



## INTERMEDIATE TREATMENT FACILITY AS A WASTE MANAGEMENT SYSTEM IN DKI JAKARTA: AN OVERVIEW

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### ABSTRACT

The limited capacity of the Bantargebang landfill as the final waste disposal site and the ever-growing amount of waste produced by Jakartans urges the development of more eco-friendly waste management facilities. Using the scoping review method, this study aims to review the feasibility of ITF development in DKI Jakarta based on identifiable impacts, social costs and benefits analysis, hindrances faced in ITF development planning, and reviewing alternative financing that can be used in constructing ITF. The results of this study show that aside from its capacity to process waste more efficiently and potentially produce electricity, ITF construction may have several negative impacts on the surrounding environment. Based on an analysis of social costs and benefits, the development of ITF is feasible. However, some obstacles are present in planning the development of ITF, such as that it requires a strong investment commitment in financing development and project operations, both from the DKI Jakarta Provincial Government, DPRD, and the private sector. Two possible financing schemes to consider are the local government budget and PPP.

## 1. INTRODUCTION

As the capital city of Indonesia, the Special Capital Region of Jakarta (Daerah Khusus Ibukota Jakarta or DKI Jakarta) becomes the main destination for the migration of residents from various regions throughout Indonesia in search of livelihoods. Statistics of DKI Jakarta Province (BPS DKI Jakarta) recorded in September 2020 that the population in DKI Jakarta reached 10.56 million people. In the ten years since 2010, there has been an increase in the population of 954 thousand people or an average of 88 thousand people per year (BPS DKI Jakarta, 2020). Nevertheless, the population growth in the capital has created environmental problems, especially those related to waste production and management. The increasing population has resulted in a higher volume of waste generated from daily consumption, while the capacity of the land to accommodate waste is not limitless.

Jakarta's waste management currently depends on the Bantargebang Integrated Waste Management Facility (Tempat Pengelolaan Sampah Terpadu or TPST) in Bekasi Regency, West Java. The volume of waste transported from Jakarta to the Bantargebang TPST averages 7,000 to 8,000 tons per day, carried by 1,200 garbage trucks; 60% is domestic or household waste (Sukwika & Noviana, 2020) through the press release, SP.BIRKOM/XII/2021/685 by the Ministry of Public Works and Housing (PUPR), the Bantargebang TPST area is stated to be 104.7 Ha consisting of 6 zones (landfill) covering 81.40 Ha as well as facilities and infrastructure area of 23.30 Ha (Laily, 2022). Several zones in the Bantargebang TPST are not managed properly and apply an open exhaust system, which leads to worsening environmental conditions due to the leachate and methane gas produced (Sukwika & Noviana, 2020).

In 2008, it was projected that the Bantargebang TPST would nearly reach its maximum capacity and would no longer be able to manage around 7,000 tons of waste brought from Jakarta per day (PT Jakarta Propertindo, 2020). As a result, the Provincial Government of DKI Jakarta must find alternative solutions for more environmentally friendly waste management. Through the DKI Jakarta Provincial Sanitation Agency, the DKI Jakarta Provincial Government is trying to resolve the waste issue by establishing an intermediate waste treatment facility or an Intermediate Treatment Facility (ITF). ITF is a waste-to-energy (WtE) based waste management system, namely processing waste to produce electrical energy. In line with the DKI Jakarta Provincial Waste Management Master Plan 2012-2032, ITF will be established in four locations in DKI Jakarta: Sunter, Marunda, Cakung, and Duri Kosambi. The construction of this facility aims to reduce the dependence on Bantargebang TPST. In addition, good waste management at the source and good energy production at the estuary are expected to be obtained with this development to share sustainable benefits (Sudadi, 2022).

