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POLICY RECOMMENDATION
RAPID ASSESSMENT ON THE EFFECTIVENESS OF GREEN STIMULUS IN THE WASTE SECTOR

"Preliminary Study on Incentive Scheme to Promote RDF from Municipal Solid Waste"

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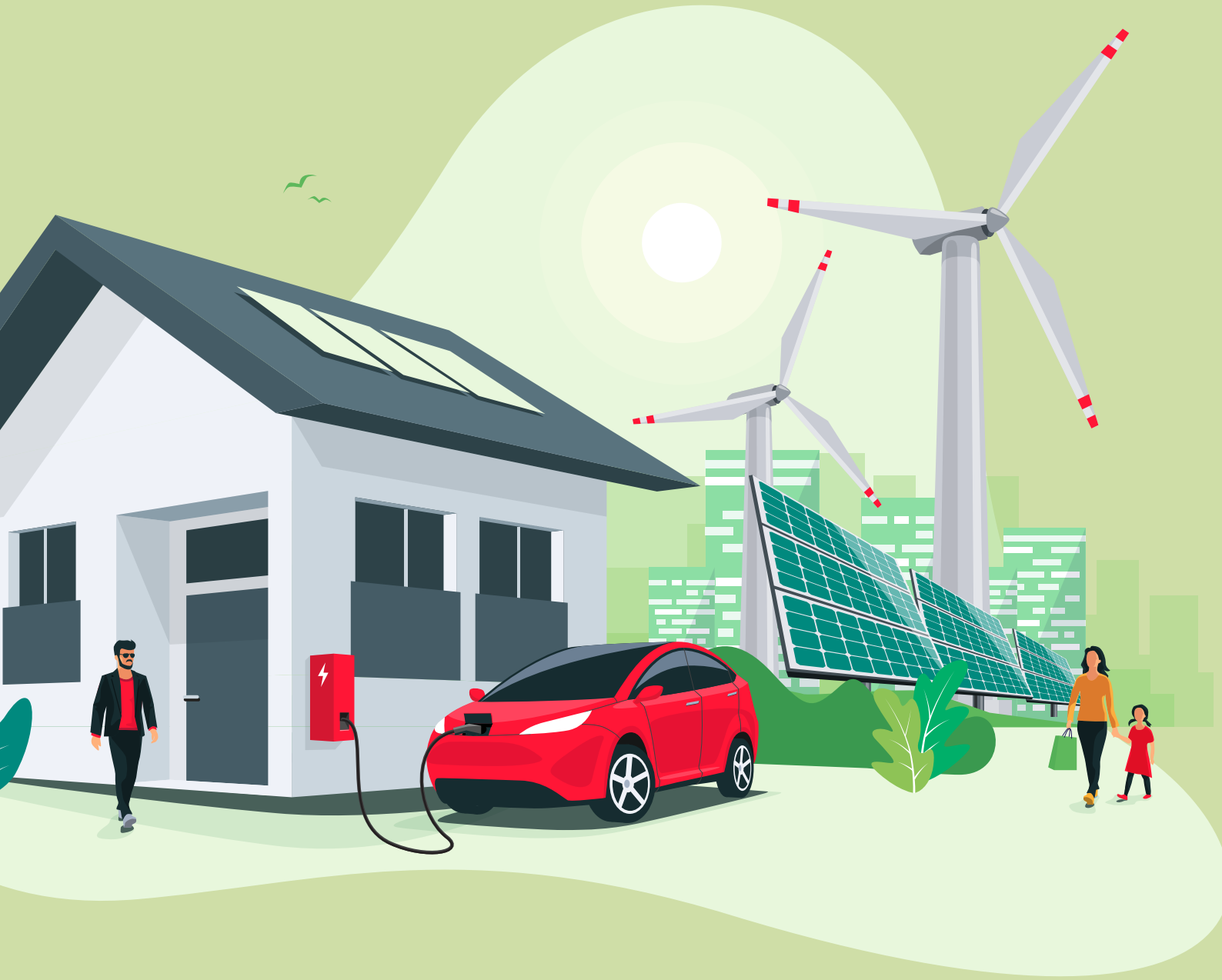
Table of **Contents**

Lis of **Tables**

Lis of **Figure**



Chapter I

INTRODUCTION

Waste problem has become a national problem in Indonesia. The growth of waste generation has made the government of Indonesia put tremendous efforts to deal with waste problem. The GoI has release several government regulations and initiatives to ensure waste generation is reduced and properly managed. In addition, the GoI also ratify the 2030 SDGs target in which waste problem is one of SGDs target. However, the effort seems deficient enough because the waste still increasing and scattered in public places. According to Minstry of Environmental and Forestry (MoEF), Indonesia waste generation 67.8 million tons1 in 2020 and it is predicted to increase as the population of Indonesia grow while the capacity of waste sector management is not improved.

Among those high waste generation, there is huge number of wastes that is not properly managed in sustainable ways. Indonesia's has only managed 68,8% of the total waste generation in 2018 (Bappenas, 2020). The rest are not managed properly which can be illegally dumped, burned, or even ended in the oceans. Those number is still far away from Indonesia's target in 2025 to manage 100% their waste by threating 70% and reducing 30% of waste generated. This target is stated in the Presidential Regulation No. 97/2017 about National Policy and Strategy on Household and Other Waste that becomes the basis regulation for government designing waste management activities. Therefore, the unmanaged waste needs to fix as soon as possible to reduce the impact on environment, social, and economic.

The significant problem created by unmanaged waste is the marine debris problem. A study done by Jambeck et al. (2015), revealed that Indonesia is the second largest contributor of marine debris in the world by producing around 1.29 million tons of marine debris each year. On the other hand, the government of Indonesia predict that Indonesia's marine debris production each year only 0.27 to 0.59 (Cordova et al., 2019). In spite of the progression, this situation is still far from the government target

[1] Ministry of Environment and Forestry. 2020. *KLHK: Indonesia Memasuki Era Baru Pengelolaan Sampah.* Retrivied from: *https*://www.menlhk.go.id/site/single_post/2753

to reduce marine debris until 0.07 in 2025. The marine debris problem has created massive problem not only for the environment but also for the economy that relies on tourism sector. Therefore, waste need to be managed properly in every management chain to reduce the negative impact.

On the other hand, the managed waste also create problem because of the capacity of waste management facilities in Indonesia. Among those managed waste, only 11-13% are recycled[2] and most of the rest is dumped in landfill. However, many landfills in Indonesia threatened by an overload. One of the examples is Piyungan Landfill which has already reached its maximum capacity which makes the dumping operation is closed for several days in early 2021[3]. The problem with piyungan landfill shows to the other landfill in another region that overload problem could be happening in the time soon as the waste still grows. For instance, Bantar Gebang, the biggest landfills in Indonesia, is predicted to reach its maximum capacity by 2021 (Siahaan, 2020). This problem should be overcome as soon as possible because it will increase waste leakage leading to serious environment problems.

The development of Waste to Electricity (WtE) (Indonesian: Pembangkit Listrik Tenaga Sampah/ PLTSa) has been initiated by the GoI, as the solution for the overloaded landfill and future waste generation problems. In order to support PLTSa project development in Indonesia, the GoI release Presidential Regulation No.35/2018 about acceleration of the development of waste to energy projects in Indonesia. In this regulation, the GoI set 12 cities across the country as the piloting city for PLTSa projects. However, until now, there is no PLTSa project that already operating in Indonesia. There are several reasons that hinder the development of PLTSa in Indonesia such as complex business model, expensive tipping fee, and low electricity price produced from PLTSa. This development stagnancy needs to be tackled by the GoI in order to solve waste problem in Indonesia.

[2] Material presented on the 3rd Webinar held by the Dana Mitra Lingkungan

[3] TPST Piyungan Overload, Sampah di DIY Menumpuk di Jalan. 2020. Accessed from https://kumparan.com/tugujogja/tpst-piyungan-overload-sampah-di-diy-menumpuk-hingga-ke-pinggir-jalan-1upWe2o7Jbq

One alternative solution to overcome those problem is developing Refused Derived Fuel (RDF) facility. RDF is an alternatives fuel that can be produce from municipal solid waste (MSW) used as an alternative for fossil fuels. In the comparison with PLTSa facility, RDF facility has lower capital expenditure (CAPEX) and operational expenditure (OPEX), suitable for any project scale, and it produce lower greenhouse gas emissions (GHG). In terms of business model, RDF products is needed by coal power plant and cement industry as their co-firing and co-processing resources. Therefore, the RDF can be a solution for combating waste problem in more sustainable ways than PLTSa.

Indonesia has already developing both small and large scales of RDF plant, but it is still limited. For Instance, Cilacap RDF plant and Klungkung Community based Waste for Energy (WtE) well known as TOSS facilities. CIlacap RDF plant is the first RDF plant in Indonesia who are now in commissioning stage with capacity to manage waste about 120/day with 50 ton/day RDF production. The Cilacap RDF plant was realized by the corporation between central government, local government, private sector and grant form Denmark. The product of Cilacap RDF Plant is used for cement industry. On the other hand, small scale RDF facilities has already been developed by the several local government and communities such as Tempat Olah Sampah Setempat (TOSS) in Klungkung, Bali which known as Gema Santi project[4]. Gema Santi Project produce RDF in the form of pellet that is used by the coal power plant to substitute coal as their inputs. Therefore, the RDF facilities can help the local government to manage their waste problem and promoting use of renewable energy.

Realizing that RDF has both potential for manage waste and produce energy, the GoI has already put a concern to develop RDF in the future. The GoI has already targeted to have ten RDF facilities by 2025 which is stated in the Presidential Decree No. 97/2017 about National Policy and Strategy on Household and Other Waste. However, the progression to reach the target is remain slow, until now Indonesia only has one RDF plant in Cilacap. The GoI still preparing another three RDF plant in Banda Aceh, Bogor and Cibinong to be built in 2021 but still has some issues to be overcome. On the other hand, the development of TOSS still depends on the community and private sectors which is still limited. Aside from the participation problems, the RDF products pricing also has been an issue that hinder the development of RDF plant in Indonesia.

Pursuant to the aforementioned background, this report tries to fill the gap in RDF development in Indonesia. This report provides a rapid assessment on RDF development in Indonesia. The aim of this report gives an overview of RDF development in Indonesia and lists of alternative business model and incentive scheme that can be implemented to support the RDF development in Indonesia. The structure of consist of four part including the introduction. **Chapter 2** provides an overview of the overview of RDF development in the context of Indonesia. This part begins by explaining the supply chain of the RDF technology from MSW with both implementation plan and potential in Indonesia. The initiation of RDF project also discussed with both technical and financial aspect of the project. This chapter end by explaining the challenges to develop RDF plant in Indonesia. **Chapter 3** discuss two alternatives of RDF business model that we proposed to be implemented in 2-3 years. While the other alternative will be elaborated on the Appendix. In order to support the business model, incentive schemes for each model will also be explained. **Chapter 4** concludes the urgency of RDF as the solution for waste problem and giving recommendation for the policy makers to promote RDF in future.

[4] Access from https://klungkungkab.go.id/inovasi/detail/toss (the Municipal Government of Klungkung website)

Chapter II

THE POTENTIAL DEVELOPMENT OF RDF IN INDONESIA

An overview of RDF

As mentioned in Chapter I, RDF is a part of an effort to achieve the sustainability agenda by producing a type of clean fuel. RDF technology generates clean fuel by shredding certain types of waste such as municipal solid waste (MSW) and other kinds of combustible refuse before incineration. It mainly involves reducing the moisture content of the waste, increasing the calorific value of the product. It also decreases the production of leachates in the case of the landfilling of the waste substance, if the organic material does not undergo further stabilization. Finally, it transforms the input into specific products, such as pellet fuel, plain mixtures, bricks, or logs to be used as RDF. The most important one, it also allows for the possibility of converting waste to energy, recovering recyclable material, and reducing the emission of environmental pollutants (Safwat et al., 2019).

