30% waste reduction in 2023; 70% waste handling in 2023

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 Lombok.

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 to 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.

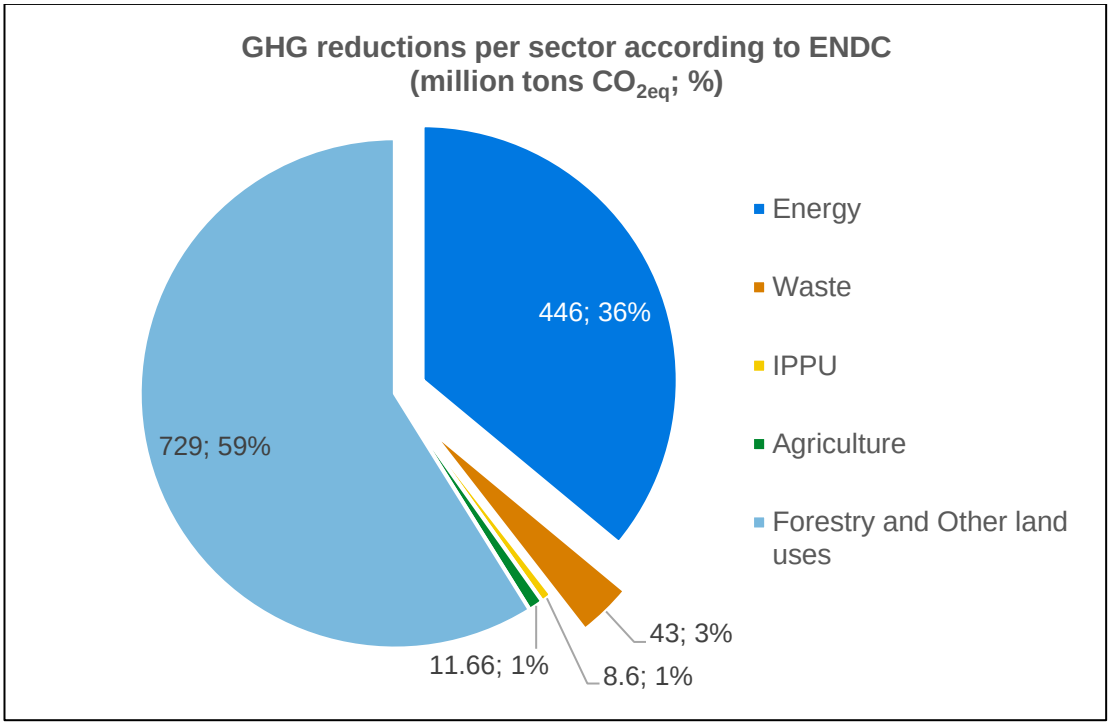


Figure 1 – Sector specific contributions to reduction targets according to Indonesia's Enhanced Nationally Determined Contributions (ENDC) submitted to the UNFCC in September 2022. Values are reported conditional commitments (UNFCC, 2022).

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.

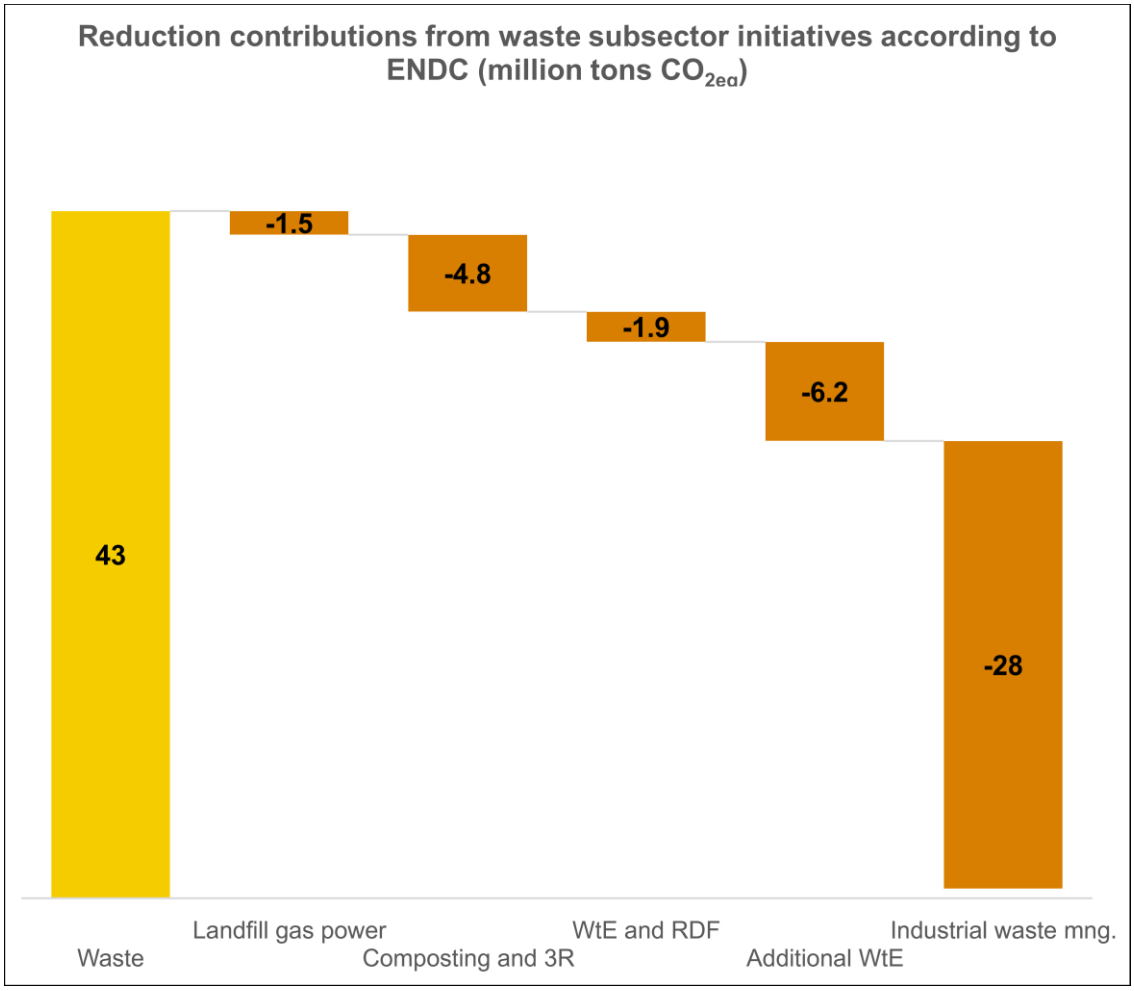


Figure 2 – GHG reduction targets for Indonesia's waste sector according to Indonesia's Enhanced Nationally Determined Contributions (ENDC) submitted to the UNFCC in September 2022. Values are reported as conditional commitments (UNFCC, 2022).

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, Presidential Regulation (Perpres) 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.

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 following section covers local waste regulations in Lombok.

2.3.2 Regional waste policies and regulation

Provincial Regulation (Perda) no. 5/2019 covers regulation of waste in NTB Province. It includes 1) waste management policies, 2) responsibilities and authorities, 3) regional waste management strategy, 4) development and application of technology, 5) area management activities, 6) bans, 7) rights and obligations, 8) information systems and guidance, and supervision. Perda 5/2019 is aligned with the national regulation Perpres 97/2017 and is commonly referred to as "Jakstrada".

In line with Perda 5/2019, NTB provincial government has launched a Zero Waste Program with an aim to realize 70% waste handling/management and 30% waste

reduction by 2023. The provincial Ministry of Environment and Forestry (Dinas LHK) has the overall responsibility for achieving the targets.

The Zero Waste Programs rest on two strategic pillars: 1) Community based waste management through waste banks and CSOs (Community Sustainable Organizations), and 2) Cooperation and partnership between different levels of government and non-governmental actors. As a result, waste management has been identified as a strategic priority in the NTB Provincial Government Medium-Term Development Plan (RPJMD 2019-2023) (DEPA, DEA & Rambøll, 2022).

While the Zero Waste Strategy can support improvement of the waste sector, there is a long way to go before Lombok can fulfil the environmental goal. As of 2021, the waste handling rate of Lombok was only 32% compared to the target of 70%, which, according to the government policy, must be realized already in 2023. It is important to notice that without law enforcement this command-and-control instrument may have little impact in practice.

In July 2022, Dinas LHK of NTB instituted a new law, requiring all waste ending up at Lombok's largest landfill (Kebon Kongok) to be pre-sorted. The dual goals are to increase waste reduction rates and increase the life of the landfill.

Lombok has set two goals concerning management of household waste: 30% waste reduction and 70% waste handling by 2023 compared to 2017. Meanwhile, the handling rate was only 32% in 2021.

Initially, the time frame for achieving this is only 6 months, although Dinas LHK recognizes that this may be hard to achieve. Dinas LHK acknowledge that this change in regulation is difficult to enforce without supporting initiatives, and the hope is that the 6 months will reveal which barriers need to be handled to get on track to realize the national and provincial waste policy goals. According to Dinas LHK, it is also a hope that political ambitions will translate into more financing into WtE and SWM solutions (Dinas LHK, Interview, 2022).

2.3.3 Regulation of the acceleration of WtE

Outside Lombok, the most important regulation for investors of WtE is 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 cUSD/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 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 licenses 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 , Interview with 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, Lombok is not covered by regulation 35/2018, and this regulation is therefore not relevant for investors looking to invest in WtE in Lombok today. However, considering that this regulation has previously been expanded to cover more cities, there may be a possibility that Mataram City could be covered by this regulation in the future.

Lombok is not covered by Perpres 35/2018 and WtE investors in Lombok are thus not entitled to gate fee compensations from the national government.

2.4 Energy policy and status in NTB province

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, 28 out of 34 provinces are yet to implement RUEDs as of December 2022 (NEC, 2022).

NTB province implemented the regional energy plan (RUED-P) in 2019. It is stated in RUED-P that the NTB province has set a goal of 60% renewable energy in the power sector in 2030 increasing to 100% in 2040. The net zero emissions target for all sectors is set to 2050 compared to 2060 in the national energy plan (Dinas ESDM NTB, 2022).

NTB Province has set a goal of 60% renewable energy share by 2030. By comparison, the national target is 23% renewable energy share by 2025.

Today, Lombok's power system is dominated by fossil power generation. Out of a total installed capacity of 416 MW in 2021, 91% comes from coal, diesel, or gas power generation. The remaining 9% comes from hydro and solar power generation (see Table 11). The peak power demand in Lombok is 290 MW resulting in a reserve margin of 126 MW in 2021 (Dinas ESDM NTB, 2022).

Existing capacity in Lombok's power system				
Abbreviation	**Generation type**	**Units**	**Total capacity**	**Share of total capacity**
PLTU	Coal fired power plant	5	140.0 MW	34.0%
PLTD	Diesel power plant	23	112.5 MW	27.0%
PLTG/MG/GU	Gas power plant	13	126.9 MW	30.0%
PLTM	Mini Hydro power plant	7	14.5 MW	3.5%
PLTMH	Micro Hydro power plant	3	1.5 MW	0.4%
PLTS	Solar power plant	6	20.8 MW	5.0%
Total generation capacity in 2021			416 MW	
Peak power demand			290 MW	
Reserve Margin			126 MW	

Table 11 – Existing capacity in Lombok's power system and peak power demand (PLN, 2022; PLN , 2021).

The national power utility company, PLN, is obligated to publish its Electricity Business Plans (RUPTL) stating the existing and planned installed capacities, incl. the renewable power generation as well as grid expansions and upgrades (OECD, 2021). PLN's *RUPTL – 2021-2030* assumes 417 MW additional capacity from 2021 to 2030. There is a 50/50 split between renewables and non-renewables in the plan. The hydro power plants (7.63 MW) are IPP structures, which means that these facilities will be owned by independent private developers, while the remaining capacities are PLN's own assets (PLN , 2021).

Additional future generation capacity in Lombok towards 2030					
Type of plant	**Generation source**	**COD**	**Status**	**Structure**	**Capacity**
PLTMGU	Gas	2021	Under construction	PLN	10 MW
PLTMG	Gas	2024/2024	Planned	PLN	100 MW
PLTM	Hydro	2021	Under construction	IPP	1.3 MW
PLTM	Hydro	2024	Planned	IPP	1.75 MW
PLTM	Hydro	2025	Planned	IPP	4.58 MW
PLTU	Coal	2021/2022	Under construction	PLN	100 MW
PLT EBT Base	Renewable Energy (not specified)	2026/2027	Planned	PLN	100 MW
PLT EBT Base	Renewable Energy (not specified)	2028/29	Planned	PLN	100 MW
Total additional generation capacity					**418 MW**

Table 12 – Additional future generation capacity in Lombok towards 2030.

The NTB Net Zero Action Plan is reflected in the latest RUPTL, but the source for most of the renewable generation is yet to be determined. Power generated from waste could provide a modest contribution to Lombok's Net Zero ambitions.

With a total waste generation of 700,000-1,000,000, the power generation potential is 45-65 MW assuming the average calorific value of waste is 8 GJ/kg. The estimated potential only considers availability of resources and disregards technical and economic barriers.