This study aims to review the feasibility of ITF development in DKI Jakarta based on positive and negative impacts that can be identified, analysis of social costs and benefits, constraints faced in planning ITF development, and review of alternative financing that can be used in implementing ITF. Several studies reviewing the application of the ITF system in waste management have previously been carried out. Bomo & Siahaan (2022) assessed that the ITF system is very suitable to be implemented in the City of Jakarta compared to the landfill system implemented at the Bantargebang TPST, resulting in huge waste accumulation. Another study was conducted by Nurdiansah et al. (2020) by using a case study on the implementation of the waste-to-energy power plant in Surabaya and obtaining results that the plant can be applied as an alternative solution in efforts to reduce waste volume, with system requirements and standardization of operations so that they can work properly and efficiently without damaging the environment. In addition, a similar study that supports the development of the waste-to-energy plant was conducted by Mulyadin et al. (2018), who stated that one of the efforts to improve waste management is to install environmentally friendly technology that can reduce waste, especially under legal umbrellas such as Governor Regulation Number 50 of 2016 concerning the Development and Operation of Waste Management Facilities in the City.

This research is expected to contribute to the provincial government of DKI Jakarta and other local governments reviewing the positive and negative impacts of the city's construction of waste processing facilities. This research is also intended to serve as reference literature for policymakers and the general public regarding the procurement of public infrastructure, especially for more environmentally friendly waste management.

## 2. LITERATURE REVIEW

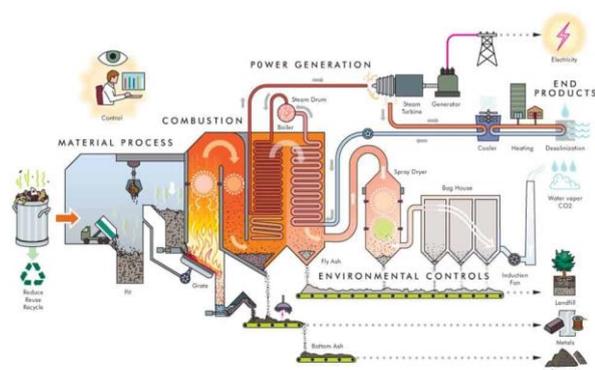
The Intermediate Treatment Facility (from now on referred to as ITF) is a final processing facility, using renewable technology, environmentally friendly and green, and generates electricity from municipal waste (Peraturan Gubernur DKI Jakarta, 2018). Regulation of the Governor of DKI Jakarta Province Number 50 of 2016 concerning the Development and Operation of an Intermediate Treatment Facility explains that ITF operations with the WtE concept as a whole aim to (1) reduce waste by at least 80-90% by modifying the form, content and the amount of waste through the use of environmentally friendly waste disposal techniques; (2) lower the dependency on final waste disposal site outside the region; and (3) reduce and handle waste following statutory provisions (Peraturan Gubernur DKI Jakarta, 2016).

Through DKI Jakarta Governor Regulation Number 33 of 2018, the Provincial Government of DKI Jakarta assigned the holding of the ITF located in Sunter, North Jakarta, to the Regional Owned

Enterprise Limited Liability Company named PT Jakarta Propertindo known as PT Jakpro (Peraturan Gubernur DKI Jakarta, 2018). The scope of ITF implementation includes development and operation. DKI Jakarta Provincial Governor Regulation Number 65 of 2019 further regulates the assignment of PT Jakpro to build and operate ITF other than those in Sunter, namely in the East, West, and South of DKI Jakarta (Peraturan Gubernur DKI Jakarta, 2019).

Implementing ITF is intended to be developed as a waste-to-energy (WtE) technology. Meanwhile, WtE is a waste management technology that processes urban waste from settlements into an energy source for power plants (PT Jakarta Propertindo, 2020). Waste processing using WtE technology involves incineration using thermal technology with a capacity of 2,200 tons per day. The heat from combustion is converted into a power of 35 megawatts (MW) per hour to become a renewable energy source, which will then be supplied to PT PLN (PT Jakarta Propertindo, 2020).