According to the American Society for Testing and Materials, there are seven types of RDF as detailed bellow in Table 1:

Table 1. Classifications of RDF

Classifications	Descriptions
RDF-1	MSW used as fuel without oversize bulky waste.
RDF-2	MSW processed to coarse particles with or without ferrous metal. A subcategory of RDF-2 is the RDF crumb, which is then separated such that 95% by weight can pass through a 6-inch square mesh screen and densified to around 300 kg/m^3.
RDF-3	Fuel shredded from MSW and processed to separate it from metal, glass, and other entrained inorganic material, with a particle size of such that 95% by weight can pass through a 2-inch square filter (also knowns as Fluff RDF).
RDF-4	Combustible waste fraction processed into powdered from, which 95% by weight can pass through a 10-mesh screen (also called dust RDF of p-RDF)
RDF-5	Produced from combustible waste fraction that is then densified into 600 kg/m3 and into pellets, slugs, cubettes, briquettes, and other forms (also known as densified RDF or d-RDF)
RDF-6	RDF in liquid form or liquid-RDF
RDF-7	RDF in gas form.

Source: American Society for Testing and Materials retrieved from Caputo et al (2002)

However, different classification schemes may exist in the various countries. To make it simpler and align with the aims of the work, this work specifically classifies RDF based on types of the sources of waste, especially solid wastes. Basically, the RDF obtained from various types of combustible solid waste fractions can generally be classified into two categories: Municipal Solid Waste (MSW) and Industrial Solid Waste (ISW). In this instance, waste is defined as any combustible, non-hazardous material generated from the output of household and industrial activities. Trang et al (2009) explained the process of acquiring potential RDF resources as depicted in Figure 1. Hence, based on waste sources, RDF can be identified into three groups:

1. RDF-MS	A type of RDF that can be produced from MSW.
2. RDF-IMC	A type of RDF that can be produced from ISW, MSW, and construction waste obtained from industrial activities.
3. RDF-IS	RDF in gas form.

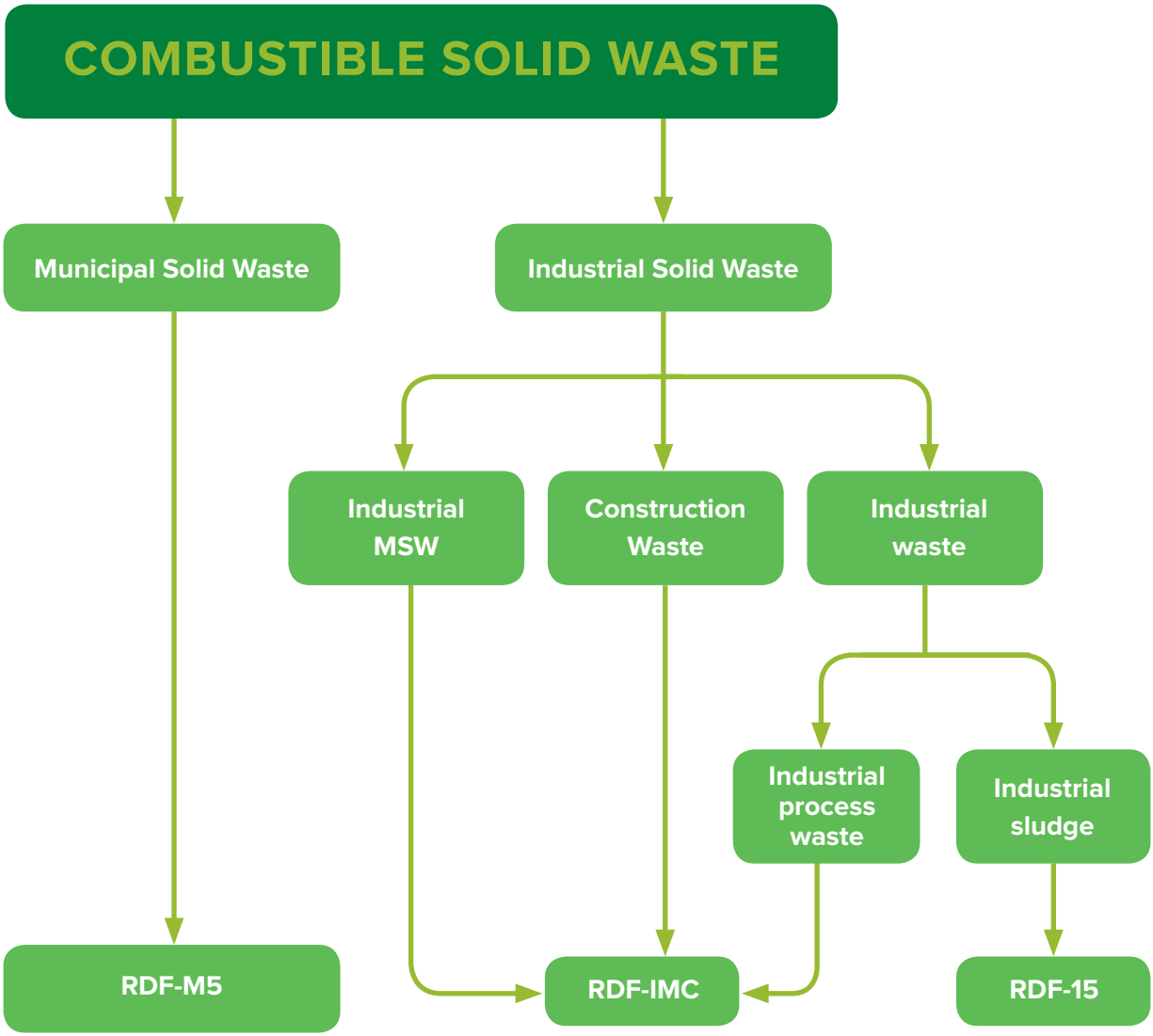


Figure 1. RDF classifications based on waste resources.

Source: Trang et al (2009)

When it comes to waste, the original waste types that can be transformed into RDF include paper, wood, textile, plastic, synthetic resin and rubber, as well as industrial sludge such as wastewater treatment sludge and process sludge from MSW and ISW. According to the study conducted by Trang et al (2009), the total generation of combustible solid waste was 830,000 ton/year, whereas the total ISW potentially amounted to as much as 4.5 times higher compared to the RDF from MSW. Approximately 50.1% of the total combustible MSW can be utilized to produce useful RDF resources. The potential RDF resources that can be generated from combustible ISW, including typical industrial solid waste and industrial sludge, were quite high, reaching 86.8% of the total combustible ISW. The reason that MSW has the lowest conversion rate into RDF is the high fraction of food and agriculture waste, which is not considered to be an RDF resource because the calorific value is relatively low than other type of waste.

Why RDF?

Even though these types of RDF are relatively varied, they contribute identical advantages. The use of RDF as clean fuel can generate high heating value and offers homogeneity in terms of physicochemical composition; it also easy to store, handle, and transport. In addition, another advantage that ought to be considered is its ability in converting waste to energy, recovering recyclable material, and lowering the emission of environmental pollutants (Safwat et al., 2019). One can therefore argue that RDF from solid waste can serve as a strategic solution for a sustainable waste management scheme, in pursuit of the recycling and reduction targets for combustible materials that are sent to the landfill.

As an alternative for clean fuel, RDF could reduce the use of fossil fuel to significant extent. For example, in the case of the cement industry, findings from Kara (2012) revealed that the advantages of using RDF include the reduction of CO_2 emissions, coal reduction of clinker production due to the use of inexpensive fuel, and preservation of resources through lower use of non-renewable fossil fuel. When 15% of RDF is used as supplementary fuel in cement production, it could cut CO_2 emission by 633 kg/h, saving up to 629.04 USD/year in costs.

Moreover, the technology of RDF is applicable to all thermal technologies scale, whether small or large. It can hence be applied to production from a community level (in Indonesia's context it calls Community Based Waste to Energy or TOSS) up to a massive commercial level. In addition, compared to other waste management technologies, the initial investment cost of RDF is relatively cheaper (See Table 2). It is for these reasons that RDF has attracted increased attention.

Table 2. Comparison of Waste Management Cost.

Type of Technologies	Initial Investment Cost (in IDR)	Capital cost (in IDR per ton)	O&M cost (in IDR per ton)	Total Cost (in IDR per ton)
RDF	85 - 425 B	170.000 - 425.000	170.000 - 340.000	340.000 - 765.000
Incinerator	510 B - 1.275 T	374.000 - 935.000	340.000 - 595.000	714.000 - 1.53 M
Gasification	1.36 T - 2.04 T	595.000 - 765.000	595.000 - 680.000	1.1 - 1.46 M
Anaerobic Digestion	240 T - 340 T	204.000 - 323.000	170.000 - 255.000	374.000 - 578.000

Source: Waste to Energy Option in MSWM, GIZ, 2017.

The Potential Development of RDF in Indonesia

As it functions as an alternative for conventional fossil fuel in industrial sectors, RDF is typically used in the cement industry and thermal power plant. The following are the potential development of RDF in Indonesia based on the potential offtaker's existence.

Cement Industry

The heavy use of coal fuel in Indonesia's cement industry provides potential opportunities for the development of RDF in the country. Cement is a promising venture because historically in Indonesia, its demand and production capacity gave tended to grow. In 2021, the production capacity of the cement industry is estimated at 116.9 million ton and will remain constant until 2026 (See Figure 2).

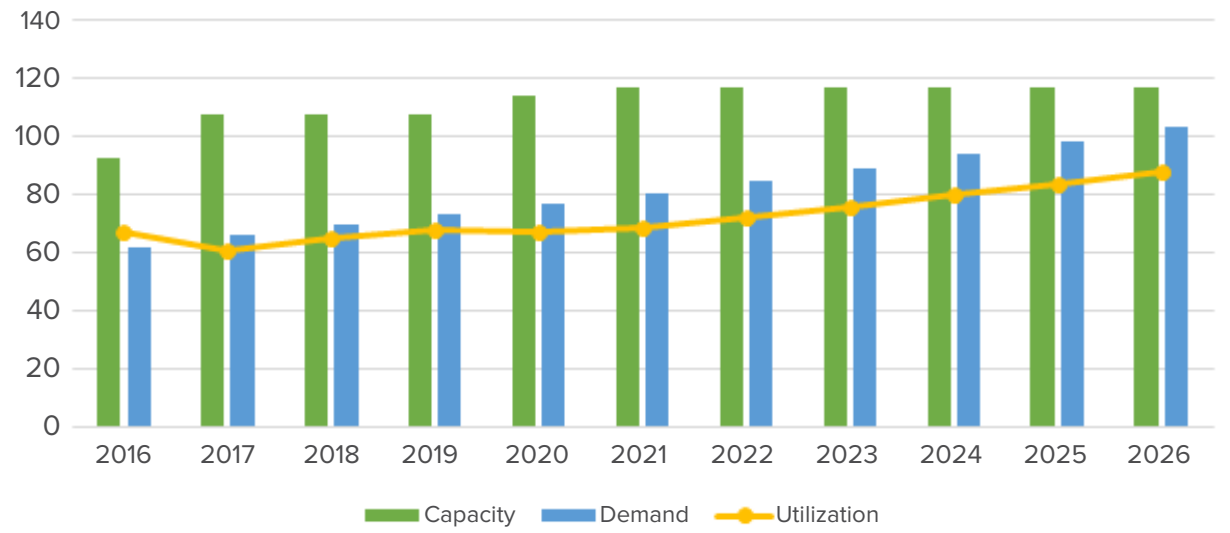


Figure 2. The Estimations of Indonesia's Cement Industry Capacity

Source: Indonesia's Cement Association, 2017

In terms of distribution of the industry's location, Indonesia's cement production is widely distributed across Indonesia's territory. Up to 2016, Indonesia has 13 cement industries and the additional of several players in 2017 contributed to the massive growth of Indonesia's cement production. Moreover, the existing industries extend its business by developed additional industries in other Indonesia's potential area. Therefore, it can be argued that the cement industry in Indonesia remains an attractive potential market as its extensive production across the country (See Figure 3).