2.5 Regulation of the PPA power contract for WtE (PLTSa)

The power system of Lombok is operated by PLN, which is Indonesia's state-owned power company (BUMN). PLN is vertically integrated meaning that PLN is responsible for distribution, generation, procurement, and sales of electricity. While PLN owns most power generation assets in Indonesia, independent power producers (IPP) can also participate in the generation of electricity. PLN is the sole off-taker of power generated by renewables from independent power producers (IPPs). PLN is eligible for budget subsidies to compensate for the economic deficits incurred by fulfilling a public service obligation (PSO) (Perpres 19/2003, 2003). In the case of WtE, the PSO lies on PLN to undertake the power purchase of PLTSa (WtE) to assist local governments in overcoming or handling municipal solid waste issues as stated in Article 10 of the national regulation on utilization of renewable energy (MEMR 50/2017, 2017).

As specified in the Second Amendment of the regulation on utilization of renewable energy, which came into effect in 2020, PLN can directly appoint the IPPs for PLTSa – chosen by the regional government to support them in the management of waste. PLTSa are, in other words, not subject to competitive tendering for the power contract with PLN as is the case for other renewable energy technologies (MEMR 04/2020, 2020). From an investor's perspective, the possibility of direct appointment is in principle an advantage, since it means they are not competing with other developers on the PPA contract with PLN. However, PLN can still turn a PLTSa project down, even if the local government has approved the waste contract. The maximum power contract length for PLTSa is 30 years (Dinas ESDM NTB, 2022).

2.5.1 Renewable energy tariffs for WtE (PLTSa)

The power price generated from municipal solid waste generation was originally a flat FiT as stipulated in MEMR Regulation 31/2009. The prevailing price setting scheme, which was initially issued in MEMR Regulation 50/2017 and carried on in Regulation MEMR 4/2020, sets a price cap on the purchase price of renewable electricity by PLN. The price cap is benchmarked against the previous year's regional average generation costs also called the "BPP" (Biaya Pokok Pembangkitan) and it follows that where the regional BPP is higher than the national BPP, the price cap of power procured from municipal waste is equal to the regional BPP.

MEMR sets the methodology for calculation of BPPs. It must include considerations of previous years' fuel prices, depreciation of assets, incurred costs of generated power, and an annual adjustment. However, in practice, it is not clear how the listed BPPs are calculated (OECD, 2021).

In 2021, the BPP for Lombok was 11.77 cUSD/kWh against a national average of 7.05 cUSD/kWh (MEMR 169.K/HK.02/MEM.M/2021, 2021). The high generation costs of Lombok are a consequence of the region's high reliance on costly diesel power generation and low availability of fossil resources.

The high generation costs of Lombok are a consequence of the region's high reliance on costly diesel power generation and low availability of fossil resources.

Following the regulation on calculation of tariffs for renewable energy, IPPs can obtain a PPA price of up to 11.77 cUSD/kWh for sales of electricity based on Municipal Solid Waste (MSW). In the meantime, PLN is more likely to offer a PPA price below 10 cUSD/kWh to keep production costs down (Dinas ESDM NTB, 2022). In relation to this, it is important to mention that PLN is not guaranteed subsidies from the Ministry of Finance (MoF) and each PPA is subject to approval from the Minister of Energy and Mineral Resources.

As illustrated in the case study described in Table 13, the PPA price required by investors of WtE depends on the gate fee offered by the local government. In this case, the IPP, PT Kaltimax, was granted a gate fee of 200,000 IDR/ton and therefore required a PPA price of 19 cUSD/kWh. The PPA price of 19 cUSD/kwh was turned down by PLN since it is higher than the price cap applicable to power generated from MSW. In conclusion, if WtE developers are not able to negotiate a sufficiently high gate fee (in this case 500,000 IDR/ton), the business case of WtE is not financially attractive under the current BPP scheme.

Case study: PT Kaltimax pyrolysis project in Sumbawa turned down
In 2021, PT Kaltimax completed a feasibility study for a 4 MW pyrolysis project in Sumbawa in NTB province. The feasibility study concluded that a PPA price of at least 19 cUSD/kWh was required to make the investment financially viable. The motivation behind the relatively high PPA price was that the Regional Government of Sumbawa could only afford to pay a gate fee of 200,000 IDR/ton of waste against 500,000 IDR/ton, which was requested by the IPP, PT Kaltimax. The project was structured as a build-own-operate (BOO) with financing from Korea and Japan. The total investment value was estimated to 22 million USD. In addition, PT Kaltimax planned to invest in collection and transport infrastructure in Sumbawa. In return, the regional government of Sumbawa committed to support the delivery of 65-70 tons of waste per day. It was planned to start construction in 2022. However, in the end, the PPA price was turned down by PLN, and the project was abandoned (Dinas ESDM NTB, 2022; SumbawaKab, 2021).

Table 13 – Case study – PT Kaltimax's pyrolysis project in NTB province.

There are several barriers related to Indonesia's price setting mechanism for WtE generation. First, the methodology does not consider the required return of equity investors. Second, the current BPP reflects the previous year's fuel prices divided by the total generation cost as opposed to a forward-looking marginal cost, which would be a more precise estimate of PLN's fuel costs. Third, BPP assumes the average depreciated book value[1] plus a financing charge allocation. However, it is very likely that fossil fuel technologies are much more expensive today than the historic costs of

[1] The book value is the historical costs incurred at original purchase minus cumulative depreciation.

PLN's existing assets. Lastly, BPP does not consider the non-financial benefits of WtE, such as the climate effects of methane reductions from landfills and the environmental and social benefits of improved management of waste (Asian Development Bank, 2020; OECD, 2021).

Furthermore, retail power prices are fixed and subsidized for most customer groups in Indonesia. It is therefore not possible for PLN to pass on any costs associated with the purchase of renewable power to customers. In addition, since PLN has no control over the retail electricity price, PLN's only option for improving profit is lowering BPP, which creates an incentive to continue to rely on subsidized coal power production (OECD, 2021).

Indonesia's President recently signed regulation no. 112 of 2022 on the acceleration of renewable power production announcing an early retirement of coal power plants. The regulation also presents a new tariff scheme for the purchase of renewable electricity by PLN. However, PLTAs are not mentioned in the new regulation creating uncertainty about the future support for power generation based on municipal solid waste in Lombok.

Based on discussions with investors and authorities involved in the WtE sector, the enactment of Perpres 112/2022 can be interpreted in one of two ways: One interpretation is, that it replaces MEMR 4/2020 on issues appearing in both regulations. According to this interpretation, it is only renewable energy technologies that are mentioned in both regulations, for which the regulation applies. Since PLTSa is not mentioned in Perpres 112/2022, MEMR 4/2020 therefore still applies for independent power producers of WtE.

The second interpretation is that presidential regulations supersede ministerial regulations, and MEMR 4/2020 is therefore no longer valid. Going forward, it is only WtE projects located in cities covered by the special regulation on acceleration of WtE technologies (Perpres 35/2018) that are entitled to renewable energy tariffs. As mentioned in section 2.3.3, cities in Lombok are not covered by Perpres 35/2018.

There is more than one interpretation of Perpres 112/2022 concerning FiTs for renewable energy. This creates uncertainty on the future price level of power generated from solid waste and sold to PLN.

Therefore, if the law is interpreted in the first way WtE investors can negotiate a PPA price up to 100% of BPP, corresponding to PPA price of 12 cUSD/kWh. Whereas, if it is interpreted in the second way, there are currently no renewable energy tariffs available for WtE investors in this region.

It is unknown which cities will be covered by special regulation 35/2018 in the future. Considering that this regulation has previously been expanded from 7 to 12 cities, it is uncertain if Mataram City will be covered by 35/2018 in the future. This may result in investors refraining from investing in Lombok until there is certainty on the regulation.

The uncertainty on the interpretation of the current regulation combined with potential future amendments of 35/2018, result in three scenarios concerning the power subsidy price for PLTSa as shown in Figure 3.

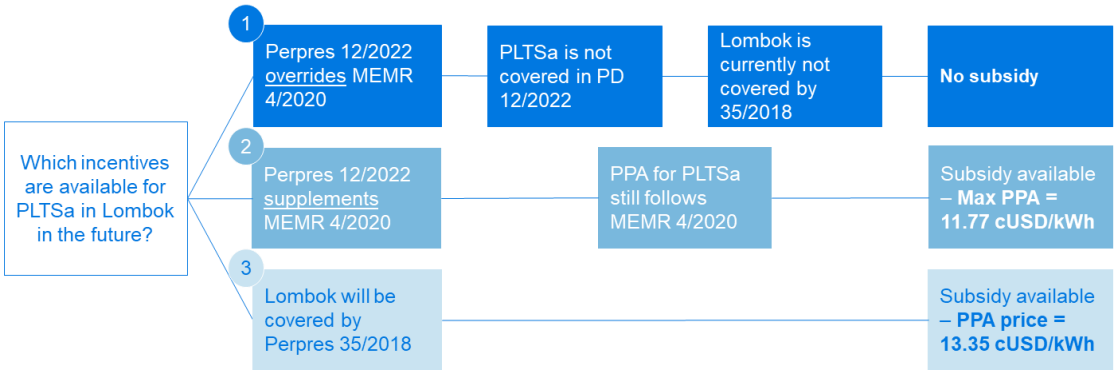


Figure 3 – Scenarios for power subsidies available to independent power producers of PLTSa in Lombok in the future.

Meanwhile, based on discussions with PLN and Dinas ESDM, there is no guarantee that PLN – if scenario 2 in Figure 3 is realized – will accept the maximum PPA price, adding yet another scenario to any prospective investor. This demonstrates the need to include sensitivities in the business case calculations to determine the robustness of the investment with respect to changes in PPA prices.

2.6 Conclusion – regulatory barriers

This chapter has identified several regulatory barriers for successful development and implementation of WtE in Lombok. 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 Lombok.

- 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 has little incentive and few financial resources to support PLTSa development	
PLN is a power company, and as such should not be responsible for waste issues. PLN's main responsibility is to deliver stable and affordable power to Indonesian consumers. Due to the regulation of PLN, PLN cannot raise electricity retail prices and PLN is therefore running negative profits. While PLN can apply for government subsidies to fulfil their public service obligation, they are still concerned about costs and will therefore always choose the most competitive technologies from a power system perspective.	
2. Uncertainty on future gate fees and PPA prices for PLTSa	
For a WtE business case to be feasible for an investor, the investor needs a significant revenue from gate fees and from power sales to cover their CAPEX and OPEX. There is a high uncertainty on both gate fees and PPA prices. Future regulation concerning PPA price setting can for instance be interpreted in 3 ways resulting in a power price range of 10-13.35 cUSD kWh.	
3. Ineffective government policies concerning waste handling and renewable energy development	
Investors need certainty for the future. The current targets being set for both waste handling and renewable energy targets are far from being realized. This creates uncertainty about the willingness to meet future goals, and for an investor this is a risky environment to enter.	

3 Structural conditions of Lombok's waste sector

This chapter reviews the structural conditions of Lombok's waste sector and focuses on issues impacting investments in 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 Lombok including how these barriers influence investors' risk when it comes to WtE development.

3.1 Data on waste generation and collection in Lombok

Investors of WtE are concerned about the availability, transparency, and reliability of 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, if 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 Lombok, the availability of data is important in relation to the NTB province's ambitious Zero Waste Program, which sets a 70% waste handling target and a 30% waste reduction goal already by 2023 compared to 2019.

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). Subnational data on Lombok's waste sector can be retrieved directly through Dinas LHK of NTB province or Dinas LH of the regencies and Mataram 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.

Local governments and community organizations hold some of the responsibility for data collection and reporting, yet they lack the capacity and resources to undertake this task.

The NTB provincial government relies mostly on a predefined theoretical model for estimation of generation and handling rates. One of the reasons is that local governments and community organizations hold some of the responsibility for data collection and reporting, yet they lack the capacity and resources to undertake this task. Lombok may use the national estimation of waste generation, which is 0.7 kg waste/capita/day or the local estimation, which is 0.49 kg waste/capita/day.

3.1.1 Waste generation data

Data on waste generation returns different results depending on whether it is based on local or national proxies for calculation of waste per capita or data submitted to the national SIPSN platform. According to national data on waste generation available from SIPSN, Lombok generated 300,000 tons of waste in 2021. However, it was observed that data from Western and Central Lombok regency is missing for the years 2018-2021. Meanwhile, the number is 2-3 times higher if applying the local or national proxies (0.49 and 0.7 kg waste/capita/day) for estimation of waste generation in

Lombok. Following the local estimation, Lombok generated ~683,000 tons waste in 2021, while the national estimation returns a volume of 976,000 tons in 2021 (see Table 14).