Picture 1. ITF Operation Scheme



Source: Main Report of DIKPLHD DKI Jakarta Province, 2018

In planning the development of an infrastructure project, a test is needed to assess the feasibility of infrastructure such as ITF to see its benefits for the public. One method that can measure the feasibility of an ITF implementation project is the social cost-benefit analysis (SCBA). Cost-benefit analysis is useful for evaluating the use of scarce economic resources so that they are used efficiently (Sugiyono, 2001). In SCBA, costs and benefits consider all societal differences, both when there is a project and without one (De Nooij, 2011). SCBA considers the impact on the policymakers and the externalities resulting from a project (De Nooij, 2011). Cost-benefit analysis is generally integrated with Environmental impact Analysis (EIA) to identify the environmental impact of a project (Sugiyono, 2001). Thus, this analysis considers individual costs and benefits and social costs and benefits as a whole (Sugiyono, 2001). From the government or society's point of view, SCBA considers the costs and benefits that the community can feel directly (Izattia & Ibad, 2022). With SCBA,

relatively intangible social costs and benefits will be viewed from an economic perspective by converting them into monetary values (Widiyani, 2018). Several methods that can be used in SCBA include:

**Net Present Value (NPV)**

The net present value uses the present value of the net benefits discounted over the project's life. The project is feasible to run if the NPV is greater than 0 or the NPV is positive. Conversely, a project is said to be infeasible if the NPV is less than 0 or the NPV is negative. If there are several projects with a positive NPV, the project with the highest NPV is recommended to be selected. The formula is as follows:

$$NPV = PV(B) - PV(C)$$

$$NPV = PV(NSB)$$

$$NSB = B - C$$

where, NPV – Net Present Value  
 PV(B) – Present Value of Benefit  
 PV(C) – Present Value of Cost  
 PV(NSB) – Present Value of Net Social Benefit

Source: Widiyani (2018)

**Internal Rate of Return (IRR)**

Widiyani (2018) defined IRR as the maximum interest rate of a project that shows the project's ability to pay for its funding and still be able to recover all investment and operating costs. The project is feasible to run if the IRR value > discount rate. Conversely, the project is said to be unfit to run if the IRR < discount rate. Then, a project with an IRR > discount rate is said to have economic attractiveness because the rate of return is higher than the rate used by other sectors/projects. The formula is as follows:

$$IRR = r_1 + (NPV_1 / (NPV_1 - NPV_2)) \times (r_2 - r_1)$$

where, IRR – Internal Rate of Return  
 r<sub>1</sub> – discount rate with positive NPV  
 r<sub>2</sub> – discount rate with negative NPV  
 NPV<sub>1</sub> – positive Net Present Value  
 NPV<sub>2</sub> – negative Net Present Value

Source: Widiyani (2018)

**Benefit-Cost Ratio (BCR)**

BCR is a ratio to calculate the number of times the benefits will be obtained from the project costs incurred (Chaerul & Rahayu, 2019). The project is feasible to run if the BCR value is > 1. Conversely, the project is said to be unfit to run if the BCR < 1. The formula is as follows:

$$BCR = PV(B) / PV(C)$$

where, BCR – Benefit Cost Ratio  
 PV(B) – Present Value of Benefit  
 PV(C) – Present Value of Cost

Source: Widiyani (n.d.)

### Payback Period (PP)

The payback period is a calculation to obtain a period when the net cash flow will be the same as the initial investment (Widiyani, 2018). The smaller the period, the faster the project will recover the costs and vice versa. The formula is as follows:

$$PP = \text{Investment Cost} / \text{Annual Net Cash Flow}$$

where, *PP* – Payback Period

Source: Widiyani (2018)

### Return on Investment (ROI)

Return on investment is used to calculate the percentage of return obtained. The project is feasible if the ROI value is > 0%. Conversely, the project is said to be unfit to run if the ROI value is < 0%. The formula is as follows:

$$ROI = \frac{(\text{gain from investment} - \text{cost of investment})}{\text{cost of investment} \times 100\%}$$

where, *ROI* – Return on Investment

Source: Widiyani (2018)