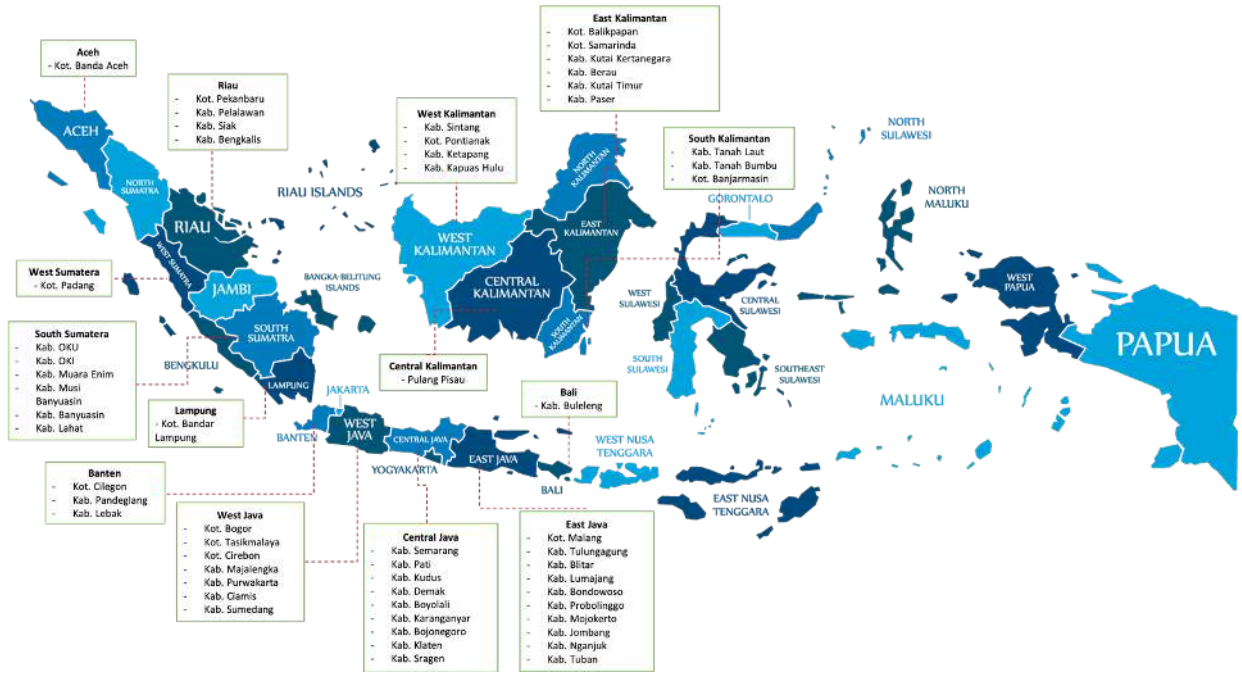


Figure 3. RDF Potential Location with Offtaker of Cement Industry

Source: Ministry of Public Works and Housing, 2021

In the cement industry, RDF is used as an alternative fuel for cement kilns, and it is generally prepared by the first cutting, sorting, and separating metals and other materials that cannot be used as fuel, then converting the resulting material to fluffy, solid fuel or other form such as pellets. It is commonly known as a co-processing mechanism. A few companies have utilized co-processing as an alternative clean fuel for its clinker production for up to about 10% of the thermal substation ration. Even this number is relatively low compared to the European market, which has an average thermal substitution ratio of 17%. Even so, there is at least an opportunity to scale up the utilization of RDF in the cement industry. In the majority of cases, the used alternative fuel is derived from agricultural waste and the RDF from municipal solid waste.

Coal-Fired Power Plant (PLTU)

With regard to Indonesia's NDC, the energy system makes the second largest contribution after the land system, specifically contributing 9% to the NDC target. Compared to the 2014 National Energy Plan, the government must launch additional endeavors to achieve the target of 23% of renewable energy share in the primary energy supply by 2025 and 31% by 2050. Additionally, Indonesia's state-owned national electricity utility, PLN, has issued the National Electricity Supply Business Plan (Indonesian: Rencana Usaha Penyediaan Tenaga Listrik or RUPTL). According to the then-year plan, annually, PLN aims to initiate the installation of 15 GW of renewable energy plants by 2027. However, Indonesia's renewable energy installment in the electricity sector in 2019 remained at 9 GW and 12.14 million liters per year in biofuels (Garrido, et al., 2019).

As an effort to pursue its renewable energy target and generate potential fuel for power plants from biomass and waste, the government has issued a strategic plan regarding the accelerated development of biomass as a sustainable energy source. The document specifies that the implementation of cofiring power plants through the utilization of biomass and waste is considered to be an alternative in hastening the deployment of renewable energy. Even though this is an endeavor to pursue the target concerning the energy system, it is also in line with waste reduction target as mentioned in the Paris Agreement.

Principally, cofiring is a fuel combustion activity that employs a mixture of coal fuel with biomass fuel. 52 out of 114 coal-fired power plants which massively allocated over the Indonesia's area are potentially capable of utilizing cofiring (See Figure 4). To meet the cofiring needs of coal-fired power plants in Indonesia, 4.15 million ton of biomass pellets are needed per year (for a percentage of 5% and 30% biomass pellets) or 749 thousand ton of waste pellets per year (1% of waste pellets).

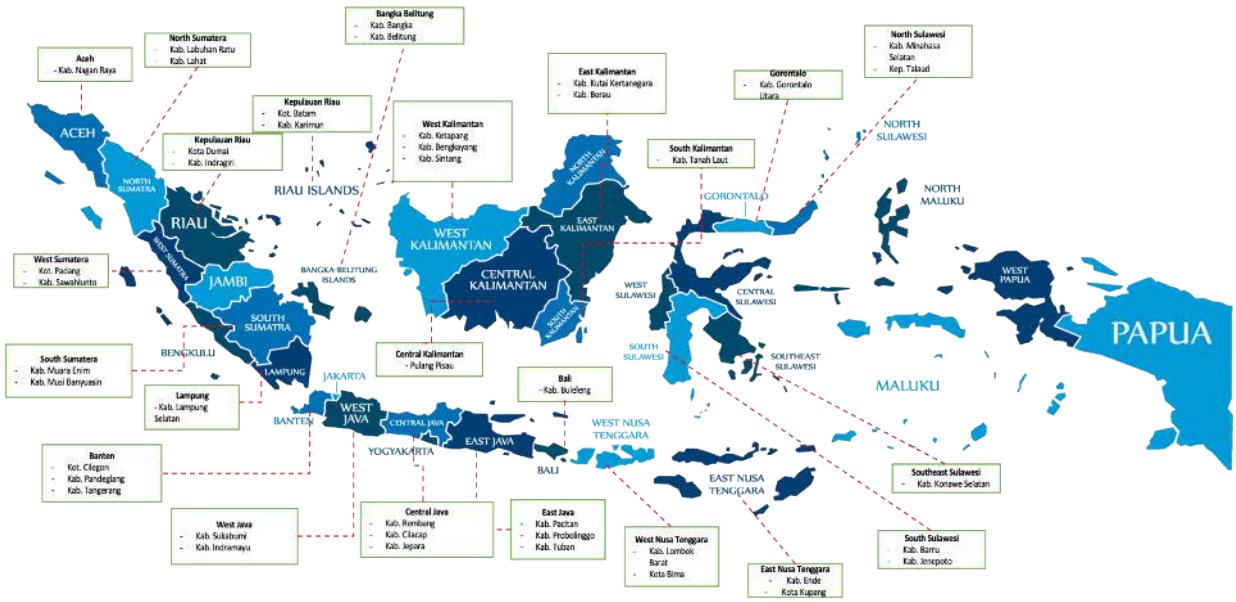


Figure 4. RDF Potential Location with Offtaker of PLTU

Source: Ministry of Public Works and Housing, 2021

Considering the massive potential of RDF market In Indonesia, it would be matters to prioritize the RDF facility development in selected regions. At least the prioritization strategy would address the issue of the limitation of state budget while the country insists to implement the RDF deployment due to its contribution in managing waste sustainably. It also aligned in supporting the government to achieve the Indonesia's RDF development target up to 2025 which documented in Presidential Regulation No. 97 of 2017.

This study deploys supply and demand analysis in determining the potential regions that should be prioritized for the RDF development up to 2025. At the demand side, the study puts its concern regarding the number of wastes. The number of wastes plays a crucial role since its fundamentally determined the sustainability of RDF production. At this context we used the threshold of 120 tonnes[5] waste per day as the minimum number of wastes in a region. When it comes to the supply side, the concern is addressed to the potential RDF offtakers. It could be affairs since the existence of the buyers would secure the RDF industry revenue stream and improve the business feasibility of RDF industry. After ranking those aspects, the list of the selected prioritized regions is attached in Figure 5.

[5] Ministry of Civil Work

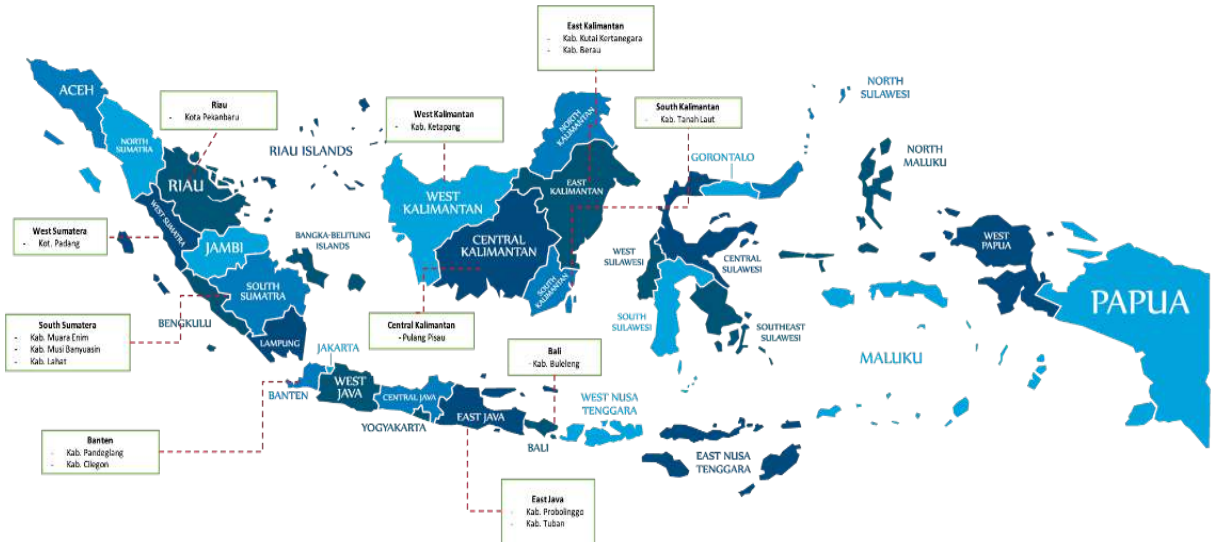


Figure 5. The Potential of RDF development for Coal-fired Power Plant and Cement Industry

Source: Ministry of Public Works and Housing, 2021

The Utilization of RDF in Small-scale Industry

Despite it functions to be utilized in cement industry and PLTU which typically are large scale production, the RDF is also being promoted to be used in small scale industry such as small-medium enterprises or community level. In Indonesia, Community Based Waste to Energy (Indonesian: Tempat Olah Sampah Setempat or TOSS) was introduced as the waste management strategy at community level. Principally, TOSS adopts the RDF modest technology to empower small- medium enterprises. As applied in cement industry and PLTU, the TOSS also transforms solid waste into pellets or briquettes which to be utilized as the clean fuel. As it functions as an alternative for conventional fossil fuel, the TOSS has its part to support GoI in pursuing its renewable energy target for the co-firing purpose. Additionally, it also accelerates the Indonesia's electrification ratio, especially in eastern Indonesia.

Principally, the TOSS develops peuyeumisasi or bio-drying scheme where solid waste is being processed without leachate, without fertilization, and no need specific skill to operate the system. Moreover, the TOSS also introduces 3 steps to manage waste easily. First, the solid waste is delivered to a tipping floor and over-sized items are removed. Subsequently, solid waste is processed with peuyeumisasi process in the bamboo cages to allows fermenting and aeration. The final step is fermented compost. Fermented compost is a crush-shredded to the preferred size.

Regarding the offtaker, the potential buyers are not limited into small-medium enterprises. Even the TOSS production is categorized in a small scale, it also potential for TOSS developer to support the GoI's cofiring plan by deliver its output to the PLTU. The TOSS is potentially able to operate up to 30 ton per day of MSW to supply the cofiring needs at 3-5% ratio.

Aligning with the list down of prioritization area in Figure 5, the development of TOSS facility is also considered to be developed firstly in that areas. Perhaps, the presence of TOSS facility in the prioritized area would strengthen the security of the stock of RDF output and make the RDF market become more sustain and mature.