Waste generation data in Lombok in 2021			
Regency	SIPSN (2021) [Tons/year]	National estimation [Tons/year]	Local estimation [Tons/year]
East Lombok	176,455	111,664	78,165
North Lombok	29,108	187,509	131,256
Mataram City	96,354	64,298	45,009
Western Lombok	N/A	268,954	188,268
Central Lombok	N/A	344,423	241,096
Total (Lombok)	**301,917**	**976,848**	**683,794**

Table 14 – Waste generation data of Lombok in 2021. Lombok's population was assumed to be 3.8 million in 2021.

Access to sufficient feedstock is a key concern for developers and they generally choose geographic locations where there is an abundance of waste. Existing waste handling rates and remaining lifetime of landfills are also important when determining the capacity of a WtE plant.

Due to the potential impact of feedstock supply limitations, investors tend to assume a conservative position when it comes to estimation of feedstock for their plants. As a result, it is more likely that they base their projections on the lower end of available data on waste generation. Furthermore, high development costs often favor large-scale projects above 0.5 million tons of waste per year. But smaller plants may also be financially attractive depending on the regulatory framework and potential subsidies.

While waste generation data provides an indication of availability of waste for WtE, data on waste handling is also important since it is an indicator of the capacity of the system and supporting infrastructure. 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 is typically not included when estimating feedstock supply for a WtE plant.

Due to the feedstock availability and the current capacity of the system, investors would not be able to harvest significant economies of scale in Lombok. A realistic plant capacity in Western Lombok and Central Lombok ranges between 100,000 and 200,000 tons per year. Northern and Eastern Lombok are not feasible locations due to lower waste generation volumes and limited infrastructure for collection and transfer of waste.

A realistic capacity for a waste incineration plant in Western/Central Lombok ranges between 100,000-200,000 tons/year.

3.1.2 Waste handling and waste reduction data

In Lombok, progress on waste management is monitored by three levels of government: the national government, the provincial government of NTB, and the city and regency governments of Lombok. Progress on two overall targets is reported: waste handling rate and waste reduction rate.

The legal definition of waste reduction rate is the measure of waste reduction taking place at the source, while waste handling is waste treated via resource recovery and

safe disposal of waste at the final processing site (landfill). The waste handling rate is then equal to the amount of waste delivered to landfills and treatment facilities against the estimated waste generation. If comparing the SIPSN data on waste handled by landfills (TPA) and waste treatment facilities (TPS 3R) in 2021 against waste generated according to local and national estimates, Lombok's waste handling rate was 21-29% in 2021. Meanwhile, Dinas LHK reports that 255,000 ton of Lombok's waste was handled by the system in 2021 resulting in a waste handling rate of 34-37% (see Table 15).

Estimated waste handling rates in Lombok in 2021		
	SIPSN	**Dinas LHK**
Waste handled in 2021 (tons)	200,733	255,590
Waste handling rate in 2021 (%)	22-29	34-37

Table 15 – Estimated waste handling rates in Lombok in 2021.

Meanwhile, sample data collection conducted by Bintang Sejahtera social enterprise finds that only 18% of waste from households end up at landfills. A revision of DLHK's method using theoretical assumptions to estimate and report waste handling and waste reduction rates may therefore be worthwhile.

According to Dinas LHK, Lombok has reduced waste by 90,000 tons in 2021, resulting in a reduction rate of 9.21% if it is assumed that waste generated per capita per day is equal to 0.7 kg. As stated in the legal definition, waste reduction is the amount of waste reduced at source. This may include household, school and industry waste that is recycled, and waste that enters waste banks. Besides, Dinas LHK also includes waste entering TPS 3R facilities in the calculation of waste reduced, although TPS 3R is also included in the calculation of waste handling rate resulting in double counting.

Dinas LHK estimates that Lombok has reduced waste by 90,000 tons in 2021, resulting in a reduction rate of 9.21%.

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.

3.2 Waste infrastructure in Lombok

Formal waste management in Lombok 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 are handled by community organizations (CSOs), while transfer of waste from TPS containers to the final disposal at the landfill (TPA), is handled by the city/regency governments through the Environment Agencies (Dinas LH).

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).

Figure 4 illustrates the typical waste management flow from households to final disposals at the landfills.

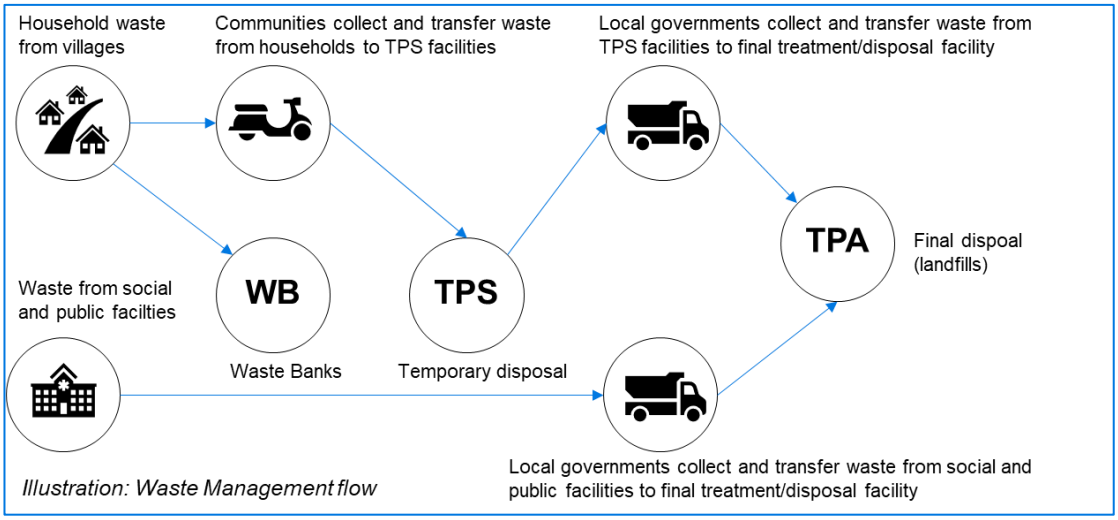


Figure 4 – Waste management flow in Indonesia. Viegand Maagoe Illustration.

The mode of transport of waste in Lombok includes trucks, pick-ups, and tuk-tuks.

Illustration 2 – Waste transporter used by communities (tuk-tuk). Photo credit: PT Inovasi.

According to Dinas LHK of NTB province, Lombok has a total of 246 operating vehicles for transporting waste. Meanwhile, city and local regencies report diverging data. According to DLH of Mataram City, 325 tuk-tuks have been delivered to villages of Mataram City (Dinas LH Mataram City, 2022) and DLH of Western Lombok reports that the regency has 39 vehicles in total (20 trucks, 11 pick-ups and 8 tuk-tuks). Additionally, Central Lombok Regency has 47 waste trucks, but because of budgetary constraints, only 17 of these are in operation (Bintang Sejahtera, 2022).

Distribution of waste transporters across region/cities in Lombok				
Regency	**Truck**	**Pick-up**	**Tuk Tuk**	**Total**
Mataram City	37	14	15 (325)	66
Western Lombok	11 (20)	4 (11)	17 (8)	32
Central Lombok	17	12	76	105
Northern Lombok	7	2	5	14
Eastern Lombok	12	NA	17	29
Total (Lombok)	**84**	**32**	**130**	**246**

Table 16 – Operating vehicles for transport of waste in Lombok (Dinas LHK, Interview, 2022)

Collection and transfer of waste from households to landfills are fragmented and irregular due to lack of basic infrastructure such as waste trucks. This means that waste is piling up at the TPS sites and burned in non-served areas. One of the main reasons behind this is that regional and local governments must comply with Presidential Regulation 33/2020, which sets a cap on the operational expenditures (fuel, maintenance) that local governments can spend per unit of truck. So, even where local governments have sufficient financial resources, regulation prevents governments from relocating (DEPA, DEA & Rambøll, 2022).

Another barrier is that the financing of new waste trucks comes from a limited national budget. Western Lombok has, for instance, only received 3 trucks and 1 tuk-tuk in the past three years.

3.2.1 Landfills in Lombok

The dominant waste handling practice in Lombok is landfilling. In 2021, 97% of waste handled ended at one of Lombok's four landfills. Kebon Kongok landfill, which receives waste from the Western Regency and Mataram City, handled 116,000 tons of waste in 2021. TPA Ijobalit, administered by Eastern Lombok Regency, was constructed in 2003, and handling 55,000 tons of waste in 2021, it is the second largest landfill in terms of waste volumes (DEPA, DEA & Rambøll, 2022; SISPN, n.d.).

Annual waste handled on Lombok's landfills (tons)			
Landfill	Service area	Construction year	Annual capacity (2021)
TPA Kebon Kongok	Western Lombok and Mataram City	1993	116,225
TPA Ijobalit	Eastern Lombok	2003	55,115
TPA Pengengat	Central Lombok	2014	18,250
TPA Jugil	Northern Lombok	2018	6,271

Table 17 – Annual waste handled (tons) on Lombok's landfills

TPA Pengengat is Central Lombok's only landfill. Since 2015, TPA Pengengat has handled 54,000 tons of waste corresponding to an average of 7,000 tons of waste per year. In 2021, TPA Pengengat handled 18,250 tons of waste. In comparison, Central Lombok Regency generated between 240,000 and 340,000 tons in 2021. Thus, TPA Pengengat only handles 2-3% of the waste generated in its service area. According to the landfill manager, one of the explanations relates to the unavailability of waste trucks (DLH Central Lombok Regency , 2022).

Illustration 3 – TPA Pengengat located in Central Lombok Regency. Photo credit: Viegand Maagoe

Lombok's largest landfill Kebon Kongok was constructed in 1993. In 2022, the landfill received on average 325 tons of waste per day with 40-60 tons (12%-18%) coming from Western Lombok and the remaining coming from Mataram City. A total of 130 trucks are transporting waste to the landfill each day.

Over the years, Kebon Kongok has undergone upgrades to live up to the legal requirements for a safely operated landfill. This includes installation of landfill gas control (LFG) including methane capture and collection pipes, and gas venting (see Illustration 4). Methane gas is utilized for cooking purposes and as an energy reserve in the event of blackouts. However, a large share of the gas is vented. Before the installation of LFG, Kebon Kongok experienced uncontrolled fires in the landfill.

Illustration 4 – Methane capture and gas venting at Kebon Kongok landfill. Photo credit: Viegand Maagoe.

Kebon Kongok has surpassed the maximum height for a landfill and is scheduled to close in 2022. The landfill is constructing an expansion of 1.4 ha. Once the main landfill is closed in 2022, waste will be delivered to the expansion area. Meanwhile, the expansion area is expected to be full in 2-3 years, and a more permanent solution is therefore needed.

As stated in Article 22 (1) in Law No 18/2008, waste should be disposed of at the final processing site in an environmentally sound manner. In the case of landfills, so-called "open dumps" are not legally compliant as they are subject to unsafe operations and environmental pollution. As specified in PP No. 81/2012, "safe disposal" concerns the disposal of waste at a 1) controlled landfill, 2) sanitary landfill. or 3) environmentally friendly technology.

Indonesia's definition of controlled and sanitary engineered landfills is shown in Table 18.

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

Kebon Kongok is engineered as a sanitary landfill, however, it has not been possible to operate it as a sanitary landfill 100% of the time. As an example, the landfill covers the waste daily, but only covers 30% of the area due to supply constraints on soil for waste coverage and lack of resources.

The leachate system has also proven difficult to manage. This has social and environmental (e.g., smell and pollution) consequences for the villages close to the landfill. Social resistance to the landfill operation is therefore also increasing.

Kebon Kongok is engineered as a sanitary landfill, however it is not operated as such due to budgetary constraints.

Poorly run landfills also have financial consequences. Since 2020 the NTB government has paid an annual compensation of 302 million IDR to three villages and in 2023 the compensation will be paid to eight villages.

3.2.2 Waste banks and recycling centers

Besides landfills, Lombok's waste management system consists of waste banks, and recycling and waste processing facilities (TPS 3R and TPSTS). The difference between TPS 3R and TSPST facilities is the incoming capacity. TPS 3R facilities in Western Lombok handle 1 ton of waste per day on average while TSTS facilities handle around 20 times as much.

Lombok has two types of waste banks: independent waste banks and government-funded waste banks. Both types of waste banks receive pre-sorted inorganic waste from villages. When households deliver their waste, they are paid a small amount, depending 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. Some independent waste banks receive waste products that have little market value and create various products such as bags and wallets. An independent waste bank in Western Lombok pays 10,000 IDR (0.5 USD) per kg. of plastic waste. Independent waste banks are highly dependent on donations and voluntary resources.

Government funded waste banks typically receive higher value waste streams such as plastic bottles or organic waste. In some cases, waste banks are combined with processing facilities (TPS 3R and TPSTS). In these facilities, several activities take place. A combined waste bank and TPS 3R facility in Mataram City sort plastic waste and process organic waste into compost via black soldier fly technology. The daily capacity of incoming organic waste is 0.5–1 ton (Dinas LH Mataram City, 2022).

Illustration 5 – Black Soldier Fly (BSF) technology at a waste bank in Mataram City.