The Guidebook for the Preparation of Preliminary Studies on Public Infrastructure Projects by Guarantee and Infrastructure Ltd. (PT PII) states that the infrastructure financing scheme is determined in the preliminary study at the planning stage. It is following Presidential Regulation Number 38 of 2015 and Minister of National Development Planning/Head of Bappenas Regulation Number 2 of 2020 that in determining infrastructure using a cooperation scheme with business entities (public-private partnership known as PPP), the Minister/Head of Institution/Head of Region conducts identification through a preliminary study. By adopting The Five Case Model and designed according to existing regulations, PT PII, the Ministry of National Development Planning/Bappenas, and the Ministry of Finance have jointly prepared guidelines for the preliminary study in determining whether public infrastructure projects are feasible. The determination of the financing scheme is in the value-for-money analysis stage. At this stage, it will be determined whether the optimal financing scheme is PPP or conventional, using the national or regional budget.

## 3. RESEARCH METHODOLOGY

This study uses a scoping review approach by studying related literature, regulations, and policies. According to Munn et al. (2018), a scoping review is an approach that includes a systematic review to find evidence originating from previous research according to the subject discussed, mapping important concepts, and reporting results according to the problems

specified. This approach was used because the available reference sources varied, such as journal articles and official websites related to providing waste processing facilities in the city.

The review included as many as 19 research articles, eight news articles, related reports, and regulations to help identify the main issues, solutions, and strategies for developing waste-to-energy facilities that can be implemented in Indonesia, especially in Jakarta.

## 4. RESULTS AND DISCUSSION

### 4.1 Impact of ITF Implementation

Tun et al. (2020) mentioned several advantages that can be obtained from waste-to-energy or WtE technology, such that this technology has fewer land requirements to operate, less need for physical space of waste storage, lower carbon emissions, less soil contamination, the chemical by-products of combustion are more stable and the use of domestically available and sustainable resources to produce electrical energy.

The ITF can convert heat energy from burning waste into electrical energy of 35 megawatts/hour or 280,000 megawatts/year (Jufri et al., 2019). In addition, the cost of processing waste with ITF technology reaches IDR 246,596/ton, while the cost of processing waste without ITF is IDR 362,122/ton, so there is economic efficiency in using ITF of IDR 115,526/ton (Jufri et al., 2019). In addition, the procurement of ITF infrastructure at Sunter and other points in DKI Jakarta also has the potential to reduce waste transportation costs because the transportation distance is shorter than before when waste must be transported to the Bantargebang TPST in Bekasi Regency. Shorter hauling distances can also increase the efficiency of fuel oil consumption.

Of the various advantages or positive impacts that can be generated, ITF construction and operations also have several potential negative impacts that may occur. According to a study from the Indonesia Center for Environmental Law (ICEL), during the construction and operation stages of the Sunter ITF, it is estimated that there will be significant impacts such as traffic jams, noise pollution, air quality degradation, public health, degradation of water quality, as well as disposal of hazardous and toxic materials (B3 waste) (Fadhilah, 2019).

Activities at Sunter ITF, such as the movement and transference of materials and construction equipment, can cause obstacles to traffic flow. It is estimated that five roads were affected during the ITF construction phase, namely Jalan Sunter Permai Raya, Jalan R.E Martadinata, Jalan Danau Sunter Utara, Jalan Danau Sunter Barat and Jalan Griya Utama. While employing the Sunter ITF, traffic on Jalan Sunter Permai Raya and Jalan R.E Martadinata is expected to be constrained by 25 garbage trucks going in and out of the Sunter ITF area during the ITF's 24-hour operating period. Unstable,

jammed, and low speeds hamper the traffic flow on the affected roads.