Government of Indonesia's Plan on RDF Project

Due to the relative novelty of RDF, regulations that specifically govern it have yet to be introduced in Indonesia. In 2020, Indonesia also had no RDF operations, and the most recently updated one is the RDF development facility in Cilacap, Central Java, where it is currently at the commissioning stage. However, the fundamental regulations of RDF development and the current government's plan for developing RDF do exist, as listed below:

Table 3. Indonesia's Related Regulation of RDF Development

Regulation and Initiation	Description
Law No. 18 of 2008	Waste management
Government Regulation No. 81 of 2012	Management of domestic waste and other waste similar to domestic waste
Presidential Regulation No. 97 of 2017	National policy and strategy on the management of domestic waste and other waste similar to domestic waste
Attachment II Presidential Regulation No. 97 of 2017	The "Utilizing waste as substitute fuel for the cement industry or RDF" program with the target of constructing facilities in 2 regencies/cities in 2017 and 1 regency/city from 2018 to 2025 every year.
2021 Priority Project in Support of the Patent of the Deputy Agency of Maritime Affairs and Natural Resources, National Ministry of Planning (PPN)/Bappenas	2021 target of 3 locations: the Regency of Bekasi (West Java), the City of Cilegon (Banten), and the Regency of Probolinggo (East Java)
PLN's Plan	Optimistic scenario: - 5% cofiring at PLTU PLN, increase of 1006 MW in capacity, rollout target in 2021 Moderate scenario: - 3% cofiring at PLTU PLN, increase of 600 MW in capacity Pessimistic scenario: - 1% cofiring at PLTU PLN, increase of 200 MW in capacity

Sources: Author's own construction

Even though Indonesia has no commercial operated RDF facility, yet several RDF facilities are under constructing. The following are selected RDF development progress in Indonesia.

Table 4. Indonesia's RDF Project Development Progress

Project Name	Location	Area	Concession (years)	Capacity (tonnes/day)	Output	RDF Offtaker	Investment cost	Project status
Regional Waste Processing and Final Processing Sites LULUT-NAMBO	Lulut Village – Nambo, Klapanunggal Distric, Bogor	15 Ha	25	1,650 – 1,800	1. RDF: 577-630 ton/day 2. Compost: 1 ton/day 3. Recycling materials 4. Residual	Cement company (PT Indoce-ment Tunggal Prakarsa)	IDR 694 Billion	Construction
PPP of Waste Processing and Final Processing Piyungan	Sleman regency, Bantul regency, Yogyakarta	12.5 Ha	25	650 – 700	RDF: 227,5-245 ton/day	Cement company (PT SBI)	USD 15.18 million	OBC
RDF - Cilacap	Tritih Lor Village, Jeruklegi District, Cilacap, West Java	4 Ha		120	RDF: 40 ton/day	Cement company (PT. SBI)	IDR 90 billion	Commissioning

Sources: Author's own construction

Challenges

In spite of its considerable potential, followed by the government's intention to further RDF development, Indonesia faces some challenges in improving the viability of RDF. The challenges and opportunities are as follows:

- **Data Availability**
    - The inadequate data availability causes an inaccuracy in feedstock analysis which potentially leads to a rising of production risk such as making the RDF project become uneconomically viable.
    - The available data on its potential needs to be updated, and it is necessary to map out the potential as well as development strategies.
- **Raw Materials Security**
    - Conflict exists between the utilization of raw materials for bioenergy and for the fulfillment of needs of such as food consumption and fertilizers.
    - It is necessary to develop second- or third-generation biomass with high productivity and reliability.
    - Take advantage of biomass from THE and sub-optimal land, as well as expanding the production of biomass pellets and RDF.
- **Investment and access to funding**
    - A profitable business scale, from an economics perspective, needs a fairly sizable amount of initial capital.
    - It is difficult to access affordable sources of funding.
    - There are international sources of low-interest funding that require support from and coordination with banking institutions to access them.
- **Power Purchase Agreement Guidelines**
    - Currently, risk sharing in Power Purchasing Agreements needs to be distributed evenly.
    - The lack of clear regulations on the development of RDF causes uncertainty and may potentially reduce the bankability of RDF projects, making it more difficult to achieve full funding.
    - The rate of return for developers of RDF remains unsatisfactory
- **The need to expand on supporting infrastructure**
    - Access to electrical power transmission and distribution network infrastructure.
    - It is necessary to improve physical infrastructure, in order to enable easier access to sources of renewable energy and reduce investment cost.

- **Challenges on developing the right business model**
    - Business model of RDF for large scale facility is limited to the initiative from both central and local government. The private sector who wants to involve in RDF project is facing complicated administration.
    - From the small-scale RDF facility, it is hard for the operational manager to cooperate with the offtaker. Cooperation with the government regarding this issue is also another problem. This problem appears because the production of small scale is relatively low than the needs of the offtaker. In addition, the RDF production at small-scale project is more uncertain compare to the large-scale RDF facility Therefore, the alternative business model in the chapter III offers a solution to have a whole buyer.

- **Alternative incentives to private sector are limited**
    - The player of the RDF facility project is still limited to the government. The private sector is still reluctant to joint because it is not attractive. Hence, the development of RDF in Indonesia is relatively low.
    - In order to involve the private sector, direct incentive to the private sector need to be given by the government. This could be an effort of government to increase the player on the industry and filling the gap on the sectors.

- **Product selling mechanisms**
    - There are currently no regulations that govern both product standard and price.
    - The RDF standard is needed to ensure that the output can satisfy the needs of the offtaker.
    - The fact that the RDF market in Indonesia is still lacking in terms of competitiveness has led to a lack of benchmarking in the process of price determination.

Chapter III

BUSINESS MODEL AND INCENTIVE SCHEME OF RDF PROJECT: A PRELIMINARY DESIGN

Given the barriers to the development of RDF in Indonesia, its RDF business model calls for some improvement. Moreover, incentive schemes should also be introduced to the RDF industry not only to bolster the competitiveness of its market but also supporting green economic recovery. We proposed five business model recommendations and incentives needed that may possibly improve the RDF industry's prospects in Indonesia. The business models are divided into two section which consist of three alternatives business model for large-scale RDF and two business model small-scale (TOSS). However, this section will only talk about two out of five proposed business model as the main model that needed to be boosted (see the rest in appendix).

The two-model chosen are Government Driven for RDF Facilities (Non-PPP Scheme) and Private/ Community Driven for TOSS Facilities. The models are chosen because it can be implemented as soon as possible due to the flexibility of the model compare to the other models. The chosen model also has several strengths that leverage their potential to be easily implemented. Despite the advantages, the model also has several weaknesses that could be a possible hindrance for TOSS development. All the strength and weaknesses of the model are shown by the Table 5. Through those two combined models, the RDF business industry is forced to have one strong dan big business model that can promote RDF development I n Indonesia. On the combined models, the large-scale RDF facilities has an obligation to buy RDF products from TOSS and distribute it to the Offtaker (see Figure 6). Therefore, the offtaker have strong supply of RDF that can boost the RDF industry.

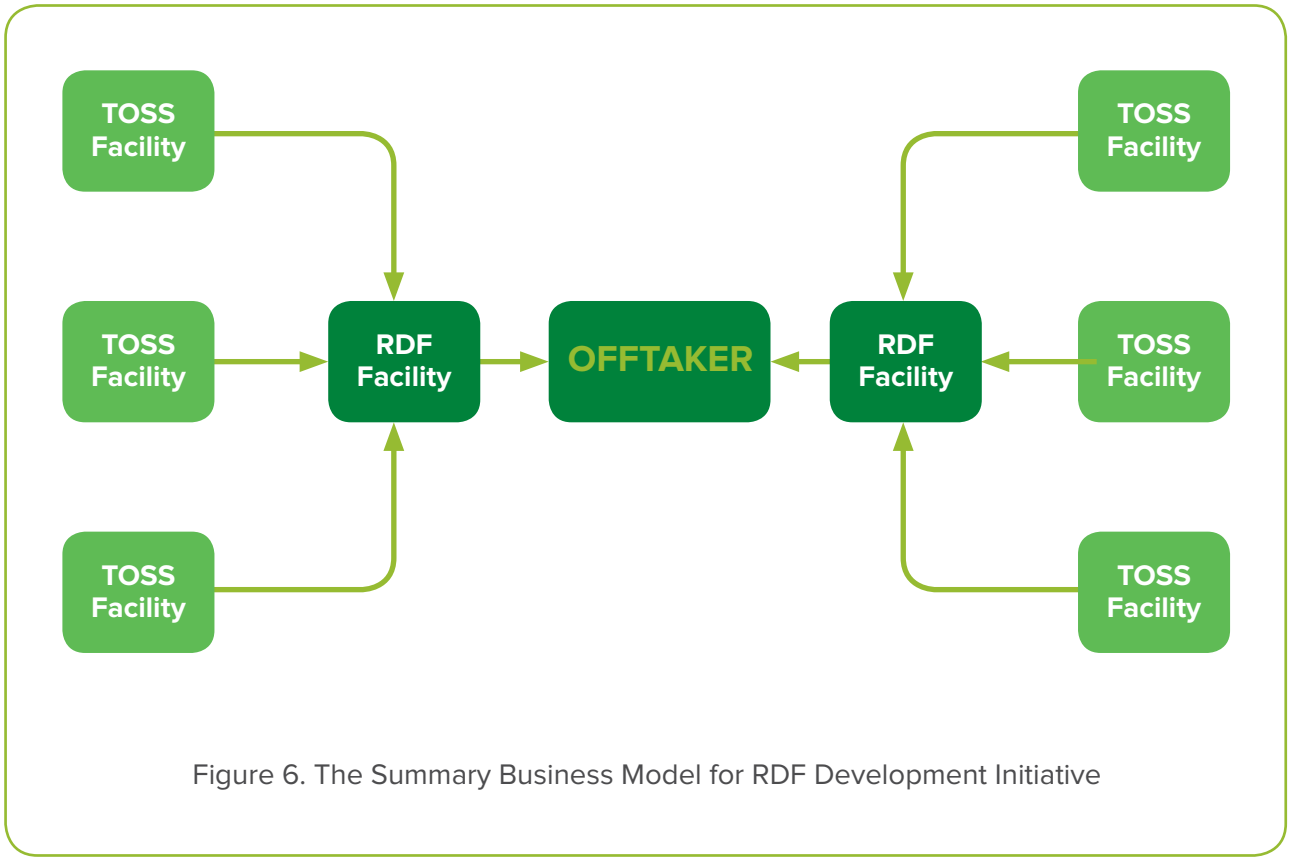


Figure 6. The Summary Business Model for RDF Development Initiative

Source: Author's own construction

Table 5. Strength and Weakness for Each Business Model.

Business Scheme for Developing RDF and TOSS Facilities	Time Aspect		Administration Aspect		Financial Aspect	
	Strength	Weakness	Strength	Weakness	Strength	Weakness
PPP Scheme	-	1. Not possible to be implemented effectively in 2021/0222	1. There is a government's project guarantee to the private as the operator which makes the project more secure.	1. The administrative procedures are relatively complicated.	1. The sharing cost between government and the private would lighten the government's burden.	-
Government Driven for RDF Facilities (Non-PPP Scheme)	1. Possible to be implemented in 2021/2022 2. The government responsible for the investment cost would attract the private interest to develop RDF and able to accelerate the RDF deployment.	-	1. Compare to PPP scheme, the administrative procedure is relatively simpler.	1. The absence of government's project guarantee raise the risk of uncertainty for the potential investor.	1. Provides more attractiveness to for potential investors since capital expenditures are borne by the government.	1. Potentially creates a larger burden for the government since all capital expenditures are borne by the government.
Private/ Community Driven for RDF Facilities (Non-PPP Scheme)	-	1. The program is potentially delay to be implemented in 2021/2022 due to the difficulty of the investors to reach financial close.	1. Compare to PPP scheme, the administrative procedure is relatively simpler.	1. The absence of government's project guarantee raise the risk of uncertainty for the potential investor.	1. The majority of investment cost is burned to the investor, hence lighten the government budget burden	1. The limitation of financial source and access to capital make it difficult for investors to carry out business acitivity.