According to publicly available data from SIPSN, Lombok has 69 waste banks and seven TPS 3R facilities in 2021.The waste banks handle a total of 5,477 tons of waste/year, while the TPS 3R facilities handle 4,799 tons/year. The average waste handling capacity of waste banks was 78 ton/year in 2021. However, most waste banks handle less waste than 10 ton/ year. According to data from (SISPN, n.d.), 9 waste banks were not handling any waste in 2021.

3.2.3 Bintang Sejahtera social enterprise

In 2008, the social enterprise *Bintang Sejahtera* was founded to empower communities in the business of waste recycling, waste collection, and circular economy. With a network of >300 waste banks across NTB province, Bintang Sejahtera is the leading hub for waste banks in NTB. Bintang Sejahtera receives recyclables (metals, plastic, and paper waste) from its network of waste bank units and process it into various products. The waste bank units that are part of the network receive 3,000 IDR/kg of waste. Bintang Sejahtera also offers capacity building and education in waste collection and sorting. Bintang Sejahtera also employs waste collectors to transport waste from households to the waste bank units. The company has estimated that waste collectors can generate a weekly income of 30,000 IDR (~2 USD).

Bintang Sejahtera's revenue comes from sales of products to third parties. Meanwhile, the company is strongly dependent on external funding to cover the costs of its operations. Since 2018, Bintang Sejahtera has received funding from the provincial government of NTB under the Zero Waste Program. The company also receives donations from NGOs and foreign governments (Bintang Sejahtera, 2022).

3.2.4 The informal waste sector in Lombok

The previous sections described Lombok's formal waste management system. Meanwhile, Lombok has a large informal sector that plays an active role in the management of waste. Informal waste collection takes place all over Lombok where waste is dumped, still most waste collectors are working on the landfills due to the large concentration of waste here. Over 200 waste collectors are active at Kebon Kongok. According to the manager of Kebon Kongok, the waste collectors at Kebon Kongok collect 5 tons of recyclable waste per day. This corresponds to 25 kg per collector per day.

A 21-year-old waste collector interviewed at TPA Ijobalit in Eastern Lombok reported a weekly income of 550,000 IDR (39 USD) (Supiandi, 2022).

As Lombok 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 other places in Indonesia, such as Jakarta, where waste collectors are protesting waste incineration projects. Potential investors of WtE in Lombok should be aware of this social risk and consider ways to mitigate it by e.g., involving the informal sector to the greatest extent possible.

> Investors of WtE in Lombok 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.

Illustration 6 – Scavengers at TPA Kebon Kongok. Photo credit: Viegand Maagoe.

Informal waste handling is likely even more fragmented and irregular than the formal sector, and it is thus very difficult to assess and obtain data on Lombok's informal sector. It is therefore not advisable to count on the supply of waste from Lombok's informal sector when making an investment decision.

3.3 Administration of Lombok's waste sector

The administration of Lombok's waste sector is distributed across different levels of government agencies, waste management implementation units (UPTDs), villages, community organizations, and third parties. Provincial government agencies of NTB are responsible for the coordination, policymaking, planning and facilitating of the province's Zero Waste Strategy (Jakstrada). The responsibilities of the specific agencies are listed in Table 19.

NTB government agencies involved in waste management	
Agency	Responsibilities
Environmental and Forestry Agency (DLHK)	• Formulation of policies and waste management program (e.g., Zero Waste Program) • Provide guidance on waste bank programs • Facilitate regional waste management cooperation • Operating Kebon Kongok provincial landfill
Regional Development and Planning Agency (Bappeda)	• Planning and coordination of development activities and alignment with targets • Provision of "soft infrastructure products", e.g., master plans, studies and reports
Village Community Empowerment Agency (DPMD)	• Assisting in the development and implementation of the waste bank program and other activities in rural areas
Public Works and Spatial Planning Agency (DPUPR)	• Planning of large-scale infrastructure
Energy and Mineral Resources Agency (DESDM)	• Development of guidelines for WtE generation
Agriculture and Plantation Agency (DPP)	• Assisting the implementation and strengthening of main waste banks and the incentive system
Animal Husbandry and Health Agency	• Assisting the implementation and strengthening of main waste banks and the incentive system
Tourism Agency	• Support the implementation of 3R activities in tourist areas
Trade Agency	• Assisting in the implementation of the incentive system
Communication and Information Agency	• Establish information system on with operational data of waste banks and TPS 3R facilities

Table 19 – NTB government agencies responsible for and supporting waste management activities in NTB province. Table modified from DEPA, DEA and Ramboll, 2022.

The provincial planning agency, Bappeda, is responsible for the planning of waste infrastructure facilities. It is stated in ministerial regulation on the implementation of waste facilities and infrastructure (MPWH 03/2013) that the general planning of waste infrastructure and facilities includes a) a masterplan, b) feasibility study, 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 a 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.

According to Article 18 of PP No. 81/2012, regional and city governments are responsible for providing regional waste management facilities in the form of waste processing facilities (TPS 3R), temporary shelters/intermediate stations (TPS), landfills

(TPA), and/or integrated waste management and processing facilities (TPST) unless a final processing site (TPA) handles waste from more than one city/region. In the case of Lombok, the regional governments of Central, Northern, and Eastern Lombok are responsible for the transport and handling of waste generated within their own regencies. The landfills in Northern Lombok, Central Lombok and Eastern Lombok regencies are operated by UPTDs, which are part of the local environmental agencies (DLHs). Since 2019, the provincial government has assumed the administrative responsibility of Kebon Kongok landfill in Western Lombok, since Kebon Kongok landfill receives waste from both the Western Regency of Lombok and Mataram City (DEPA, DEA & Rambøll, 2022). Transport of waste from TPS sites to final disposal at the landfills is also the responsibility of local and city governments through DLHs.

DLH of Mataram City provides infrastructure and educational campaigns to villages and sub-districts in Mataram City. Meanwhile, the infrastructure provided to villages is limited; so far, only 325 tuk-tuks have been delivered to the villages in Mataram City corresponding to approximately one tuk-tuk per village of 200-250 households (Dinas LH Mataram City, 2022).

The environment office of Mataram City also sells organic waste bins and bags to villages to encourage source separation at the household level. This is part of Mataram City's waste management strategy to reduce organic waste that ends at the landfill in Kebon Kongok. While this is expected to encourage some households to separate waste, some may not be able to afford this service. 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.

Whether households feel incentivized to source-separate will depend on their financial situation, educational level and whether they live adjacent to waste banks.

CSOs are also in some cases responsible for collection of waste payments (retribution fees) from households to government agencies. In other cases, Retribution officers are employed directly by the Environmental Agencies (Dinas LH) of the respective local regencies. Retributions from households and settlements are paid in cash and collected manually and subsequently deposited in the bank account of the local treasuries. In areas that are connected to local water utility systems, including Mataram City, retribution fees are included in a combined water and waste bill collected by the water utility authority (PDAM) (DEPA, DEA & Rambøll, 2022). Where retributions are

collected manually, there is a high risk of fraud. Besides, the manual process is highly resource intensive and Mataram City alone employs 30 retributions collection agents.

Illustration 7 shows a retribution ticket distributed to households in Eastern Lombok.

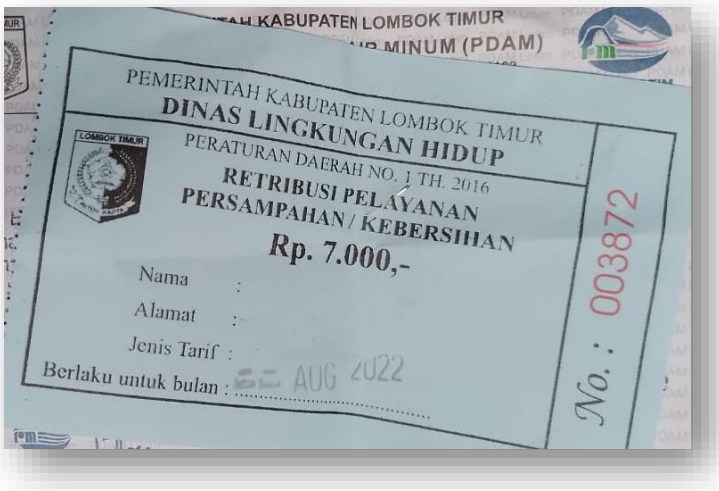


Illustration 7 – Retribution ticket, Eastern Lombok. Credit: PT Inovasi

As stated in Article 37 of PP 81/2012, ministers/Governors/regents and Mayors may provide technical support and guidance, education, and legal advice to communities when it comes to management of waste. Capacity building and training of local villages is also a highlighted initiative in NTB's waste management strategy. In the meantime, the resources allocated for capacity building activities are limited, resulting in varying degrees of local anchoring and very low implementation of 3R principles (Bintang Sejahtera, 2022). As an example, the Northern and Central Regencies have no records of waste banks or TPS 3R facilities. Furthermore, in the 2022-2026 strategic plan for Kebon Kongok, "low community participation" is mentioned as one of the reasons for the high share of mixed waste sent to the landfill. In the absence of strong community organizations and sufficient budget allocated for long-term change, waste collection and sorting remain a challenge in Lombok.

3.4 Conclusion – structural barriers

This chapter has identified several structural barriers for successful development and implementation of WtE in Lombok. 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 Lombok.

- 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	
The lack of basic infrastructure such as trucks 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 are a risk for the investors, since they jeopardize the revenue stream, which is needed to maintain the waste management sector.	
7. Low transparency and accountability of waste data	
The availability and transparency of waste data is critical for a private company planning an investment in WtE. It is therefore a risk for the investor when data is misleading, inaccurate, and based on theoretical assumptions.	

4 The financing of Lombok's waste sector

This chapter analyses the financing of the waste sector in Lombok. 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 Lombok.

4.1 Government financing for the waste sector in Lombok

Local budgeting in Lombok follows the financing arrangement of the rest of Indonesia. The budgets of NTB province and the city/regency governments in Lombok are combinations of fiscal transfers from the national government budget (APBN) to regions and village funds, 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 Lombok 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.

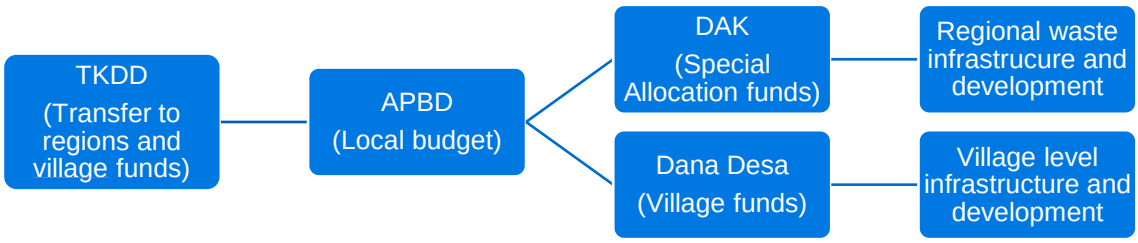


Figure 5 – Budget flow for capital expenditures in the waste sector

4.2 Lombok's waste budget

The total waste budget of the NTB province for 2019-2023 was 182 billion IDR corresponding to approx. 12 million USD. Besides management activities, most of the budget goes to investments and upgrades of existing infrastructure. Most of the funding comes from APBN transfers and PAD and a small share comes from the private sector and development banks such as the World Bank (WB) and the Asian Development Bank (AIB). See also Figure 6.

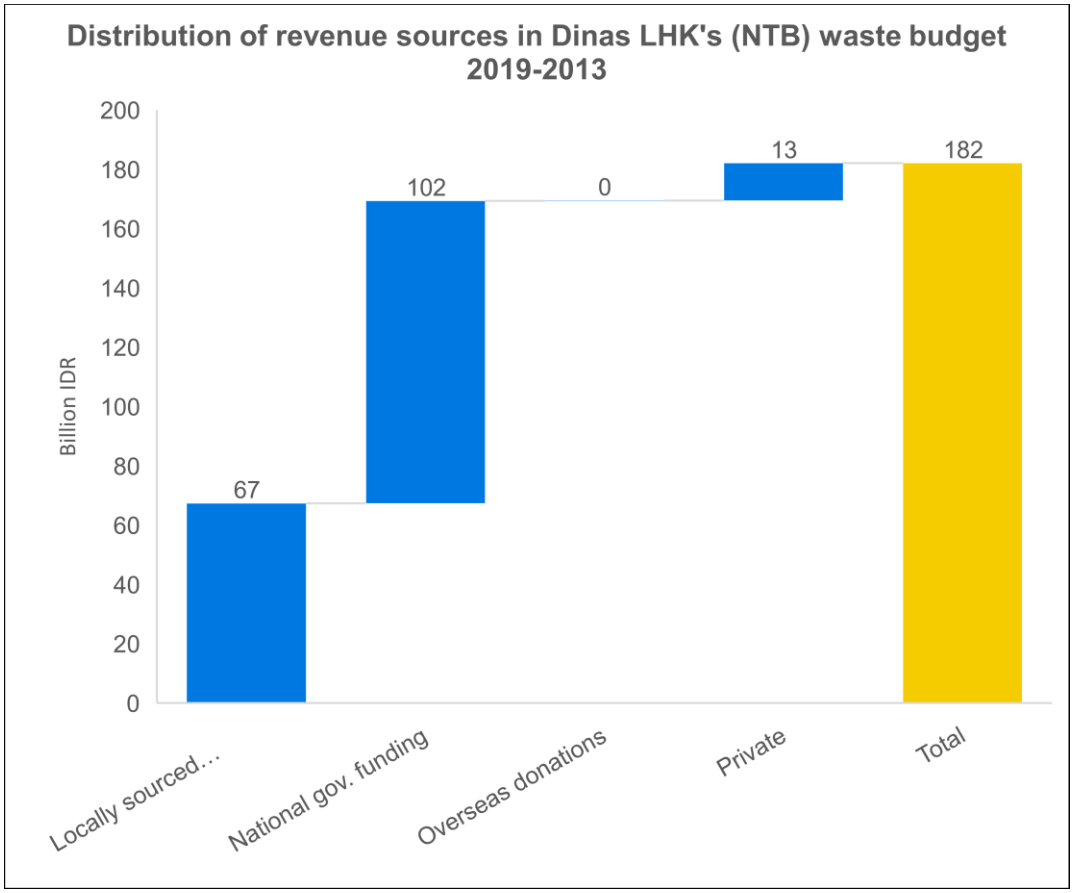


Figure 6 – Distribution of revenue sources for the waste sector (infrastructure, R&D and new technologies, excl. operating costs for management existing facilities/transport services, etc. (Dinas LHK, Waste budget 2019-2023, 2022)

Each local government of Lombok is responsible for the management of waste and therefore also has a budget for this. In the meantime, the total budget for the waste sector (OPEX and CAPEX expenditures) constitutes a very small fraction of the total budget of the regions/cities. As shown in Table 20-Table 24, the share of APBD spend on waste management varies from 0.17% to 1.15%.