Seven locations around the Sunter ITF were identified and assessed for noise levels. The seven locations include ITF sites, settlements in the west, settlements in the southwest, offices in the south, recreation areas in the east, settlements in the north, and BMW Park in the south. Without the Sunter ITF project, four of the seven points have passed the noise quality standards: the settlements in the west, the settlements in the southwest, the settlements in the north, and the BMW Park in the south. When the Sunter ITF's construction and operation occur, an increase in noise exceeding the noise quality limit will occur at all locations except the recreation area east of the Sunter ITF, where the noise increase is still below the quality standard. ITF construction and operation activities can also cause the air quality decline in the Sunter ITF area. The environmental impact analysis (EIA) of Sunter ITF predicts that there will be a decline in air quality. However, it is still below the safe limits of the quality standards stipulated by the Decree of the Governor of DKI Jakarta Province No. 551 of 2001 concerning Determination of Ambient Air Quality Standards and Noise Level Standards (Decree of the Governor of DKI Jakarta No. 551/2001). At the same time, the main building construction activities, installation of Sunter ITF equipment, as well as the movement and transference of materials and equipment during the construction phase will increase Nitrogen oxide (NO<sub>x</sub>) concentrations at four points, which exceed the safe limits of quality standards according to DKI Jakarta Governor Decree No. 551/2001.

EIA of Sunter ITF estimates that several types of disease will arise due to declining air quality. These health problems include upper respiratory tract infections (acute respiratory infection or ARI), cancer, swelling of the lungs (pulmonary edema), and asthma. However, the EIA of Sunter ITF was only able to gauge an estimated increase in cancer incidence, namely 0.01 cases for 157,082 residents living in three sub-districts around the site point. In addition, emissions from Sunter ITF activities can also cause other diseases, such as bronchitis, pneumonia, and cardiovascular disease.

The types of hazardous waste generated from the Sunter ITF operations include air pollution control residues, slag, sludge from the Wastewater Treatment Plant (WWTP), waste oil, and drums or barrels used to store waste oil and chemical packaging. The main access includes Jalan Sunter Permai Raya, Jalan Danau Sunter Barat, Jalan Sunter Permai Raya - Jalan Danau Sunter Barat intersection until it enters the Sunter ITF complex (all from the south) will be passed by transporting B3 waste out of the Sunter ITF area. The transportation of B3 waste can have a negative impact on the people who carry out activities in the road area if it is not carried out in a safe and controlled manner.

Fadhilah (2019) stated that Sunter ITF activities would produce as much as 140 m<sup>3</sup> of domestic wastewater and leachate daily. The wastewater will be collected into a water reuse tank and treated in the WWTP. After being treated, the wastewater will be diverted to the Sentiong/Sunter I River. EIA of Sunter ITF assesses that the water quality in Sentiong/Sunter I River has exceeded the safe limit of water quality standards based on nine parameters, namely Electrical Conductivity, Total Dissolved Solids (TDS), Chromium, Valence 6 (CR 6+), Dissolved Phosphate, COD, BOD (5 days 20oC), Anionic Surfactants and total coliform oils and fats. Thus, the disposal of Sunter ITF wastewater will further reduce the quality of Kali Sentiong/Sunter I.

#### **4.2 Social Cost-Benefit Analysis of ITF Implementation**

One of the researchers who has conducted a social cost-benefit analysis of the Sunter ITF, namely Widiyani (2018), adopted five formulas, which are Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR) or also known as Profitability Index (PI), Payback Period (PP), and Return on Investment (ROI). The social cost-benefit analysis was carried out with a 25-year infrastructure implementation (construction and operation) period based on a cooperation contract between the Provincial Government of DKI Jakarta and Jakarta Propertindo (Jakpro). Costs and benefits are secondary data from researchers from Jakarta Propertindo in 2017.