Business Scheme for Developing RDF and TOSS Facilities	Time Aspect		Administration Aspect		Financial Aspect	
	Strength	Weakness	Strength	Weakness	Strength	Weakness
Government Driven for TOSS Facilities	-	1. It is feared that negotiation process of the formation of a contract for the delivery of facilities will incur additional time costs.	-	1. There is an administrative procedure related to the handover of the built facilities to the operator (community).	1. There is certainty about the source of funding.	1. Potentially creates a larger burden for the government since all capital expenditures are borne by the government.
Private/ Community Driven for TOSS Facilities	1. Possible to be implemented in 2021/2022 (particular regions have been implemented this business scheme.)	-	1. the community is more flexible to innovate the output of the RDF production. 2. Contributing education to the society regarding sustainable waste management.	1. There is an agreement contract between the government and community which potentially leads to the complication of administrative procedural.	1. Relatively uncomplicated access to funding. 2. The majority of investment cost is burned to the community, hence lighten the government budget burden	1. Risk of uncertainty regarding sources of funding,

Source: Author's own construction

I. Non-PPP scheme – Government-driven

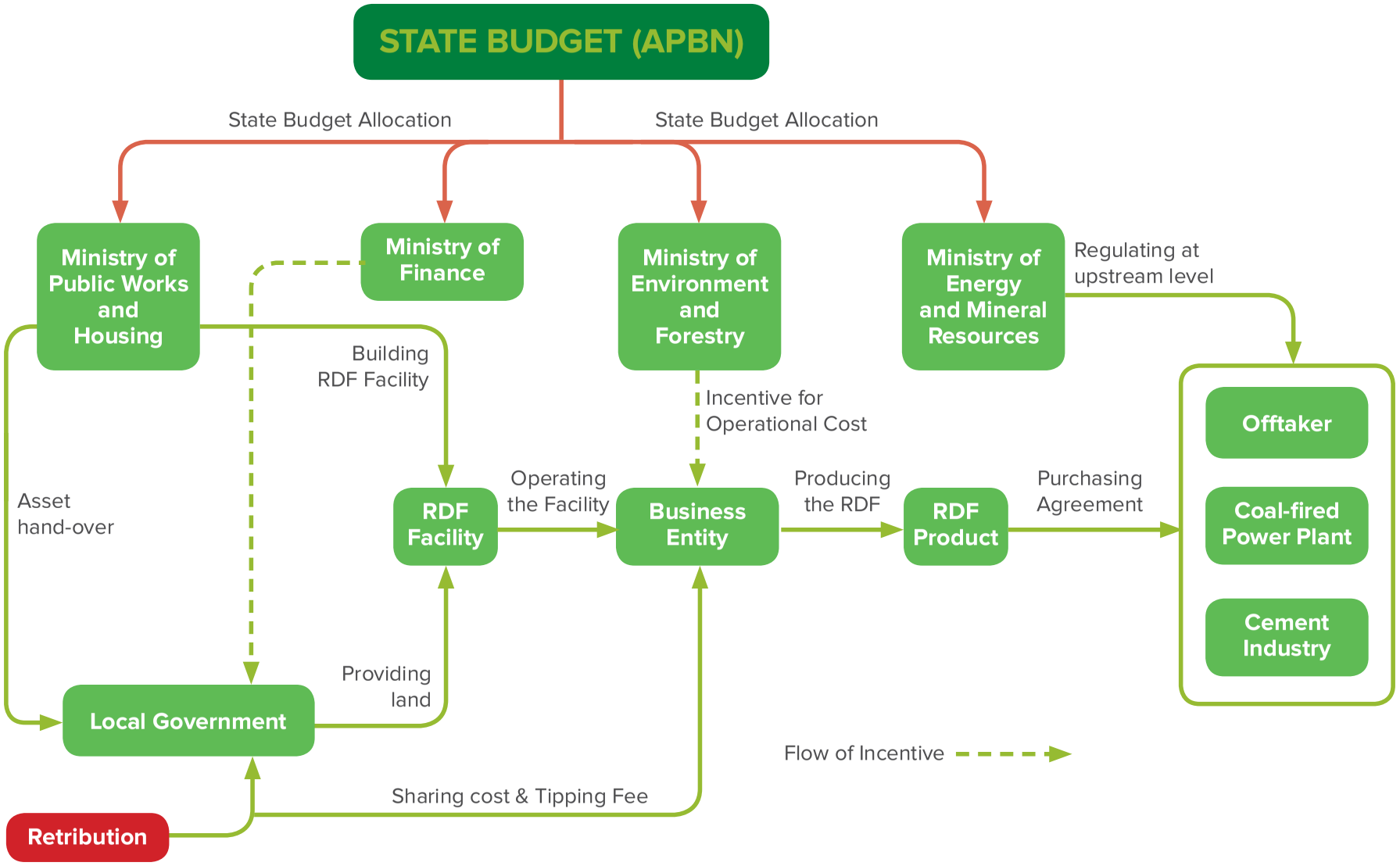


Figure 7. Business Model for Non-PPP scheme – Government-driven

Source: Author's own construction

Even though a PPP scheme looks promising in terms of promoting the development of RDF facilities, it is not a preferable option for the private business entity. In the context of Indonesia, PPPs involve complicated administration and consume a substantial amount of time for the business entity. In some cases, the private entity will also struggle to achieve its financial close. Up to this day, an RDF infrastructure that has enjoyed success under the PPP scheme is the development of an RDF facility in Nambo, which also faces some delays in finishing the project. In light of these conditions, a government-driven non-PPP scheme could be considered an alternative that may be adopted to accelerate the proliferation of RDF facilities. Although the model does not provide guarantees from the government to the business, as it does in the case of the PPP scheme, the government will provide the infrastructure development in full and hand over the facility for the private business entity to operate and maintain for up to the agreed-upon years as stated in the contract. As the operator, the private entity will consequently bear the maintenance and operation costs.

Principally, the local government will provide the land, and the rest of the infrastructure will be constructed by the Ministry of Public Works using funding from the state budget. Once the facility has completed its construction, it will be a hand-over process from the Ministry of Civil Work to the local government. Subsequently the facility is delivered to the private entity, which will operate and maintain it for the purpose of producing RDF output, then sell the products to prospective offtakers through purchasing agreement contracts. The return investment for the entity will be sourced from the products sold to the offtakers and the tipping fee from the local government, which is derived from local retribution. To make the market more promising, the local government will provide a high rate of tipping fees, subsidized by the Ministry of Finance and monitored by the Ministry of Environment and Forestry. In the long term, to sustain its finances, the local government will need to charge the local population with higher retribution in the waste sector. In addition, the Ministry of Environment and Forestry will offer operational incentive facilities to the operator, aiming to lighten its costs. This incentive is a pressing matter in particular, at least from the perspective of improving the competitiveness of RDF output compared to conventional fuel. The detail of the incentive will be explained in the next section.

II. Business Model for Private Sector/Community Driven TOSS Facility

The second alternative business model for developing TOSS facility is private sector and community driven. This business model is proposed to overcome the limitation arise from the local government limited capacity. Therefore, the private sector/community need to be pushed as the initiator of TOSS facility. This business model offered private sector/ community more flexible space for designing the TOSS project. However, this project will need more time from the designing process until the facility can be operated because the initiator needs to find their own source of fund before the construction begins. In addition, the initiator also needs the local government permission to run the TOSS facility because waste management is the responsibility of the local government. Nevertheless, the initiator also needs support from the government and the other actors that are summarized by Figure 8 below.

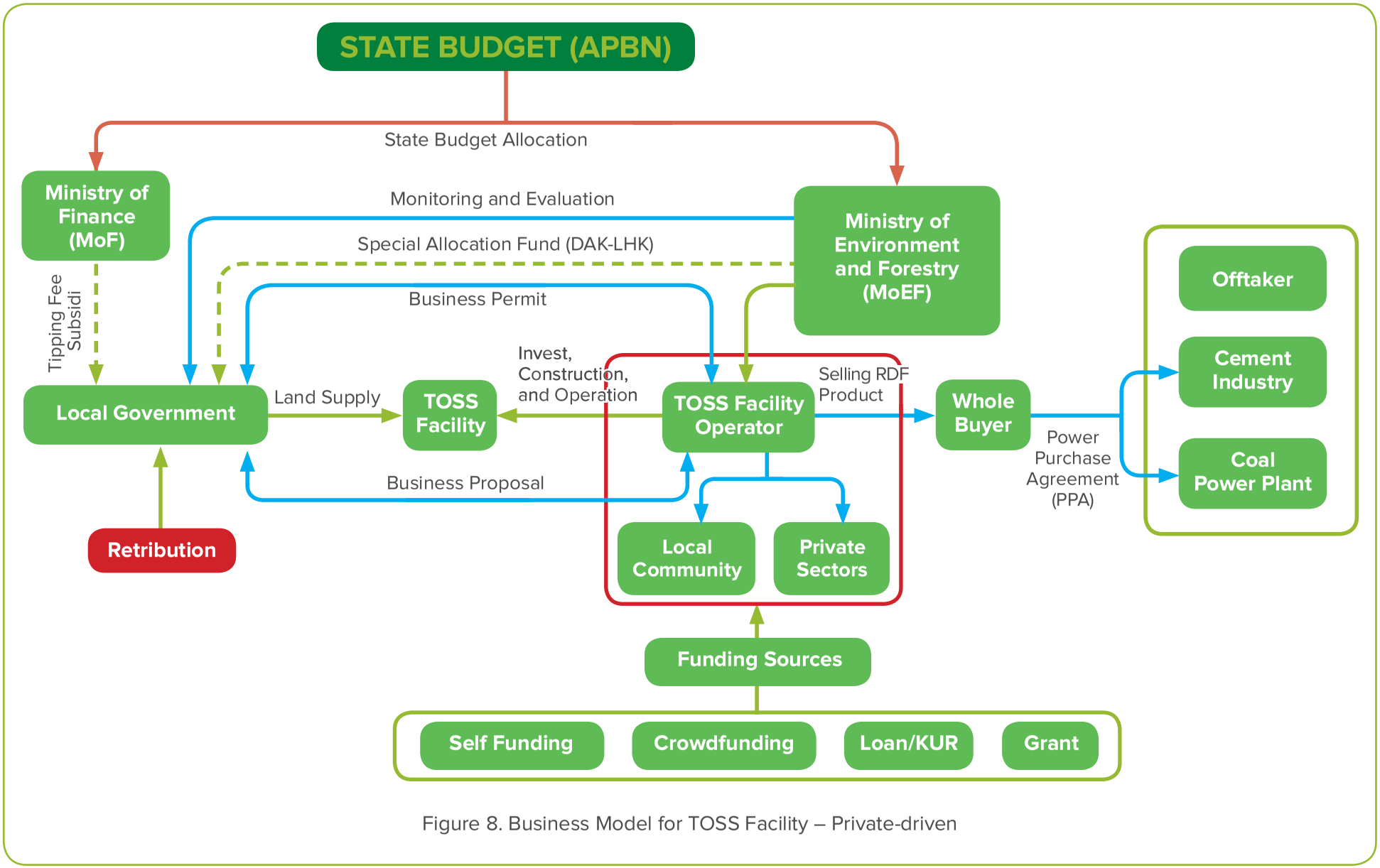


Figure 8. Business Model for TOSS Facility – Private-driven

Source: Author's own construction

The private sector or community, which are the initiator, has the main role on this business model as the TOSS facility manager. In order to become the TOSS operator, the initiator needs to propose a business permit to the local government. Once the local government released the permit, the selected operator needs to construct the facility in the waste shelter (TPS) which the government supply. In order to construct the facility, the TOSS operator can utilize several sources such as self-funding, crowdfunding, project financing or microcredit, or grant. The TOSS operator also has the responsibility to manage the waste to become RDF products. The TOSS operator also needs to have a connection with whole buyer which is the RDF seller to the off taker.

Without any support, the private sector or community driven business model cannot be well implemented. The problem with this business model is the financial viability of the project. As TOSS technology and facility is still not massively developed, the money lenders need a guarantee to approve the project. Therefore, incentives are needed to support this model. The incentives model will be explained in the section below.

Investment Cost and Proposed Incentive

Aimed at developed the RDF and TOSS facility with the detail scheme mentioned in Chapter III, we identified the amount of investment cost that should be allocated. Table 6 shows the estimated investment cost for the RDF and TOSS development in prioritized regions.

Table 6. The Estimation of Investment Cost.

Facility	Area	Production Capacity (ton RDF/ day)*	Treated waste (ton/ day)	Number of targeted facility development**	Estimated investment cost per facility (in billion)***
RDF	Java	175	500	5	361
	Non-Java	53	150	10	160
TOSS	Java	1.75	5	22	1
	Non-Java	0.35	1	30	0.22

Source: Author's own construction.