Mataram City (fiscal year 2021)	billion IDR	mill. USD
Local budget (APBD)	1441	93.05
Total waste budget	16.5	1.07
Share of waste budget in local budget (APBD)		1.15%

Table 20 – Waste budget managed by DLH of Mataram City in fiscal year 2021. (DEPA, DEA & Rambøll, 2022)

Central Lombok Regency (fiscal year 2015)	billion IDR	mill. USD
Local budget (APBD)	1550	100.08
Total waste budget	2.7	0.17
Share of waste budget in local budget (APBD)		0.17%

Table 21 Waste budget managed by DLH of Central Lombok Regency in fiscal year 2015. (DEPA, DEA & Rambøll, 2022)

East Lombok Regency (fiscal year 2020)	billion IDR	mill. USD
Local budget (APBD)	2796.7	180.58
Total waste budget	5.195	0.34
Share of waste budget in local budget (APBD)		0.19%

Table 22 – Waste budget managed by East Lombok Regency in fiscal year 2020

North Lombok Regency (fiscal year 2019)	billion IDR	mill. USD
Local budget (APBD)	1087.6	70.23
Total waste budget	4.856	0.31
Share of waste budget in local budget (APBD)		0.45%

Table 23 – Waste budget managed by North Lombok regency in fiscal year 2019 (DEPA, DEA & Rambøll, 2022)

West Lombok Regency (fiscal year 2020)	billion IDR	mill. USD
Local budget (APBD)	1991.3	128.58
Total waste budget	10.6	0.68
Share of waste budget in local budget (APBD)		0.53%

Table 24 – Waste budget managed by North Lombok regency in fiscal year 2020 (DEPA, DEA & Rambøll, 2022)

The waste budget of Western Lombok was reduced to 8 billion IDR in 2021. 4 billion IDR was allocated for OPEX, and 4 billion IDR was allocated for CAPEX (investments in trucks, transfer stations etc.). Of the total waste budget, 1.8 billion IDR were financed via special allocation funds (DAK) from the national government while 3.4 billion IDR was collected via own-sourced revenue from waste retributions. This leaves a gap of 2.8 billion IDR.

To understand why the APBD budget allocated for the waste sector is so low, it is necessary to look at the budget hierarchy for public sector services in Indonesia.

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 six 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.

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

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. 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 small fraction of APBD. On top of that, a large share of the budget is absorbed in administration and red tape (INSWA, 2022).

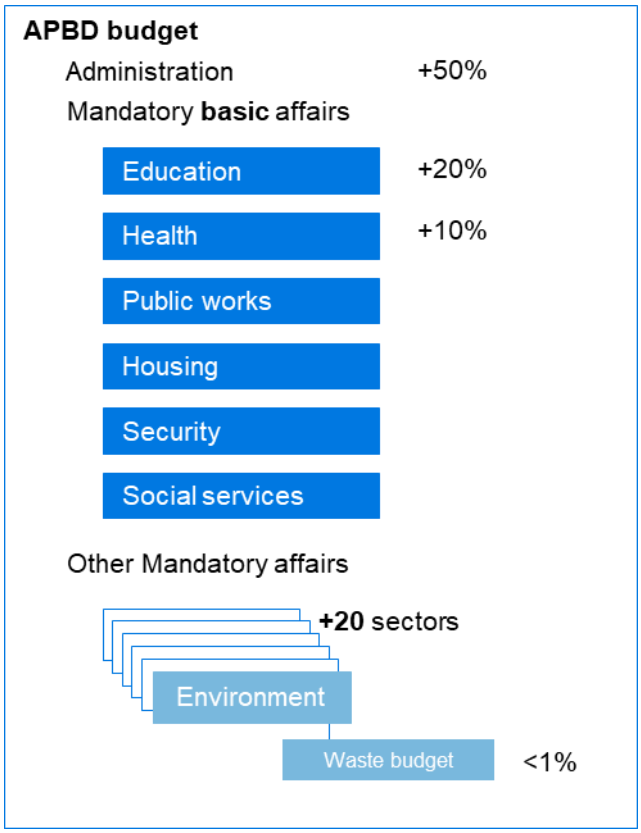


Figure 7 – The budget hierarchy of APBD. Viegand Maagoe illustration.

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 public and therefore not as appealing for elected officials (Oligo Infrastructure Group Interview, 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 of advanced SWM and WtE require a higher gate fee than the current level, which affects the local waste budgets. Increasing the waste budget will thus make WtE in Lombok more attractive to investors. Meanwhile, raising financing for CAPEX investments in new transfer stations, roads or trucks will not be sufficient. Increases in the operational budget need 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 25).

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 25 – Taxes retrieved 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 general RCPA, provides very little transparency on how waste retributions are spent (Vidyaningrum, 2020). This not only increases the risk of budget misallocations but also lowers the incentive for waste generators to pay if they find that the waste management service is not provided.

Formally, retribution rates are defined in the local regulations of the four regencies and Mataram City. As shown in APPENDIX 2, retribution rates are highly differentiated according to customer groups, covering industrial customers, government offices, educational facilities (private/public), social facilities, street vendors, restaurants, hotels, malls, health institutions (private/public), and households. Most categories are further divided according to the size of the individual customer. Except for Mataram City, households are for instance divided into smaller and larger houses, where smaller houses pay a smaller fee. In Eastern Lombok, a household with less than 45 m^2 should pay 7,000 IDR/month (0.45 USD/month) while the so-called "Elite Housing" category should pay 20,000 IDR/month (1.29 USD/month). However, in practice, the system has been found difficult to manage, which is why households typically pay a similar rate regardless of income group.

Retributions rates for small households as stated in local regulations are shown in Table 26.

Retribution rates in Lombok		
Regency/City Customer group	Retribution rate [IDR/month]	Retribution rate [USD/month]
Mataram City *Household*	5,000	0.32
Central Lombok *Household (<54 m^2)*	2,000	0.13
Eastern Lombok *Household (<45 m^2)*	7,000	0.45
Northern Lombok *Household (21-45 m^2)*	5,000	0.32
Western Lombok *Household (21-45 m^2)*	3,000	0.19

Table 26 – Retribution fees paid by small households

In 2021, Mataram City collected 5.5 billion IDR in retribution fees against a target of 6.5 billion IDR, while Northern Lombok only collected 0.276 billion IDR against a target of 1.2 billion IDR (see Table 27). This large gap is a result of an inefficient retribution collection system and low law enforcement.

Retribution revenue in Lombok in selected years					
	Target [bn IDR]	Realized [bn IDR]	Target [mill. USD]	Realized [mill. USD]	Realized/ Target [%]
Mataram City (2021)	6.50	5.50	0.42	0.36	85
Northern Lombok (2021)	1.20	0.28	0.08	0.02	23
Eastern Lombok (2020)	0.84	NA	0.05	NA	NA
Western Lombok (2021)	3	3.4	0.19	0.22	113
Central Lombok (2015)	0.0025	NA	0.0002	NA	NA
Total	11.54		0.75		

Table 27 – Government revenue collected from retribution fees in Lombok (Dinas LHK, Waste budget 2019-2023, 2022; DEPA, DEA & Rambøll, 2022).

The total retribution target of all regencies and Mataram City is estimated to be 11.54 billion IDR corresponding to 0.75 million USD. It should be noted that the retribution revenue targets have been retrieved from different fiscal years and they are therefore not directly comparable.

Looking at the total retribution revenue target, it appears that it differs significantly from the actual potential if all households pay retribution fees. The potential has been derived by multiplying a flat retribution fee of 5,000 IDR/month with the number of households in Lombok, which is assumed to be ~1 million. This gives a potential of 62 billion IDR/year. Thus, the target retribution revenue submitted by the four regencies and Mataram City only corresponds to 19% of the actual potential (Table 28).

Estimated revenue potential from retribution fees if 100% of household retributions are collected		
Indicator	Unit	Value
Lombok Population	no. of people	3,700,000
Average household size	no. of people	3.6
Households	no. of households	1,027,778
Flat retribution rate	IDR/month	5,000
Potential retribution revenue	billion IDR/year	62
Retribution target in % of potential revenue	%	19

Table 28 – Estimated revenue potential from retribution fees if 100% of household retributions are collected.

4.5 Financing of landfills in Lombok

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 Kebon Kongok, which is Lombok's largest landfill.

The landfills in Lombok are funded by regional and local governments. The budget allocations from governments to the landfills are also called compensation fees (KJP) or gate fees. The gate fee of Kebon Kongok landfill is 50,000 IDR/ton waste according to regulation (Dinas LHK, Waste budget 2019-2023, 2022). Kebon Kongok services both Mataram City and Western Regency. However, due to budgetary constraints in the regency/city budgets, the Western Regency only finances 25% of the gate fee corresponding to 12,500 IDR/ton while Mataram City finances 75% corresponding to 37,500 IDR/ton. The remaining share is subsidized by NTB provincial government.

Gate fees in 2021 – Kebon Kongok landfill		
	IDR/ton waste	**USD eq./ton waste**
Mataram City	37,500	2.4
Western Lombok Regency	12,500	0.8
Gate fee according to regulation	50,000	3.2

Table 29 – Gate fees in 2021 – Kebon Kongok landfill.

The annual budget for gate fee compensations in 2021 from regency/city governments and the provincial government is estimated to be 0.38 million USD/year. The annual compensation is derived by multiplying the annual capacity (116,225 tons) with the gate fee as shown in Table 30. With a gate fee of 37,500 IDR/ton, the annual costs for gate fee compensations to Kebon Kongok from Mataram City is 0.23 million USD in 2021. By comparison, Mataram City collected 0.36 million USD in retribution revenue in the same year. Gate fee compensations thus constituted over 60% of retribution revenue leaving only 40% of the budget to other waste management activities including waste collection, transfer, and capacity building.

Annual gate fee compensations to Kebon Kongok landfill in 2021		
	billion IDR/year	**million USD/year**
Mataram City budget (80% of waste @ 37,500 IDR/ton)	3.5	0.23
Western Regency budget (20% of waste @ 12,500 IDR/ton)	0.3	0.02
Subsidy from NTB budget (80% of waste @ 12,500 IDR/ton + 20% of waste @ 37,500 IDR/ton)	2.03	0.13
Total compensation	5.8	0.38

Table 30 – Annual budget for gate gee compensations to Kebon Kongok in 2021 divided between the city/regency and provincial budgets.

Up until now, the landfill management has had very little influence over the budget allocated for gate fees to the landfill.

In 2023, the institutional structure is changing and Kebon Kongok will be operated as a regional public service agency (BLUD). This gives the landfill partial control of the financial management of the landfill and more room to set gate fees that reflect the costs of operating the landfill. As a result of this change, the gate fee is expected to increase to 60,000 IDR/ton corresponding to 3.87 USD/ton for Mataram City and the Western Lombok Regency. However, a subsidy of 12,500 IDR/ton from the provincial government is still required to fulfil the requirement of a sanitary landfill, according to the landfill manager at Kebon Kongok (Kebon Kongok Interview , 2022).

Expected gate fees in 2023 – Kebon Kongok landfill		
	IDR/ton waste	**USD eq./ton waste**
Mataram City and Western Lombok Regency	60,000	3.87
Gate fee subsidy from NTB	12,500	0.81
Gate fee plus subsidy	72,500	4,68

Table 31 – Expected gate fees in 2023 – Kebon Kongok landfill.