Costs that can be identified are costs for Jakpro, consisting of investment costs of IDR 3,622,250,000,000 and annual operational costs of IDR 562,953,027,182. The benefits consist of potential annual income obtained from the Provincial Government of DKI Jakarta in the form of a tipping fee of IDR 363,000,000,000, potential annual income from supplying electricity to a State-owned electricity company (Perusahaan Listrik Negara known as PLN) of IDR 3,293,136,000, yearly savings from reducing compensation costs for the Bekasi area for Bantargebang TPST amounted to IDR 107,799,291,642, annual savings from reduced transportation costs from Jakarta to Bantargebang TPST amounted to IDR 9,336,360,000. Annual added value from metal components and bottom ash sales amounted to IDR 7,644,780,000. Widiyani (2018) added that the community's willingness to pay is in the form of a waste collection fee of IDR 284,688,720,000 for improving the quality of waste processing. Another social benefit that can be identified by Widiyani (2018) is an improvement in the quality of a healthier environment, which is assessed in monetary terms by insurance claims for the lowest class of the state-owned Health Care and Social Security Agency (BPJS Kesehatan) service.

Ignoring factors such as taxes, inflation, and population growth, these social costs and benefits are assumed to be constant yearly. The discount rate used

in this analysis is 10%, according to a study conducted by the Clinton Climate Initiative on ITF development in 2011. The calculation results show that (1) the NPV is positive, showing an amount of IDR 505,939,441,996.93; (2) IRR of 11.8%, which means higher than the discount rate used; (3) the BCR value is 1.06; (4) the ROI value is 214%; and (5) PP in 8 years. Based on the results of an analysis using these five criteria, the project for the implementation of the Sunter ITF is determined to be feasible for the Provincial Government of DKI Jakarta to undertake because the project provides benefits that are greater than the costs required, is attractive from an economic perspective, and has a fairly high rate of return on investment and investment cost recovery period of 8 years or less than the period of the ITF construction and operation cooperation contract itself.

#### 4.3 Obstacles in the Implementation of the ITF

Until now, waste management in DKI Jakarta still relies on Bantargebang as a final disposal site with a landfill or landfill system. This method is the cheapest for managing large amounts of waste (Damayanti et al., 2021). However, excessive dependence on Bantargebang as the final waste disposal site has caused health problems, especially for the people around Bantargebang, as well as social problems (Tan et al., 2015). Departing from this issue, the Provincial Government of DKI Jakarta began considering sustainable waste management using environmental, economic, social, and public health approaches (Damayanti et al., 2021). The Provincial Government of DKI Jakarta chose the ITF as an intermediate waste management facility as a solution for waste management that can function as a waste-to-energy power plant and reduce the volume of waste stockpiled in Bantargebang.

Tun & Juchelková (2018) stated that currently, in Southeast Asia, waste management by incinerating into energy is still rare. If implemented, it generally experiences problems in the form of financing difficulties due to the high costs of capital, operation, and maintenance of these facilities. However, developing countries in Southeast Asia can learn and transfer waste-to-energy technology as a waste management system implemented in developing countries (Tun et al., 2020). Tun et al. (2020) summarized some of the challenges in developing ITF as a solution for waste management in terms of technical aspects, financial aspects, environmental aspects, and socio-political aspects, namely as follows:

**Table 1**  
**Summary of ITF Development Challenges**

No.	Challenge	Aspect
1.	Quality and quantity of waste	Technical
2.	Skilled experts and Personnel	Technical
3.	Regulations	Technical

4.	High operational and maintenance costs	Finance
5.	Financing limitations	Finance
6.	Management of residues and emissions	Environment
7.	Facility location	Environment
8.	Public perception	Social politics
9.	Government initiative and political will	Social politics

If we look at China, until 2013, there were at least six waste management system facilities through the incineration process with a capacity of up to 3000 tons per day (Zhang et al., 2015). With that many facilities, China is still experiencing problems in the implementation process.

The first thing that becomes an obstacle is that it requires a strong investment commitment in the construction process and the high operational costs required. According to Zheng et al. (2014), based on the value of investment needed, waste management facilities' construction and operating costs using waste-to-energy technology are unsuitable when built in most cities in China. Therefore, the Chinese government built these facilities in the centers of the most economically developed cities (Zheng et al., 2018) so that these cities can finance their own operational and maintenance costs for these facilities.