**Production capacity was calculated by assumed that the facility is able to produce the RDF at its full capacity which is 35% of the total treated waste.*

***Each region is targeted to be developed at least one RDF facility. The list of the prioritized RDF facility development location is attached in Figure 5.*

****The number of the estimated investment cost are benchmarked to the existing RDF development.*

1. Incentive for RDF

Considering the enormous number of required investment cost, particular incentives are needed to fasten the development of RDF facility, including TOSS. According the in-depth interview with the investor and developer also from desk analysis process, we found that the investment cost is acknowledged as the biggest burden for the development or RDF facility. Most of the operators also struggle in finding the sponsors to support its project. Therefore, through Non-PPP scheme with a government driven, the government plays an important role in initiating the development of the RDF by provide the investment expenditure at all cost (i.e capital expenditure, civil works, exploration cost, intangible drilling cost, and other financing costs).

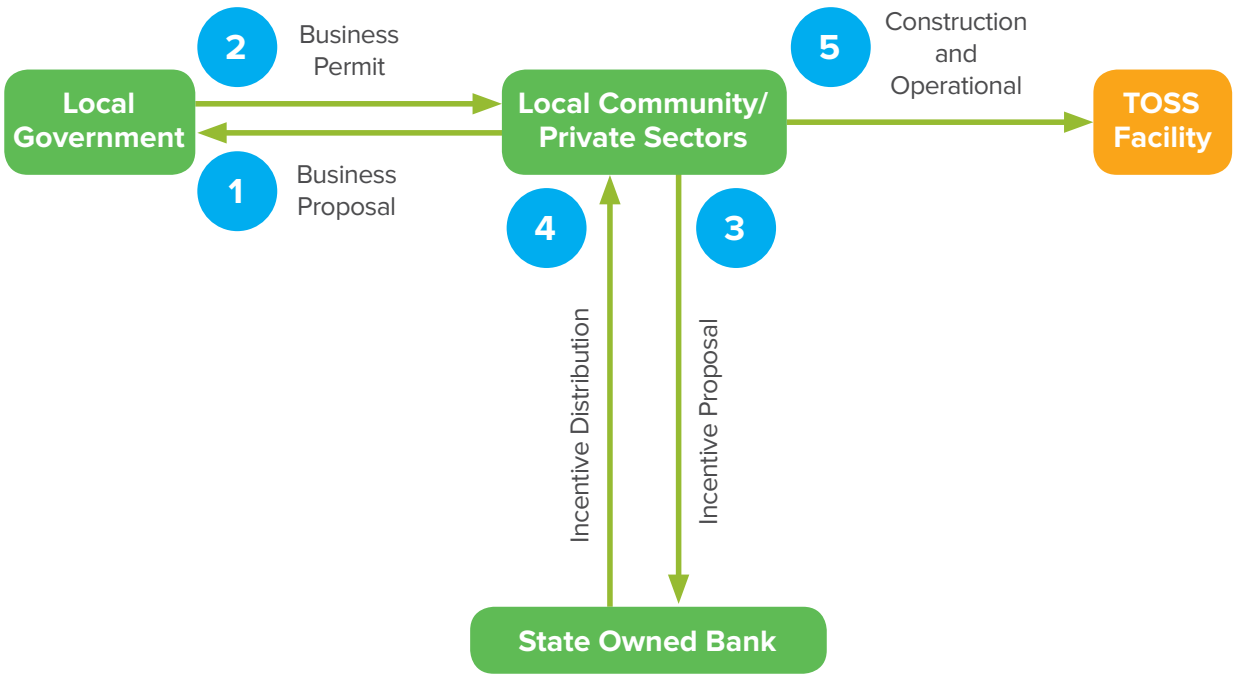
Moreover, the support in capital expenditure also needed to be provided aiming to make the RDF facility pursue its commercial business as soon as possible. At this case, the government will provide the cash subsidy by 30% of the total expenditure cost. Procedurally, the operator sends a subsidy proposal to the Ministry of Industry. The selection of Ministry of Environment and Forestry as the authority to assess the proposal, distribute the incentive, and monitoring and evaluation is aligned with its ambitious to improve the waste management sustainably. Previously, the ministry will set up the criteria for the eligible private entity to receive the incentive, including the track record, the years, and how its expertise in producing the product from waste related. The subsidy will be distributed once that is at the first year of the commercial process. The detail of the incentive cost is attached in Table 7.

2. Incentive for TOSS Model

The role of incentives scheme in the TOSS business model is to overcome the financial liability problem both comes from CAPEX and OPEX aspect. However, the incentives are focused on giving private/local community support to construct because the OPEX will be supported by tipping fee given by the local government. The capital expenditure will be given in the form of loan through state owned banks. The amount of the incentives that the private sectors can apply for is capped at 70% of the total project values, while the others 30% will be covered by the local government in the terms of supplying the place and basic utilities. Therefore, the burden that the initiator bear will be lower and makes the project more attractive for the private/local community.

The incentives will be given for 22 TOSS facilities in Java and 30 facilities outside Java with total incentive needed is IDR 19.88 Million that will be distributed from 2023 until 2025 (see Table 7.). The private sector/ local community who wants to get the incentives will needed to get business permit from the government. Then, the initiator need proposed the incentives to the state-owned banks who has giving the mandate for distributing the incentives. Once the proposal is received form the initiator, the state-owned banks will check the initiator background and feasibility of the project before deciding whether to give the incentive or not. After it is accepted, the initiator needs to build the facilities and payback the loan. This process is summarized by Figure 9 below.

Figure 9. Incentives Scheme for TOSS Busines Model



Source: Author's own construction

Table 7. The Calculation of Incentive Cost.

Facility	Year of Construction*						Incentive**		
	2023		2024		2025		2023	2024	2025
	Java	Outside Java	Java	Outside Java	Java	Outside Java			
RDF	2	3	1	4	1	3	Rp 1,2 T	Rp 1 T	Rp 842 M
TOSS	5	10	9	13	8	7	Rp 5,04 M	Rp 8,14 M	Rp 6,7 M

Source: Author's own construction

**Due to the limited state budget capacity, the development of RDF and TOSS facility in prioritized areas will be developed step by step up to 2025.*

*** The incentive for RDF facility is the sum up of the cash subsidy for capital expenditure and operational expenditure. The amount of capital expenditure is identical to the estimated investment cost which attached in Table 6 while the amount of operational expenditure is assumed at Rp109,500/ ton of RDF which coming from the operational cost calculation at Namboo project. The incentive cost for TOSS development is calculated by multiply the 30% as the number of subsidies with estimated investment cost which attached in Table 6. The mentioned incentive costs in the table have been adjusted with the number of facility development based on its target of year of construction.*

The Impact of Incentive on RDF development to Green Economic Recovery

Despite of its contribution in managing waste sustainably, in fact the advantages of RDF development is not exclusively limited to waste management. This report identifies the advantages of RDF production into two categories, namely environmental and economic benefit. In terms of environmental benefit, the development of RDF contributes to the emission reduction. The used of RDF as its fuel substitution would reduce the CO2 emission by 1.61 kg per one kilogram of RDF output. The additional emission reduction also proves at the waste treatment process before it produces the RDF output. Every reduction of a ton of waste would reduce the CO2 emissions up to 210 kg. Moreover, when it comes to economic advantages, the development of RDF facility plays a contribution in creating the green jobs. In Java prioritized regions which is able to treat waste in a more massive amount, the development of RDF facility would create up to 180 and 26 jobs positions for the production of RDF and TOSS facility, respectively. In case of non-Java prioritized area, the estimation of job creations is at the level of 125 and 26 jobs position for RDF and TOSS facility development, respectively. Table 8 shows the summary calculation of the advantages of RDF development.

Table 8. The Benefits of RDF on Green Economy Recovery*

Green Economy Recovery Indicator	2023	2024	2025	Total
RDF Production (ton/day)	509	387	334	1.230
Waste Reduction (ton/day)	1.450	1.100	950	3.500
Emission Reduction from Production Process (ton CO_2/day)	819.490	623.070	537.740	1.980.300
Emission Reduction from Production Process (ton CO_2/day)	304.500	231.00	199.500	735.000
Green Jobs Creation	735	688	563	1.986

Source: Author's own construction

**The calculation has been adjusted with the targeted number of RDF development which attached in Table 7.*

Chapter IV

CONCLUSION AND MAIN RECOMMENDATION

Waste has created massive environment, social, and economic problem for Indonesia. The increasing trend of waste generation did not follow by a sustainable waste management which result to overloaded landfill and leakage problem. Responding this problem, the GoI initiate to develop WtE (PLTSa) facility in twelve cities to overcome the problem. However, until now, there is no PLTSa facilities operating in Indonesia. The problems faced to develop PLTSa in Indonesia are complex started from designing the business model until the energy prices. Therefore, an alternative solution is needed to overcome the waste problem in the future.

One alternative solution to overcome those problem is developing Refused Derived Fuel (RDF) facility. RDF is an alternatives fuel that can be produced from municipal solid waste (MSW) used as an alternative for fossil fuels. In the comparison with PLTSa facility, RDF facility has lower investment and operational cost, suitable for any project scale, and more environmentally friendly in terms of business model, RDF products is needed by coal power plant and cement industry as their co-firing and co-processing resources. Despite having several advantages, developing RDF faces several challenges from designing the RDF facilities project until selling the RDF product.

In spite of its barriers, RDF facility relatively provides more generous advantages compare to other waste management facilities. In terms of environmental benefits, the RDF facility is able to reduce waste and emission massively at once which align with the government plans to achieve its NDC

target. When it comes to economics benefits, the RDF facility could create a massive job creation. One RDF facility is estimated to absorbs up to 125 new employment. Hence, if RDF is developed extensively it would support the government to reduce the national unemployment.

Considering benefits in above, utilizing RDF as the technology for sustainable waste management has to be considered at all cost. Hence, policy improvement regarding RDF development is required to accelerate its development. With regard to this issue, this report recommends numerous policy recommendation along with the business model and potential incentive schemes. In essence, we classified the business model into several categories: Public Private Partnership (PPP), non-PPP with a government driven, non-PPP with a private driven. Moreover, we also focus to develop RDF at a small scale with a community base (TOSS) initiative. In doing so, the proposes business models are TOSS with a government driven and TOSS with a private driven. These proposed business model will be equipped with incentive schemes covering the operational-, maintenance-, construction-, and civil work-cost.

Perhaps, the provision of incentive scheme would accelerate the deployment of RDF facility. In addition, the proposed business models are also expected to improve the business climate in RDF industry and make the industry become more attractive. Given all scenarios are going well, Indonesia will be one step further in mitigating the complicated waste issues.

References

Asosiasi Semen Indonesia. (2017). Pedoman Spesifikasi Teknis Refuse Derived Fuel (RDF) Sebagai Alternatif Bahan Bakar Di Industri semen.

Bappenas. (2020). *Rancangan Terknokratis Rencana Pembangunan Jangka Menengah Nasional 020-2024*. Retrieved from https://www.bappenas.go.id/files/rpjmn/Narasi%20RPJMN%20IV%202020-2024_Revisi%2014%20Agustus%202019.pdf

Caputo, A. C. & Pelagagge, P. M. (2002). RDF production plants: I Design and costs. *Applied Thermal Engineering*, 22, 423-437.

Cordova, M. R., Falahudin, D., Puspitasari, R., Purbonegoro, T., Wulandari, I., Iskandar, M. R., & Rositasari, R. (2019). *Naskah Akademik Inisiasi Data Sampah Laut Indonesia Untuk Melengkapi Rencana Aksi Nasional Penanganan Sampah Laut Sesuai Peraturan Presiden RI No.83 Tahun 2018*. *83*, 30. https://sampahlaut.id/wp-content/uploads/2020/02/Naskah-Akademik-Inisiasi-Data-Sampah-Laut-Lembaga-Ilmu-Pengetahuan-Indonesia-LIPI.pdf

Garrido, L., Medrilzam, Amalia, A., Yananto, I. D., McGregor, M., Brand, J., . . . Quevedo, A. (2019). Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia. Low Carbon Development Indonesia.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). the ocean. *Science*, *347*(6223).