With the adjusted gate fee from 2023, Kebon Kongok is expected to receive a total of 0.54 million USD in annual gate fee compensations.

Adjusted annual gate fees compensations to Kebon Kongok landfill (expected from 2023)		
	billion IDR/year	**million USD/year**
Mataram City budget (80% of waste @ 60,000 IDR/ton)	5.58	0.36
Western Regency budget (20% of waste @ 60,000 IDR/ton)	1.39	0.09
Subsidy from NTB budget (100% of waste @ 12,500	1.45	0.094
Total compensation	8.43	0.544

Table 32 – Adjusted gate fee compensations to Kebon Kongok if the gate fee increases because of a new governance structure in 2023.

Assuming the annual tonnage of waste handled remains constant, the annual costs for gate fee compensations for Western Lombok Regency increases from 0.02 mUSD/year to 0.09 mUSD/year corresponding to a 79%-increase. The annual gate fee compensations for Mataram City increases from 0.23 mUSD/year to 0.36 mUSD/year corresponding to a 38%-increase. This will have a significant impact on the regional and city budgets and will most likely require an increase in waste retribution fees for households and businesses.

While the upward adjustment of gate fees is an improvement of the financial situation of Kebon Kongok, the allocated gate fee of 4.68 USD/ton (incl. subsidy) is still significantly below the typical costs in lower- and middle-income countries, according to a World Bank study from 2018 (Table 33).

International waste management costs for lower-middle income countries		
Activity	**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

Table 33 – Typical international waste management costs in lower-middle income countries (World Bank, 2018).

4.6 Financing of advanced SWM and WtE

In the process of advancing solid waste management in Lombok, 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 Lombok. The business case shows that a gate fee of at least 19 USD/ton will be required assuming the developer is able to negotiate a power price of 11.77 cUSD/kWh with PLN. However, as reported by several stakeholders in the WtE sector (investors, PLN, Dinas ESDM), it is not uncommon for PLN to reject WtE projects that require a PPA price above 9-10 cUSD/kWh. If the assumption on PPA price is reduced to 9 cUSD/kWh in this business case example, a gate fee of at least 32 USD/ton (500,000 IDR/ton) is required to make the business case financially viable.

Increasing the gate fee is challenging for several reasons. First, there is a general opposition towards subsidizing private companies who are believed to make a 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. And third, 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 Lombok, 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 part 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 Lombok. 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 Lombok.

- 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	
9. 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 fulfilling environmental standards and requirements, the gate fee must be higher than the current level in Lombok, which is 3.2 USD/ton. Due to the high CAPEX for WtE and the assumed PPA price of around maximum 117.7 USD/MWh, a gate fee of around 19 USD/ton is required to realize break-even (see also business case evaluation in Chapter 5). This is not realistic considering the budget constraints of the city government.	
10. 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 <1%.	
11. Inefficient retribution fee system	
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.	
12. Limited autonomy to DLH when it comes to waste sector spending	
Although the responsibility of waste management is formally and legally delegated to local governments, national (and subnational) regulation prevents local governments from exercising full autonomy over the administration and financing of the waste sector. One concrete barrier relates to regulation Perpres 33/2020, which specifies regional unit costs for various public services, incl. vehicles. The issue with the regulation is that it disregards the functionalities of the service, such as the additional fuel required for waste trucks vis-à-vis the average vehicle administered by a public office. Another issue is the restriction on the use of national funding for CAPEX expenditures, leaving OPEX to be financed with waste retribution. The locked-in budget for CAPEX and OPEX creates a barrier to implementing integrated waste management solutions.	

5 Business case for WtE

This chapter presents a business case example of a potential WtE project in Lombok. Starting with a description of a typical business model for a waste incineration plant (PLTSa) in Lombok, 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.

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 for presenting a business model.

<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 (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 Lombok's municipal waste and clean electricity delivered to the regional grid.</td>
<td rowspan="2"></td>
<td>Customer Relationships

Municipality (on behalf of waste generators)

PLN (power offtake)</td>
<td rowspan="2">Customer Segments

Transmission grid operator, PLN, on behalf of electricity users connected to the grid in Lombok.

The local governments responsible for waste management in Lombok, on behalf of waste generators</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 Lombok</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></td>
<td colspan="2">Revenue Streams
Power price agreement (PPA) with PLN including feed-in tariff (FiT) for WtE.
Gate fee for waste received under waste supply agreements.</td>
</tr>
</table>

Figure 8 – Business Model Canvas (BMC) applied to a waste incineration project.

As preparation for the subsequent financial analysis, the model provides an important overview of up- and downstream relations, customer segments and channels.
It should be noted that waste incineration projects with private finance will typically be structured as a Public Private Partnership (PPP) 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")*

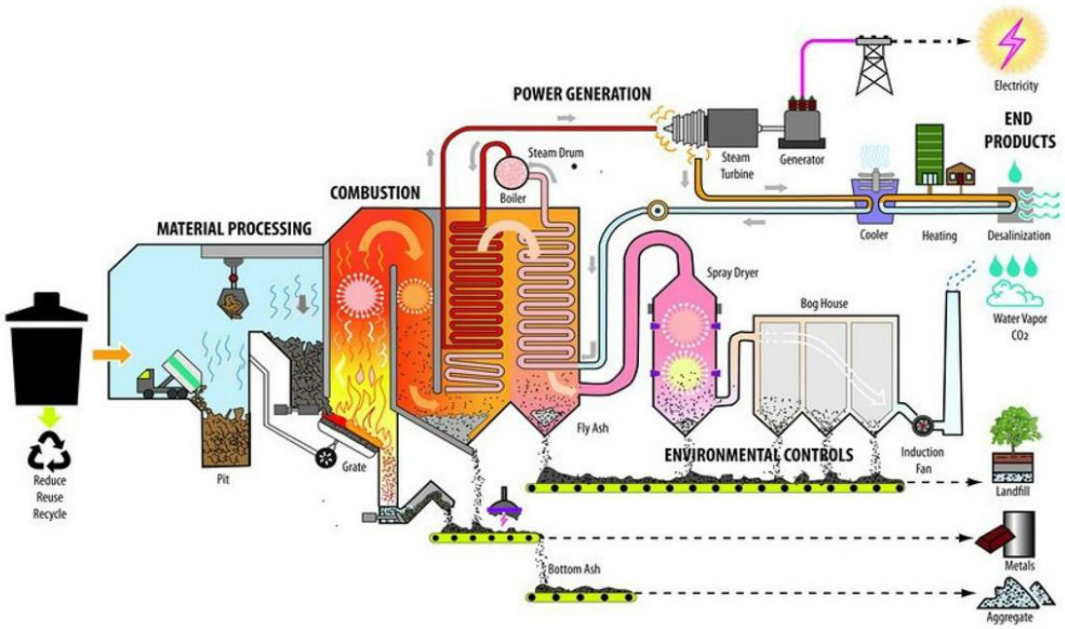


Figure 9 – Waste-to-energy process (IEA, n.d.)

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.

To estimate resource availability, collection and infrastructure aspects are important factors. The WtE plant should have proper access to main roads which enable the transport of waste collection trucks or heavy-duty transfer vehicles and should be located close to sections of the power grid with available capacity. As shown on Illustration 8, the four landfills in Lombok are located with relatively close distance to the power grid.

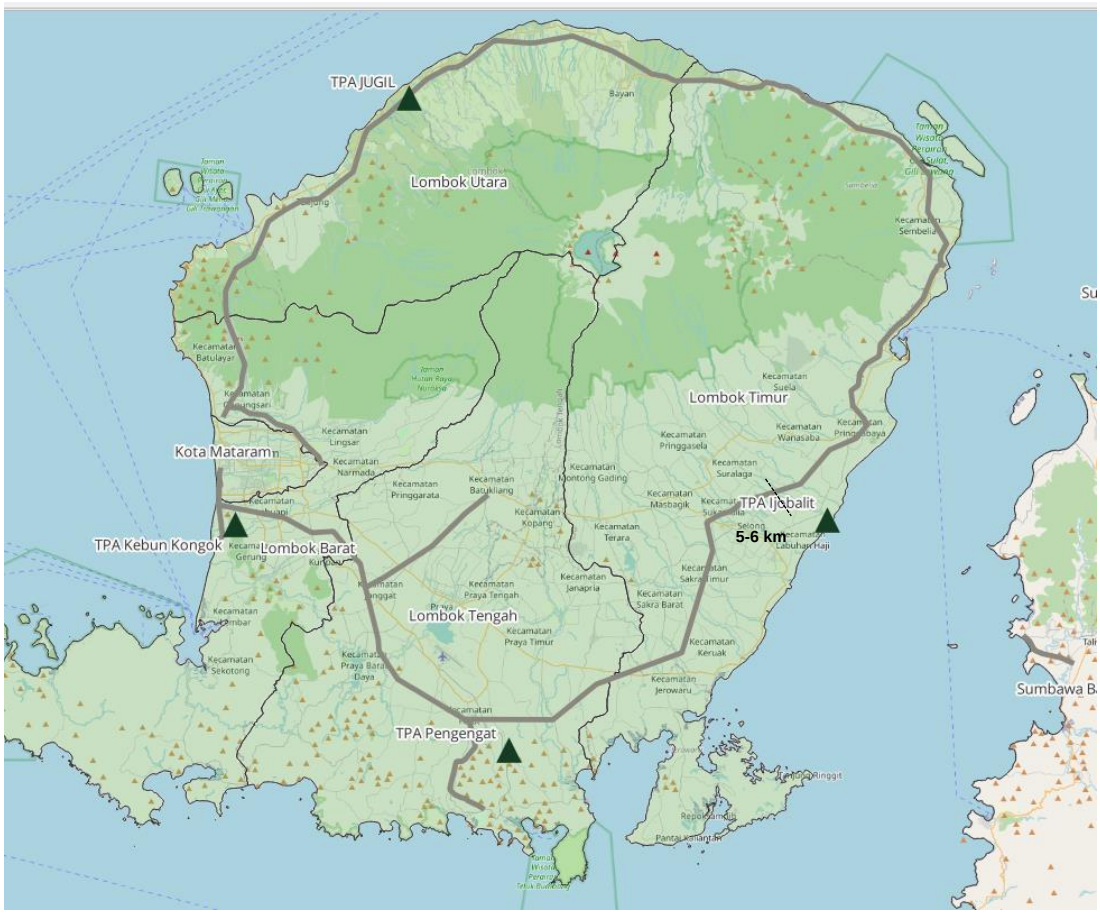


Illustration 8 – Map showing PLN's power grid in Lombok, landfills, and regional borders.

Lombok handles 255,590 tons of household waste and industrial waste in 2021 (Dinas LHK, Interview, 2022). Around half of the waste handled by the system currently ends up at TPA Kebon Kongok landfill, as shown in Table 34. In the future, TPA Pengengat is expected to increase its intake of waste as the Special Economic Development Zone of Mandalika develops.

Landfill input volumes in Lombok (2021)	
Landfill	**Input volume (tons/year)**
TPA Kebon Kongok	116,225
TPA Ijobalit	55,115
TPA Pengengat	18,250
TPA Jugil	6,270

Table 34 – Landfill input volumes (tons/year) in Lombok in 2021.

Based on the assumptions and data of Lombok, it is assumed realistic to design a WtE plant with a capacity of 100,000 tons/per year. To ensure sufficient waste flows, Western Lombok Regency is the most feasible location for this plant size.

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.

According to DEA, DEPA & COWI (2022), MSW in Lombok comprises 77% organic waste and the resulting calorific value is estimated to be 5.8 GJ/ton.

Another study, conducted by DEPA, DEA & Rambøll (2022), found large geografic variations in the share of organics in Lombok's waste. According to their findings, the North and Central regencies have much higher shares of organics than e.g. Western Lombok Regency and Mataram City, where there is a higher level of industrial activity, resulting in higher calorific value of waste, since industrial waste has higher shares of plastic, cardboard etc.

As mentioned in the previous section, the best location for a WtE plant is Western Lombok Regency. The calorific value of the waste is therefore assumed to be 8 GJ/ton, reflecting the higher share of industrial waste in this area compared to Lombok on average.

Over time, the quality of waste in Lombok 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 (DEA, DEPA & COWI, 2021). For the business case, 7,900 equivalent full load hours annually are assumed.

The electrical efficiency of a modern WtE plant depends on issues 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 Lombok, 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 Lombok (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 35, 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 in USD/ton		
Country/Region	Indicator	Value
China	USD/annual ton	190-400
Europe	USD/annual ton	600-1000

Table 35 – CAPEX expenditures in China and Europe. (World Bank, 2018)

By comparison, the Cross-Sectorial Technology Catalogue for SWM and Energy for Lombok 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 Lombok 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 costs: Salaries and other 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 Lombok are estimated to range between 2,700 and 15,000 USD/employee on average (see Table 36). The minimum wage in Mataram City is 1,705 USD/year.