The next obstacle that will likely occur in the development of ITF in DKI Jakarta is the low heat generated by the waste, as experienced by China. According to Rand et al. (2000), for waste burning in the ITF to generate optimal heat, the waste must have a calorific value of at least 2,500 kCal/kg or the equivalent of 10.5 MJ/kg. The calorific value is the heat released per unit of fuel burned. In this case, waste is the fuel. Based on research by Damayanti et al. (2021), the calorific value of waste in the area of DKI Jakarta tends to be lower than the minimum standard for it to be processed into energy through the combustion process, which is 1,100 to 1,340 kCal/kg. Therefore, the ITF built by the Provincial Government of DKI Jakarta needs pre-treatment facilities to fulfill the required calorific value.

Furthermore, Damayanti et al. (2021) stated that the calorific value of waste in DKI Jakarta tends to be lower than the minimum standard for it to be processed into energy through the combustion process, which is 1,100 to 1,340 kCal/kg, 40-85% of the waste generated is organic waste (Nguyen et al., 2020), where organic waste has a lower calorific value (Drudi et al., 2019). Thus, the ITF that the Provincial Government of DKI Jakarta will build must have pre-treatment facilities to fulfill the required calorific value.

The development of ITF in Sunter has not shown any progress, even though the laying of the first stone has been carried out since December 2018 (Ramadhan, 2018). Similar to the obstacles experienced by other countries in the development stage of a waste management system that employs waste-to-energy technology, the Provincial

Government of DKI Jakarta is also having problems with funding. PT Jakarta Propertindo or Jakpro, the business entity appointed to construct Sunter ITF, failed to get funding from its cooperation partner, Fortum Finland (Wijaya, 2021). In fact, in 2018, PT Jakarta Propertindo made payments for land leases to the Provincial Government of DKI Jakarta to construct Sunter ITF for five years (2018 to 2023) in the amount of IDR 20,535,463,000 (Pemerintah Provinsi DKI Jakarta, 2018). Until 2022, the Provincial Government of DKI Jakarta, together with the DKI Jakarta Regional Legislative Councils (DPRD DKI Jakarta) are still conducting an analysis related to the most optimal financing method, whether to look for new cooperation partners or to be transferred fully using the regional budget (Azzahra, 2022).

According to elucidating possible impacts, costs, benefits, and obstacles above, constructing an ITF in DKI Jakarta is feasible and necessary. Nevertheless, it must be supported by an ample budget and strong commitment and coordination among responsible parties in combating the increasing amount of waste generated annually. Furthermore, developing such a huge project will need regular and intense monitoring and evaluation to ensure meeting the stipulated goal of providing a sustainable waste-processing facility with minimum negative impacts.

#### **4.4 Financing Scheme Options for the ITF Development**

In May 2022, the Head of the DKI Jakarta Environment Agency stated that the construction of the Sunter ITF would be diverted using the regional budget (APBD) through regional investment or pure APBD, but currently, the process is still being discussed with DPRD DKI Jakarta (Wiryono, 2022). Conventional financing using APBD can be an option for local governments in building infrastructure. The cost required to construct the Sunter ITF is around 250,000,000 USD or around IDR 3.7 trillion (Wiryono, 2022). The value of the road, network, and irrigation capital expenditure sub-heading in the 2022 DKI Jakarta APBD is around IDR 4.9 trillion, with a total regional expenditure value of around IDR 75.7 trillion (Peraturan Daerah Provinsi DKI Jakarta, 2022). Thus, it can be concluded that financing for one Sunter ITF development project is almost equivalent to the value of DKI Jakarta Provincial Government's roads, network, and irrigation capital expenditure in one year. With an investment value of that size, if the DKI Jakarta Provincial Government wants to finance using the APBD, then the possibility that the DKI Jakarta Provincial Government can divide it into several budget years or multi-year contracts so as not to interfere with budget implementation.