Kara, Mustafa. (2012). Environmental and economic advantages associated with the use of RDF in cement kilns. Resources, Conservation and Recyling. http://dx.doi.org/10.1016/j.resconrec.2012.06.011

Presidential Decree No. 97/2017 about National Policy and Strategy on Household and Other Waste

Siahaan, V. Robertua. (2020). *Politik Lingkungan Indonesia Teori & Studi Kasus.* Jakarta: UKI Press. Retrieved from http://repository.uki.ac.id/1826/1/PolitikLingkunganIndonesiacetak.pdf

Safwat, H., Motasem, S., Salam, A.-Z., Mahmoud, I., Abdallah, N., & Michael, N. (2019). Potential Utilization of RDF as an Alternative Fuel to be Used in Cement Industry in Jordan. *Sustainability*, *11*(5819). https://doi.org/10.3390/su11205819

Trang T.T, D., & Byeong-Kyu, L. (2009). Analysis of potential RDF resources from solid waste and their energy values in the largest industrial city of Korea. *Waste Management*, *29*, 1725–1231. https://doi.org/10.1016/j.wasman.2008.11.022

Appendix

THREE ALTERNATIVE BUSINESS MODEL AND INCENTIVE NEEDED

1. Large Scale

ii. Public-Private Partnership

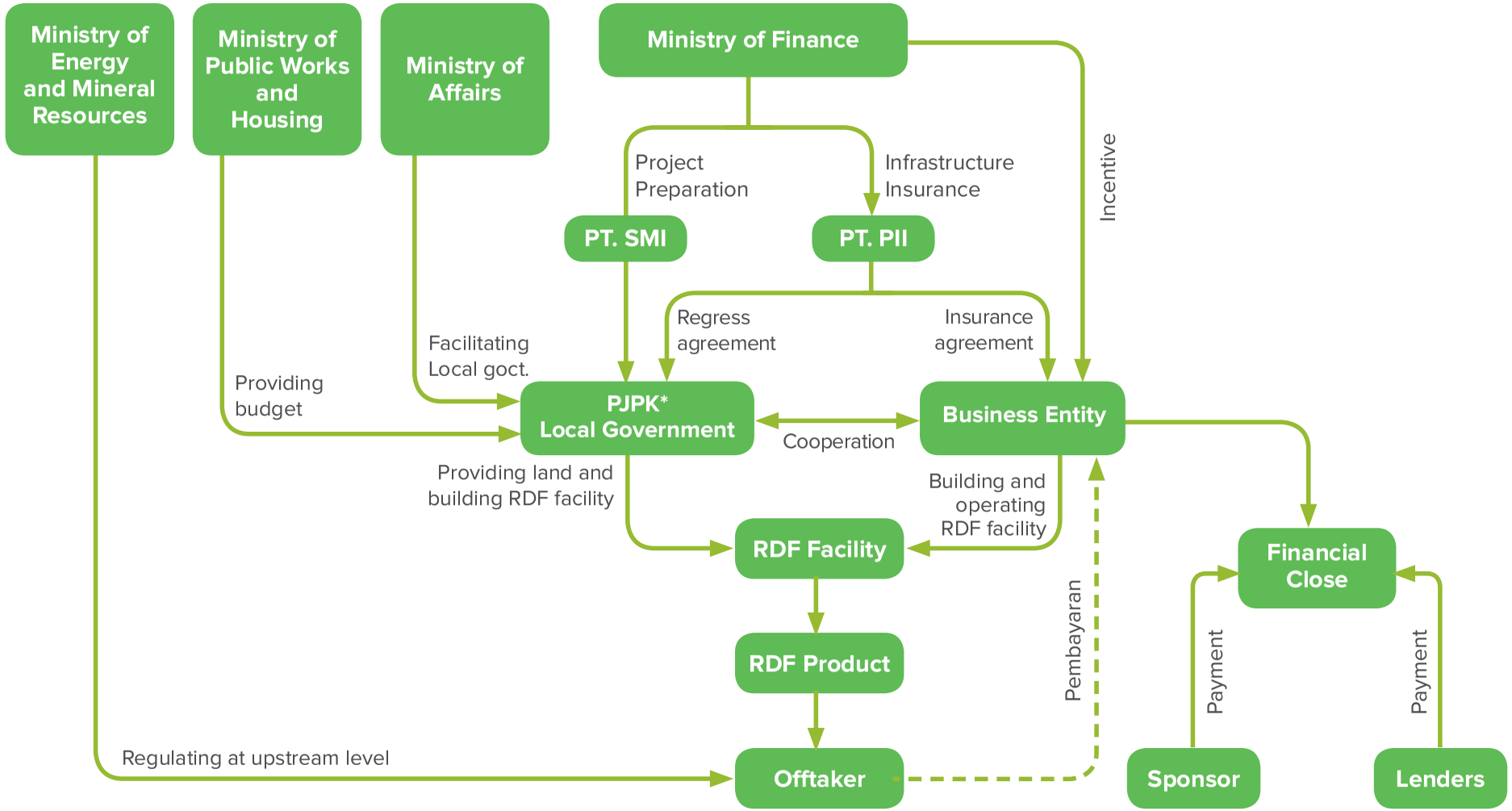


Figure 10. Business Model for Public-Private Partnership Scheme

Source: Author's own construction

Owing to the prominent role of infrastructure in accelerating economic growth, it is indeed an important matter for the government to consider expending comprehensive effort in infrastructure development. However, a national budget that imposes strict limitations on the financing of the complex public infrastructure and services encourages the government to instead allow the involvement of private entities in infrastructure provisions. In the interest of improving the investment climate and promoting the participation of private business entities in infrastructure provisions, the concept of Public-Private Partnerships (PPP) was introduced. In Indonesia, PPPs are regulated under Presidential Decree Number 38 of 2015. One of its benefits is that the waste sector is listed as one of the sectors that qualify for development under the PPP scheme. Hence, the development of RDF facilities may be initiated under a PPP. Under the PPP, the government will appoint a private business entity as its colleague in developing the infrastructure, particularly in the case of the waste sector.

Since the waste sector falls under the authority of the local government, it will appoint a local government contracting agency (GCA) who will be in charge of the cooperation project (Indonesian: Penanggung Jawab Proyek Kerjasama or PJPK). In simpler terms, the PJPK is a government representative who will be cooperating closely with the business entity during the agreement contract. The PJPK will also be responsible in provisioning the infrastructure, either the construction work or operation and maintenance aiming to improve the benefit of the developed infrastructure. At this case, as the PJPK, the local government will be responsible for providing the land and, up to an extent, will also build the RDF facility. In order to do so, it will be assisted by the Ministry of Public Works and the Ministry of Home Affairs. The Ministry of Public Works will provide the budget to clear the land and build basic infrastructure, whereas the Ministry of Home Affairs will facilitate the local government in implementing its coordination across the relevant ministries. Moreover, to attract the business entity's interest in developing the RDF project, the government will provide some endorsement through the Ministry of Finance. Through PT PII (the state infrastructure guarantor business entity), the Ministry of Finance will provide guarantees to the private business entity for the financial responsibility of the PJPK. Moreover, PT SMI (the multi-infrastructure facilities business entity) will assist the local government in preparing the project.

Regarding the private business entity that will operate the project, the selection process could either take the form of a competitive or direct appointment. This process will be handled by the local government as the PJPK. Principally, the business entity will be responsible for building and operating the RDF facility for up to several years, depending on the concession agreement. The funding will be sourced from sponsors and lenders. To finance its operation and maintain its ability to pay costs, the business entity will rely on two main sources; the sales of RDF and the tipping fee (a fee paid by the local government). Regarding the sales of RDF, the output produced by the business entity will be sold to prospective offtakers through a purchase agreement. In this part, the government will improve regulations at the upstream level (such as risk distribution under the PPA, as well as the prices and quality standards of the RDF products) through the authority of the Ministry of Energy and Mineral Resources. In addition, the business entity is also entitled to a tipping fee from the local government at a specified rate.

Considering the enormous costs of RDF operation and maintenance, however, the given price of RDF output and the tipping fee from the local government alone do not suffice for offsetting the costs. Therefore, incentives prove to be crucial and play a significant role in improving the financial feasibility of the RDF business (Table 5). Under this model, the viability gap fund (VGF) could be included as one of the prospective incentives. In essence, the VGF is a type of government support in the form of contributions to some of the construction costs for a PPP project, given in cash. Under

Ministry of Finance Regulation No. 223 of 2012, the VGF covers several costs including construction-, equipment-, installations-, and interest rate costs. A project with a minimum investment of IDR 100 billion qualifies for receipt of a subsidy of up to 49% of the construction costs. Another option that may be pursued is to provide project development funds as the incentive for the business entity to alleviate the costs of implementing facilities in preparation for the final feasibility study and supporting facilities for transactions. Moreover, tax reduction policies such as tax holidays and tax allowances could also be implemented for the development of RDF projects under the PPP scenario.

Table 9. Incentive Scheme and Actors Roles for PPP Scenario

Incentive	Actors roles		
	Central Government	Local Government	Private/Community
Support for Capital Expenditure (CAPEX)	1. Within PPP scheme, the central government has **Viability Gap Fund (VGF)** incentives for business entity through **MoF** for the construction purpose. 2. The government also has another option such as **grant or equity support** for construction. 3. The Ministry of Civil Work build a basic infrastructure facility	The local government provides land.	The private sector receive the incentives for reducing the investment cost.
Support for Operational Expense (OPEX)		The local government pays tipping fee regularly to the operator	
Tax Incentive	Tax reduction incentives for business entity such as tax allowance and tax holidays.		The business entity who got the incentives will import the RDF equipment without paying import duty.
Loan Support	1. The government provides a loan guarantee to a business entity to improve the developer bankability. 2. The government subsidize the interest rate		1. The business entity receives a loan easier and achieve a financial close. 2. The business entity pays the interest rate a lower cost.
Project Development Support	Speciality of the PPP scheme is the **PT SMI** as the representative of central government can give an incentives of project **development support.**	The local government who got the project development support will be assisted by PT SMI so the project will be economically viable.	
Project Underwriting			