Estimated salary costs in Lombok (USD/employee/year)				
Salary category	Indicator	Low cost	High cost	Average
Manager	USD/year	11,623	19,371	15,497
Skilled/educated workers	USD/year	3,874	7,748	5,811
Staff admin, unskilled workers	USD/year	1,705	3,874	2,789

Table 36 – Estimated salary costs (USD/year) in Lombok

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 high salary costs from Table 37, 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 Lombok		
Salary category	No. of staff	Annual costs
Plant manager	2	38,742
Skilled workers	25	193,711
Staff admin, unskilled workers	13	50,365
Total	40	282,818

Table 37 – 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 expenses are 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

To estimate the PPA price for WtE, it is important to understand regulations on renewable energy tariffs. Up until recently, renewable energy tariffs for WtE facilities in Indonesia followed Regulation MEMR 4/2020 which states that the PPA price is equal to the average generation costs (BPP) of a region. In 2022, a new regulation (112/2022) came into effect, creating a new FiT system for renewable energy. However, since WtE is not mentioned in the new regulation, it is assumed that the old regulation (MEMR 4/2020) applies. The assumed PPA price used in the business case calculation is therefore 117.7 USD/MWh.

A more detailed description of regulations affecting feed-in-tariffs for WtE is provided in section 2.5.1.

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 per ton of waste. 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*, and the gate fee is a price per ton of waste deposited on a site. 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.

In Lombok, the gate fee paid to Kebon Kongok to cover the costs of the landfill is 3.2 USD/ton (50,000 IDR/ton). Based on discussions with private investors of WtE in Indonesia, a gate fee of 32 USD/ton is required to make the business case financially viable. A gate fee of 32 USD/ton has therefore been assumed for the business case calculation.

Recognizing that it is challenging to negotiate a gate fee with the local government which is ten times higher than the current rate offered to Kebon Kongok, 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 38.

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 38 – 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 39 – 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, 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	117.7	Equal to 100% of BPP in Lombok
Heat price	USD/MWh	0	
Gate fee	USD/ton	32	The typical required gate fee for investors of WtE in Indonesia

Table 40 – Economic assumptions used in the business case calculation

Assumptions on financing costs			
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 41 – 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 10.6% and NPV of 14 million USD.

Results of the business case calculation		
Parameter	**Indicator**	**Value**
Project net present value (NPV)	mUSD	14
Project internal rate of return (IRR)	%	10.6

Table 42 – Results of the business case calculation

The gate fee, which returns a break-even business case in an all-things-equal scenario, is 19 USD/ton.

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 four variables 1) gate fee, 2) PPA price, 3) calorific value and 4) project lifetime.

The impact on IRR at different PPA prices and gate fees is shown in Table 43. 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 30 USD/ton, the PPA price needs to be at least 100 USD/MWh to reach the break-even point of the business case. However, if PLN is only able to offer a PPA price of 80 USD/MWh, the gate fee must be at least 40 USD/ton to make the business case financially viable for the investor.

IRR (%)		**PPA (USD/MWh)**					
		80	90	100	110	120	130
Gate fee (USD/ton)	10	1%	3%	4%	5%	6%	7%
	20	4%	5%	6%	7%	8%	9%
	30	6%	7%	8%	9%	10%	11%
	40	8%	9%	10%	11%	12%	13%
	50	10%	11%	12%	13%	14%	15%

Table 43 – Overview of sensitivity of IRR against the PPA price and the gate fee.

Another assumption, which can have a significant impact on the result of the business case, is the calorific value of the waste. At lower calorific values, the less attractive is the return of the investment (see Figure 10). While this business case assumes a calorific value of 8 GJ/ton, a previous study (DEA, DEPA & COWI, 2021) states that Lombok's waste has an average calorific value of 5.8 GJ/ton. Assuming the calorific value is reduced from 8 to 5.8 GJ/ton and the PPA price is fixed at 117.7 USD/MWh, the investor needs a gate fee of 37 USD/ton to realize break-even (IRR=8%).

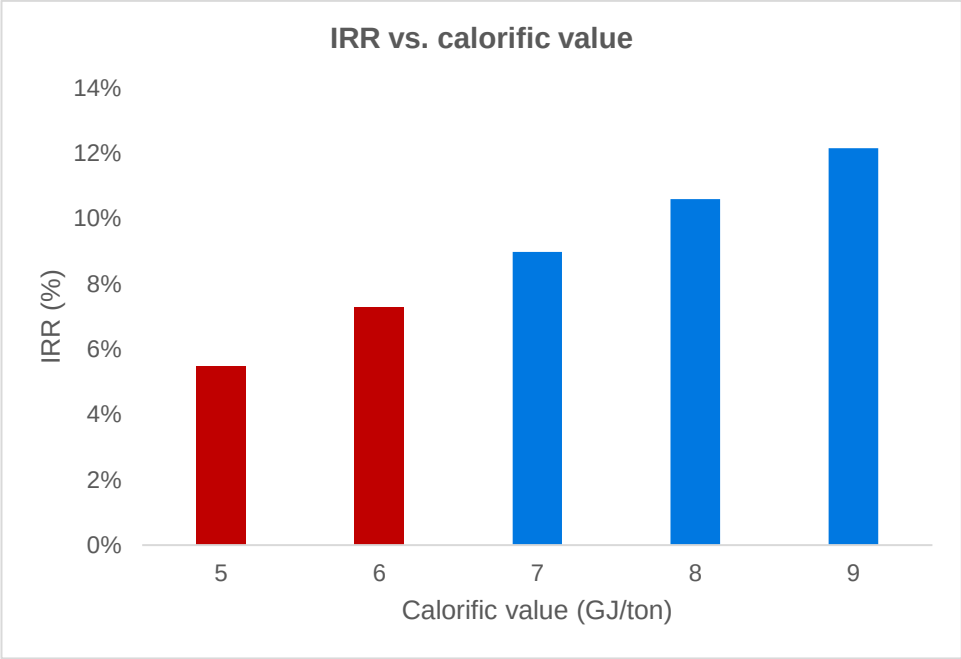


Figure 10 – Sensitivity assessment of IRR compared to the calorific value of waste

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 117.7 USD/MWh, the investor needs, in an all-things-equal-scenario, a gate fee of 15 USD/ton to realize break-even (IRR=8%) compared to 19 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 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 44).

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 44 – 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 Lombok. 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.

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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 accept high-risk projects with potentially high returns.

Investors can be divided into three overall groups: RE producers, RE consumers and financial investors.

6.1.1 Investor group: RE consumers

RE consumers include commercial and industrial end-users, public and private institutions like hospitals and village/household cooperatives. Highly energy intensive consumers of energy, like data centers, will be motivated to have access to reliable, stable power supply, which can be provided by WtE, as 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 long-term 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 11, 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.

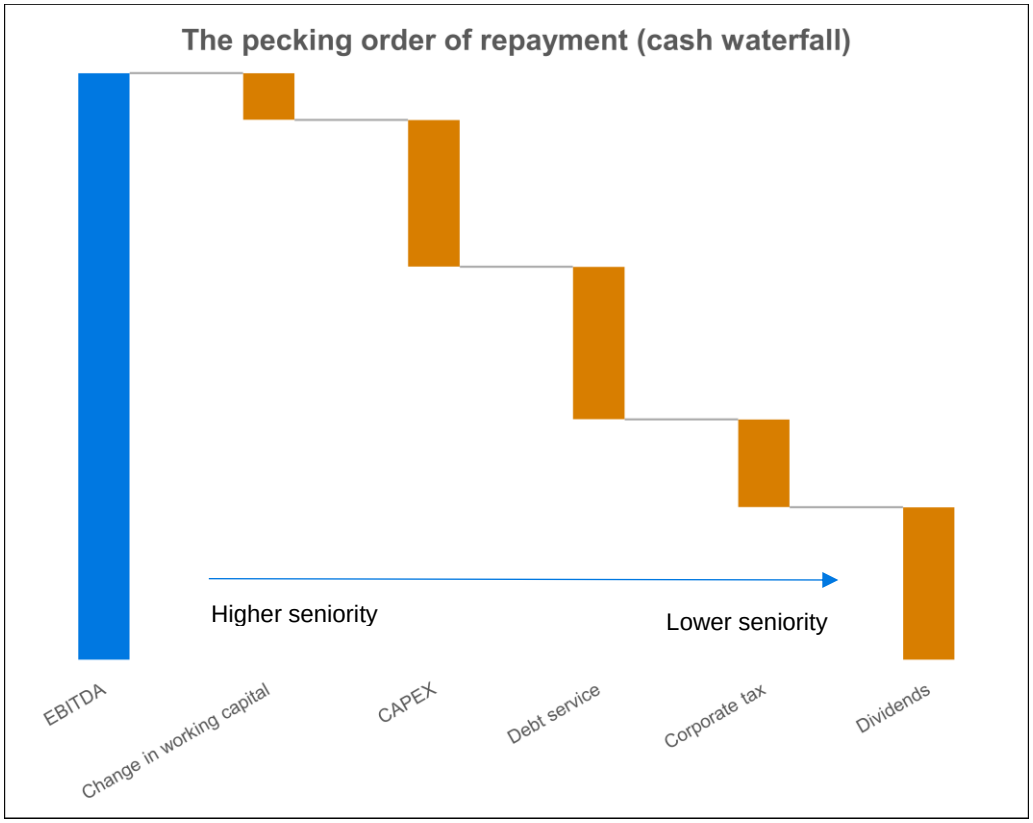

Figure 11 – The pecking order of financing repayment/cash waterfall.

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 12 and described subsequently.

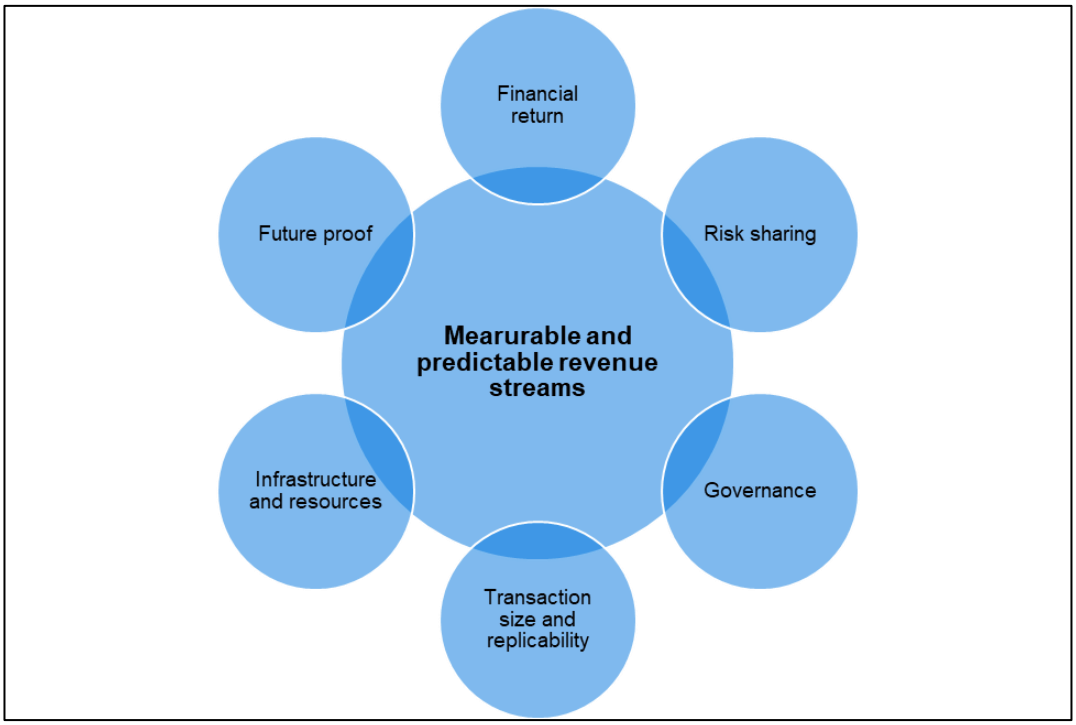

Figure 12 – Investment decision factors for waste-to-energy investors. Source: Macquire GIG, 2020.

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 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 Lombok. 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 Lombok.

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.[2]

[2] 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

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 45 – 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.

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.

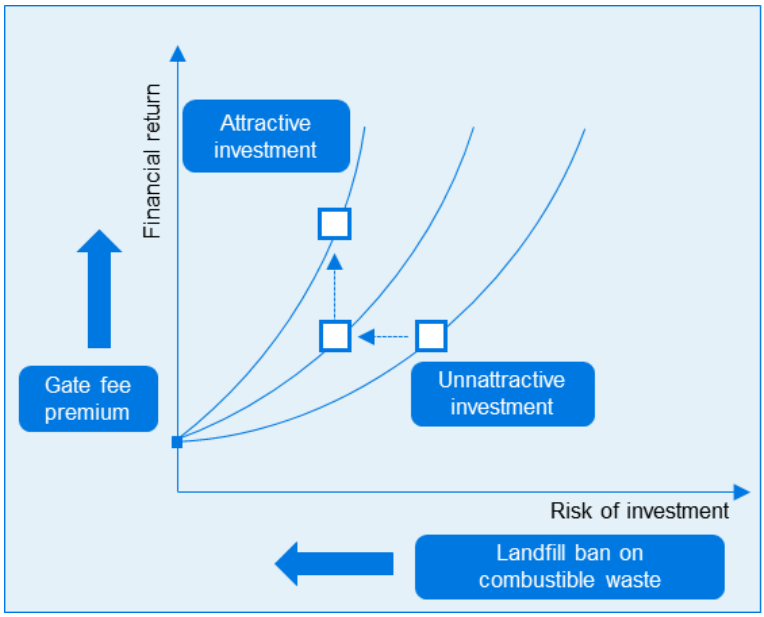

Figure 13 – Moving the risk-return profile of a WtE investment. Source: Glemarec (2011), modified.