The thing that needs to be paid attention to by the Provincial Government of DKI Jakarta in the process of budgeting the development costs of the Sunter ITF into the APBD is whether the construction costs exceed the set budget. If Sunter ITF's construction costs exceed the budget, the construction process may be disrupted

or halted. In general, an increase in the budget for constructing a waste management system can occur if the budgeting process does not adequately cover the economic and social impacts of the project's development (Szabo, 2007). According to Szabo (2007), local governments must also be able to analyze several factors that can affect changes in development costs, namely inflation, changes in currency exchange rates, increases in costs due to changes in technical requirements, changes in costs due to changes in regulations and business partners' expectations of project returns and government support.

The budgeting process in the regional financial management process takes a long time. For example, the construction costs for the Sunter ITF, which will be included in the 2022 DKI Jakarta APBD, could result from an analysis carried out in the previous year because the initial development plan was carried out in 2018. It usually causes an increase in construction costs, such as lengthy preparatory procedures and complicated budget approval mechanisms (Szabo, 2007).

Widiyani (2018) stated that other financing options for reducing the burden on the regional budget for the development of the Sunter ITF could be carried out under a PPP scheme because it has economic attractiveness, based on the IRR value (11.8%) that is greater than the discount rate (10%). However, these financing options have several potential risk factors that could affect implementation. According to Cui et al. (2020), six top risk factors affect the financing scheme concerning public-private partnership waste-to-energy incineration projects in China. First is public opposition, where there are people who oppose it as there will be differences in perceptions of the benefits and risks of the development or people who do not receive balanced compensation for the negative impacts of the development. Second, inadequate government decision-making creates public distrust until the termination of the project. Third, the legal and regulatory system has many deficiencies, such as non-uniform regulations between regions, weak law enforcement, and implementation of related laws and regulations, resulting in falsifying environmental impact assessments and corruption by stakeholders. Fourth is environmental pollution due to private parties not complying with regulations and disposal standards. Fifth, the lack of supporting infrastructure for power plants can significantly affect waste-to-energy performance. Sixth, unreasonable and unrealistic government credit to attract the private sector but cannot fulfill its obligations. Considering those identified risk factors, adequate risk management is needed.

## **5. CONCLUSIONS AND SUGGESTIONS**

The following conclusions are presented as a result of a review of the implementation of ITF in DKI Jakarta, specifically one in Sunter. First, in addition to positive impacts, such as the efficiency of land

requirements and the potential electrical energy that can be generated domestically, the ITF construction and operation process can also have negative impacts, such as traffic jams, noise pollution, degradation of air quality, affected public health, degradation of water quality, and disposal toxic and hazardous materials (B3 waste) disposal. Second, implementing ITF in Sunter, North Jakarta, using social cost-benefit analysis is feasible because it has a positive NPV value, IRR of 11.8%, greater than the discount rate of 10%, BCR of 1.06, ROI of 214%, and payback period of 8 years. Third, the main obstacle in the development of Sunter ITF is that it requires a strong investment commitment in terms of development financing and project operations, both from the DKI Jakarta Provincial Government, DPRD, and the private sector. Fourth, financing options for establishing the ITF in Sunter, North Jakarta, include regional budget (APBD) and PPP.

The regional government, especially DKI Jakarta Provincial Government, can cooperate with regional-owned enterprises or other business entities in conducting a feasibility study on the establishment of ITF in a more comprehensive, adequate, and following current financial, economic, and social conditions to meet the community's need for a better and more environmentally friendly waste processing facility.

## 6. IMPLICATIONS AND LIMITATIONS

This research is still limited to scoping reviews sourced from literature or previous research related to the development of ITF. In terms of quantity, research discussing the provision of waste-to-energy processing infrastructure in Indonesia is still very limited, so it cannot yet cover the latest discussions on the ITF development planning process in Indonesia, especially related to financing options. To find out the latest information related to ITF development planning in DKI Jakarta, this research still quotes a lot from official news sites available on the internet. Therefore, case studies or cost-benefit analyses for future research can be adapted to the latest government plans using primary data obtained through field surveys with reliable informants or sources.

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