III. Non-PPP scheme – Private-driven

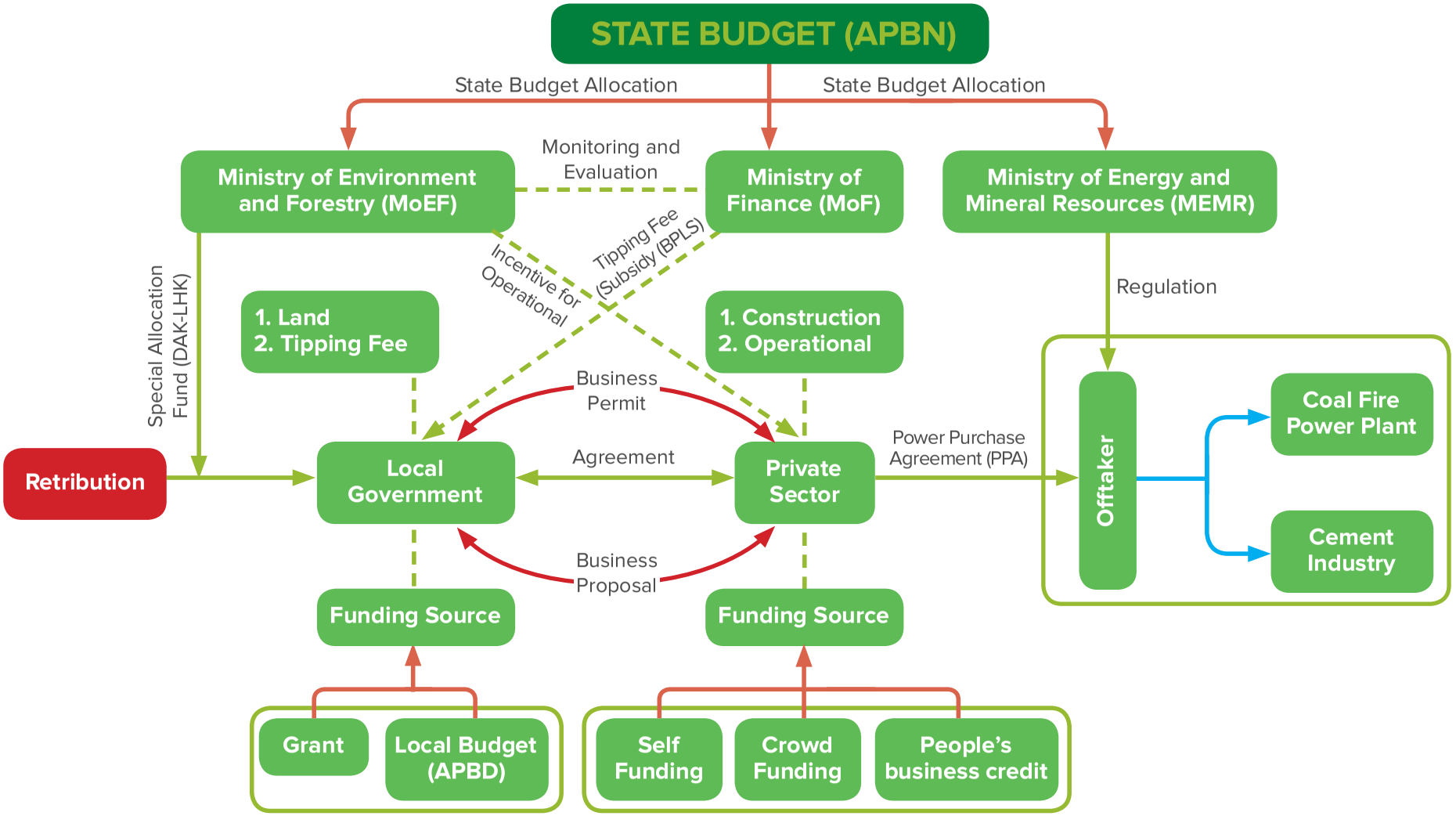


Figure 11. Business Model for Non-PPP scheme – Private-driven

Source: Author's own construction

Aside from the government, which has the authority to initiate non-PPP schemes to provide RDF facilities, the private entity also has the opportunity to drive the market through a non-PPP scheme. In this case, the private business entity will formulate a business proposal to send to the local government regarding its intention of building an RDF facility in a selected area. Once the local government approves this venture, the proposer will build the end-to-end infrastructure, maintain, and operate the facility for up to the agreed-upon years before transferring ownership to the local government. In addition, as with the other business schemes, the private business entity will sell the RDF products to potential offtakers, most of whom are from the cement and/or coal fire industry.

Principally, the local government will provide the land that will be converted into the area for the RDF facility. Furthermore, the local government will also be responsible for transferring the tipping fee to the private business entity at a specified rate. The source of the local government's funding to finance its obligations could originate from grants, the local budget, and retribution as well. Meanwhile, for the private business entity, the funding for financing the construction and operational costs could be supplied from crowdfunding, people's business credit, or self-funding.

Under this scheme, the potential incentives are, to some degree, identical to the ones provided under a government-driven non-PPP scheme. With the allocation of the state budget as its source, the Ministry of Finance will provide an incentive in the form of subsidies dedicated to the local government to pay its tipping fee to the private business entity. Before the Ministry of Finance grants the subsidy, however, the local government must first submit an application concerning the incentive

to the Ministry of Environment and Forestry. Once the Ministry of Environment and Forestry approves the application, it will forward it to the Ministry of Finance. Subsequently, the Ministry of Environment and Forestry will monitor and evaluate the local government's performance in managing the tipping fee subsidy. It should be noted that this particular form of subsidy will not be applicable in the long term, unlike the case of a government-driven non-PPP scheme. In the long term, the local government will need to charge retribution at a higher rate to sustain the funding for the tipping fee.

Moreover, the Ministry of Environment and Forestry will also be responsible for providing an incentive to the private business entity that is derived from the state budget allocation. In this context, a possible incentive can take the form of a cash subsidy to compensate for the expensive operational costs. In addition, another incentive could be given in the form of RDF price subsidies under the authorization of the Ministry of Energy and Mineral Resources. Aligned with its responsibility to offer the subsidy incentive, the Ministry of Energy and Mineral Resources will also be tasked with the improvement of RDF regulations at the upstream level. The incentives are summarized by table 7 below.

Table 10. Incentive Scheme and Actors Roles for Non-PPP Scenario – Private Driven

Incentive	Actors Roles		
	Central Government	Local Government	Private/Community
Support for Capital Expenditure (CAPEX)	The Ministry of Civil Work build a basic infrastructure facility.	The local government provides land.	
Support for Operational Expense (OPEX)	1. The central government incentivise the local government by giving tipping fee subsidy through the MoF. The existence support for WtE project (BLPS) could also be realocated to support RDF. 2. Special allocation funds (DAK-LHK) also could be an option to the reduce the operational cost. 3. Another option subsidy for operational expenditure is given directly to private sector.	The tipping fee subsidy received by the local government is needed to reduce the tipping fee that is paid by the local government to the business entity.	Privat/community who operates the facility get subsidy will reduce the operational cost makes it more efficient.
Tax Incentive	Tax reduction incentives for business entity such as tax allowance and tax holidays.		The business entity who got the incentives will imported the RDF equipment without paying import duty.
Loan Support	Loan support incentives for business entity given by the government in the form of loan interest subsidy.		The loan support will reduce the cost that operator bear to construct and operate the facility.
Project Development Support	-	-	-

2. Small Scale RDF Facility

I. Business Model for Government Driven TOSS Facility

This business model is a business model for supporting the development of TOSS Facility that is fully initiated by the local government in collaboration with private sectors. This model will only work if the local government take the first action to initiate this project. Furthermore, this model has an advantage because the local government has many funding options to fund the project initiation such as local budget or funding from local owned enterprises. Village Fund/ Dana Desa (DD) could also be a potential funding source to initiate TOSS facility development. Despite the advantages, this model has a drawback because it is heavily relied on the local government capacity. Those local government capacities become drawback for RDF development because the capacity is limited. Therefore, the local government needs support from both state government and private sectors. Those actor roles and supports are shown by a figure 8 below.

Fully initiated by the local government, does not mean the government only initiate this project at the first place. The local government also has a full control since designing until the construction of the project. The local government also has an obligation to fund the project until the construction finished and fully equipped. Then, the operational of the facility will be handled by the manager of the facility who already obtained an operational permit from the local government. In addition, the local government have to support the operational of the facility by regularly pay the tipping fee to the facility manager.

The local government is supported by several actors such as the facility manager, whole buyer, and off taker to make the initiation of TOSS facility could be successful. First, The TOSS operator, who was fully control of the facility operation, could be a local-owned enterprise (BUMD) or village-owned enterprise (BumDes), local community, private sector, or cooperation among those actors. The operator of this facility was chosen by the local government through a direct appointment or selection. The opeator of the facility has a main role to operate the facility to produce RDF and sell the product to the whole buyer. Then, the whole buyer has an important role to collect and connect RDF product from several TOSS facility with the end-users. The role of whole buyer in TOSS business model is important since the TOSS facility only produce small number of RDF product which is not enough for the offtaker and the offtaker need a certain amount of RDF product to their production process. Lastly, the off taker is the consumer of the TOSS product who has a role to consume the RDF product. In order to make the demand of RDF produce by TOSS indwell, the whole buyer and off taker pushed to sign an agreement for the RDF transaction.

Since the TOSS technology for processing waste is still developing, the role of incentive is important to sustain the development as a part of green economic recovery. There are several incentives that can be given by local government such as capital expenditure and tipping fee subsidy for the local government or operational expenditure subsidy for the TOSS manager. In fact, these incentives are the most needed support to make the RDF product of TOSS facility become financially interesting to the off taker. However, these incentives scheme are only for short-term development of TOSS facility. The sustainability of TOSS facility in the long-term will be supported by the waste retribution taken by the local government. Therefore, parallel with the development of TOSS facility, the government need to be pushed to designing their retribution scheme to sustain the TOSS facility in the future. The table 8 below summarized the incentives scheme needed for the business model.

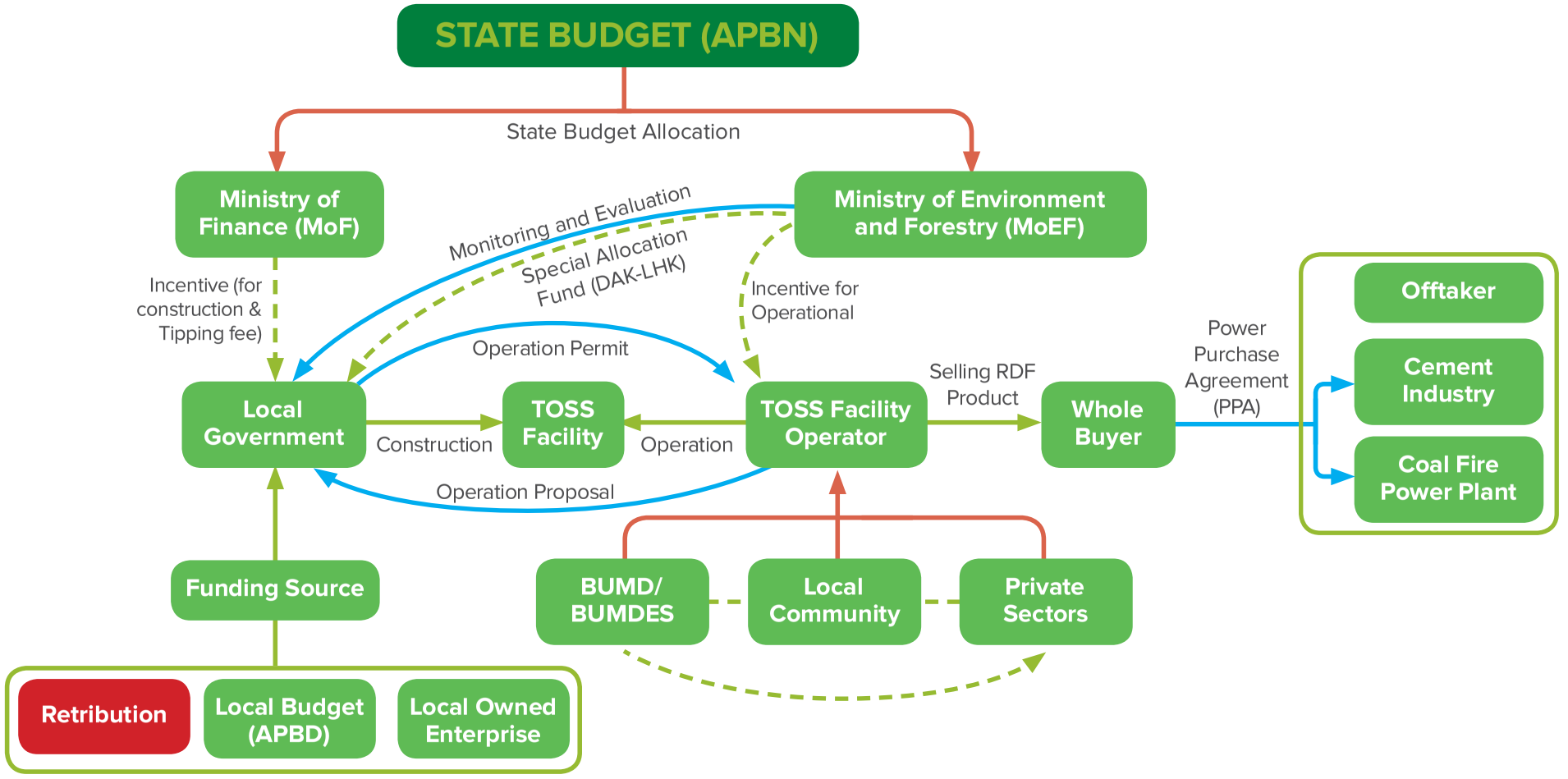


Figure 12. Business Model for TOSS Facility – Private-driven

Source: Author's own construction

Table 11. Incentive Scheme and Actors Roles for Small-Scale RDF Facility (TOSS) – Government Driven

Incentive	Actors roles		
	Central Government	Local Government	Private/ Community
Support for Capital Expenditure (CAPEX)	Construction subsidy: the central government through MoF incentives local government to construct TOSS facility.	The local government receive the incentive will do the constructions of the facility.	
Support for Operational Expense (OPEX)	1. Tipping Fee Subsidy: through MoF, the central government give a tipping fee subsidy for reducing tipping fee paid the local government. 2. Operational Incentives to operator 3. Operational Incentives: through DAK-LH to local government to support private to operate the facility.	The local government who receive the incentive will used the incentive to pay the tipping fee and support the operator.	The private/ community who receive the incentives will use it for operational purpose.
Tax Incentive			
Loan Support			
Project Development Support			
Project Underwriting			