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 fees 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. Kebon Kongok landfill receives what corresponds to ~3.2 USD/ton in gate fees from the local and provincial government. Meanwhile the gate fees are not sufficient to cover the costs of sanitary landfills or more advanced solutions, like 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 like waste incineration more attractive.

Landfill levies have been introduced in Australia – ranging between 40 and 100 UDS/tons (see Table 46). 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 46 – 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 has 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 Lombok 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 Environmental Agencies (DLHK/DLHs) and waste retributions. One the one hand, retribution fees may be collected even if waste is not collected. One the other hand, DLHK/DLH 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 Lombok.

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 Lombok.

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 Lombok's residents.

3. **Introduce a combined utility bill**
   In some regions of Lombok, the waste retribution and water bill are paid in a combined "utility" bill and collected by the local water utility company. 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. An example of a direct financial incentive is feed-in-tariffs on power produced with renewable sources.

7.3.1 Remove the price cap on PPA prices for PLTSa

As described in Section 2.5, Indonesia already has a FiT system for power production using municipal solid waste (PLTSa). As stated in MEMR 4/2020, the maximum PPA price for PLTSa in Lombok is 117.7 USD/MWh (equal to 100% of BPP in Lombok).

A PPA price of 117.7 USD/MWh is high compared to other places in Indonesia, however, it still isn't sufficient to cover the costs of a WtE facility assuming a gate fee in the 20-30 USD/ton range.

Amending regulation MEMR 4/2020 to remove the price cap on PPA for PLTSa could enhance the financial viability of WtE investments.

7.3.2 Introduce a "load" subsidy

WtE is a base load thermal energy technology. Today, Lombok has sufficient baseload generation due to a high share of coal and natural gas generation. However, in the future, Lombok needs to phase out coal and other fossil fuels to align with national climate and renewable energy targets. A specific base-load subsidy for renewable thermal generation could foster investments into WtE, hydro and other baseload renewable energies, while lowering Lombok's dependence on coal and natural gas.

7.3.3 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 investments into 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.

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 Lombok include:

1) Expand Perpres 35/2018 to all large cities in Indonesia (e.g., cities with a 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., Mataram City) 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 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 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.

Put-or-Pay guarantees are common 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, and in case the government party is unable to fulfil its obligation, provides a financial compensation covering any costs incurred to the private investor. 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 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

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

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.

In relation to 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 47 – 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.

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 the table below.

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 48 – 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 potential project 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 Lombok and Indonesia. So far, the waste sector has been underrepresented in DFI activities compared to other forms of clean energy, however, 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.

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

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 49.

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 using 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 risks
2. Landfill levies	
3. Emissions quota system and carbon taxes	
4. Reform of the waste retribution system	
Financial incentives	
5. Remove the price cap on PPA prices for PLTSa	Compensation for private sector risk
6. Introduce a “load” subsidy	
7. Revisit Perpres 35/2018 and larger roll-out	
Financial de-risking instruments	
8. Put-or-Pay guarantee	Risk reallocation - from private sector to the public sector
9. Off-take risk guarantee	
10. PPP guarantee through IIGF	
11. Grants and concessional financing	

Table 49– Public instruments that could enhance the risk/reward profile of WtE investments in Lombok.

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 Lombok.

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APPENDIX 1

Interview questions used for data collection.

Topic	Specific questions
Regulatory framework conditions for WtE	12. What are the most significant barriers for WtE from your point of view? 13. In your opinion, what do you think needs to change (from a regulatory standpoint) to advance WtE? 14. 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	15. What is your organization's role in the SWM and WtE value chain and how do you work to advance WtE? 16. What is your organization's interest in WtE and how does WtE support your organization's goals? 17. Which other organizations (whether private or public) do you have close collaboration on this specific topic?
Attracting private investments and barriers	18. Generally, what is your view on the ability of your region to attract private investments for WtE? 19. Are you aware of concrete initiatives or funding mechanisms which have been successful in attracting private investments into WtE? And are you aware of/are you working on future initiatives? 20. How do you assess private investors' appetite for investing in WtE and are you aware of private investors actively working on WtE projects in Lombok?
Public private partnerships and project financing	21. What do you consider to be the most critical criteria in securing a financially sound business case for WtE? 22. 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	23. 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	24. On the power generation side, what is your view on the role of WtE in your region? 25. What would it take to increase the share of WtE
Open questions	26. What is your view on WtE more broadly? (could be from an environmental, social or economic perspective..) 27. What do you believe it would take to accelerate WtE in your region?

	28. In your opinion, what are the most significant challenges concerning development of WtE (financial, regulatory, social, environmental or technological?) 29. Status of the landfill, projects in pipeline etc.?

APPENDIX 2

Retribution Tariffs in Mataram City

	IDR/month	USD/month
Non-commercial tariffs		
Household	5,000	0.32
Government institution	25,000	1.61
General tariffs		
Grocery store	1,000	0.06
Stall	5,000	0.32
Market complex	10,000	0.65
		0.00
Schools and kindergardens	10,000	0.65
Universities	25,000	1.61
Hospitals and health clinics	250,000	16.14
Airport	500,000	32.29
Practicing Doctor	25,000	1.61
Commercial tariffs		
Shop	5,000	0.32
Restaurant	25,000	1.61
Budget hotel	50,000	3.23
Star hotel		0.00
1. Star hotel 1	200,000	12.91
2. Star hotel 2	300,000	19.37
3. Star hotel 3	400,000	25.83
Supermarket	250,000	16.14
Pharmacy	50,000	3.23
Mall	1,000,000	64.57
Shops (outside the market)	25,000	1.61
Industry tariffs		
Motorcycle repair shop, industry waste households etc.	25,000	1.61
Motorcycle dealer	75,000	4.84
Ice factory, soy sauce factory, coconut oil factory, food/	350,000	22.60
Rice mills, etc.	75,000	4.84
Landfill disposal tariffs		
	IDR/m3	USD/m3
Disposal of waste by third parties	10,000	0.65

Table 50 – Retribution tariffs in Mataram City (Peraturan daerah Kota Mataram 14/2011, 2011).

Retribution Tariffs in Northern Lombok Regency

	IDR/month	USD/month
Social facilities		
Schools, universities, and health sector	5,000	0.32
Non-commercial customers		
Households (21-45 m2)	5,000	0.32
Households >45 m2	7,000	0.45
Government institutions	10,000	0.65
Commercial customers		
Class A	5,000	0.32
Class B	10,000	0.65
Class B	25,000	1.61
Class C	50,000	3.23
Class D		
-Hotel (1 star)	150,000	9.69
-Hotel (2 stars)	200,000	12.91
-Hotel (3 stars)	300,000	19.37
-Hotel (>3 stars)	500,000	32.29
-Hospital	250,000	16.14
-Health clinic	250,000	16.14
-Gulf course	100,000	6.46
-Supermarket	200,000	12.91
-Mall	1,000,000	64.57
	100,000	6.46
Industry customers		
Small industrial company	10,000	0.65
Medium industrial company	50,000	3.23
Large industrial company	250,000	16.14
Special customers		
	IDR/day	USD/day
Small grocery store	500	0.03
Street vendor	5,000	0.32
Shop	5,000	0.32

Table 51 – Retribution rates in Northern Lombok Regency (Lembaran daerah kabupaten Lombok Utara 4/2010, 2010).

Retribution Tariffs in Western Lombok Regency

	IDR/month	USD/month
Social/Educational facilities		
Elementary school	100,000	6.46
Middle school	200,000	12.91
Public universities	300,000	19.37
Private colleges	400,000	25.83
Other private educational Institutions	500,000	32.29
Non-commercial customers		
Households (21-45 m2)	3,000	0.19
Households >45 m2	5,000	0.32
Government institutions	200,000	12.91
Public health center	200,000	12.91
General hospital	300,000	19.37
Commercial customers		
Class A	50,000	3.23
Class B	150,000	9.69
Class C		
-Hotel (1 star)	750,000	48.43
-Hotel (2 stars)	1,000,000	64.57
-Hotel (3 stars)	1,500,000	96.86
-Hotel (4 stars)	1,750,000	113.00
-Hotel (5 stars)	2,000,000	129.14
Restaurant/café/karoake bar	450,000	29.06
Private hospital	500,000	32.29
Health clinic	500,000	32.29
Gulf course	500,000	32.29
Mall	2,000,000	129.14
Industry customers		
Small industrial company	100,000	6.46
Medium industrial company	250,000	16.14
Large industrial company	400,000	25.83

Table 52 – Retribution rates, North Lombok Regency (Lembaran daerah Kabupaten Lombok Barat 3/2011, 2011)

Retribution Tariffs in Central Lombok Regency

	IDR/month	USD/month
Private households		
Large house >1000 m2	5,000	0.32
Medium house 54-100m2	3,000	0.19
Small house >54 m2	2,000	0.13
Hotels		
Social housing	4,000	0.26
Dormitory	75,000	4.84
Hotel (Jasmine class)	150,000	9.69
Hotel (1-2 stars)	250,000	16.14
Hotel (>2 stars)	500,000	32.29
Homestay	100,000	6.46
Restaurants		
Small restaurant	7,500	0.48
Large restaurant	100,000	6.46
Shop	4,000	0.26
Offices		
Government Agencies and ABRI level District/Village	5,000	0.32
Government Agencies and ABRI level Regency	10,000	0.65
General hospital (private/public)	250,000	16.14
Maternity clinic	150,000	9.69
Doctor	150,000	9.69
Educational institutions		
College	50,000	3.23
Street vendors		
Electronics store	15,000	0.97
Grocery store	7,500	0.48
Glass shop	9,000	0.58
Pharmacy	15,000	0.97
Warehouses		
Large warehouse >200m2	50,000	3.23
Small warehouse =/<200 m2	25,000	1.61

Table 53 – Retribution rates, Central Lombok Regency (Lembaran daerah kabupatan Lombok Tengah 4/2017, 2019).

Retribution Tariffs in Eastern Lombok Regency

Educational facilities				
Private college	IDR/month	100,000	USD/ month	6.45
Elementary school and other equivalents	IDR/month	50,000	USD/ month	3.2
Kindergarten	IDR/month	25,000	USD /month	1.6
Tutorial Agency	IDR/month	100,000	USD/ month	6.5
Health facilities				
Hospital	IDR/container/transport	300,000	USD/container/ transport	19.4
Public health center	IDR/container/transport	300,000	USD/container/ transport	19.4
Auxiliary health center	IDR/month	50,000	USD/ month	3.2
Doctor	IDR/month	50,000	USD/ month	3.2
Pharmacy	IDR/month	50,000	USD/ month	3.2
Households				
Small house (<45 m2)	IDR/month	7,000	USD/ month	0.5
Large house (>45 m2)	IDR/month	10,000	USD/ month	0.7
Elite housing	IDR/month	20,000	USD/ month	1.3
Apartment	IDR/month	50,000	USD/ month	3.2
Government offices				
Urban area	IDR/month	150,000	USD/ month	9.7
Rural area	IDR/month	100,000	USD/ month	6.5
State-owned and private offices				
BUMN/BUMD	IDR/month	150,000	USD/ month	9.7
Financial organization	IDR/month	150,000	USD/ month	9.7
Telecommunications provider	IDR/month	150,000	USD/ month	9.7
Contractor services	IDR/month	75,000	USD/ month	4.8
Cooperative	IDR/month	50,000	USD/ month	3.2
Political party office, NGOs, etc.	IDR/month	25,000	USD/ month	1.6

Trade and services				
Market/market stall	IDR/day/stall building	1,000	USD/day /stall building	0.06
Motorcycle dealer	IDR/month	150,000	USD/ month	9.7
Shop	IDR/month	25,000	USD/ month	1.6
Supermarket/mall	IDR/month	250,000	USD/ month	16
Mini Market	IDR/month	150,000	USD/ month	9.7
Hotel/Motel	IDR/month	250,000	USD/ month	16
Café	IDR/month	150,000	USD/ month	9.7
Disco	IDR/month	150,000	USD/ month	9.7
Industry				
Small industrial company	IDR/month	25,000	USD/month	1.6
Medium industrial company	IDR/month	75,000	USD/month	4.8
Large industrial company	IDR/container/transport	300,000	USD/container/transport	19.4

Table 54 – Retribution rates in Eastern Lombok Regency (Bupati Lombok Timur Provinsi Tenggara Barat 1/2016, 2016).