Waste to Energy in Sunter, Jakarta, Indonesia: Plans and Challenges

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Abstract. Waste-to-energy (WtE) power plants in waste management have been applied widespread because it is considered the best waste management solution compared to other waste management technologies. However, Jakarta has relied heavily on landfills regarding its waste management. Bantargebang landfill has been the only landfill owned by Jakarta and has been operating since 1989, so it has almost reached its capacity limit. Thus, to solve the problem, the Provincial Government of Jakarta has planned to build an Intermediate Treatment Facility (ITF) in a WtE power plant in Sunter. This article aims to find out the plans and the challenges of WtE in Sunter, Jakarta. This research was conducted with a literature study on waste to energy in several countries that have applied it to their waste management systems and literature related to the progress of waste to energy development in Indonesia especially ITF Sunter, and the challenges that must be done faced. Based on the literature study, building an ITF is one of the Jakarta Provincial Government’s responsibilities. However, the composition and characteristics of the waste tend to be lower than (WtE) standards, so the waste cannot be effectively processed. Therefore, the use of a pre-treatment facility should be considered.

1. Introduction

Waste is a logical consequence of the progressive increase in population, especially in urban areas, due to human activities associated with economic development and lifestyle that contribute to the waste generated [1][2]. Many developing countries lack solid waste management facilities and use traditional disposal methods such as landfills and open dumping to manage their waste. Some of the waste management carried out in Indonesia are: waste is disposed of at the final processing site (TPA) 60%, buried (10%), burned (5%), recycled (7.5%), and unidentified processing of 8.5% [3]. There are other ways that people also dispose of this garbage, such as throwing it into the river, throwing it on the roadside or vacant land, or letting garbage scattered on the road and reducing the aesthetics of urban space [3]. Most of the waste in Indonesia is not managed adequately, resulting in negative impacts on the economy, society, and the environment. The dynamics in the waste management sector trigger the need for new approaches in waste management, a paradigm shift in waste management from the waste collecting-transporting-dumping paradigm to a paradigm that relies on waste reduction and handling [3][4].
The landfill is the cheapest technique for handling large amounts of waste. On the other hand, there was a rejection from the community, and there were problems related to the lack of available land for landfills purposes. Excessive dependence on landfill and improper landfills has continuously led to environmental and public health problems [5]. Public awareness of environmental protection and landfill restrictions has prompted the government to find more efficient ways to dump waste. The Jakarta Provincial Government has been trying to solve the problems regarding waste management by building an Intermediate Waste Management Facility or Intermediate Treatment Facility (ITF). ITF is a waste management facility in which rubbish collected is then selected, assessed, destroyed, burned, melted, and reduced water content based on the quality of the waste [6]. Based on the 2012-2032 Jakarta Provincial Waste Management Plan, the waste-to-energy (WtE) power plant facility will be built in 4 (four) locations in Jakarta, including Sunter, Cakung, Marunda, and Duri Kosambi.

Urban waste management must be sustainable from an environmental perspective and an economic and social perspective. Sustainable Waste Management is carried out by taking a comprehensive approach applied in all operational activities. One of the sustainable development goals (SDGs) of the United Nations (UN) is SDG-11, reducing environmental impact of cities per capita, including paying particular attention to air quality and municipal and other waste management by 2030. On the other hand, SDG-7 ensures access to affordable, reliable, sustainable, and modern energy for all by 2030. A possible solution to this problem is (WtE) generation, in particular electricity generation [7][8][9][10].

WtE is considered an economically viable and environmentally sustainable solution for recovering energy from heat, fuel, and electricity waste. Typically, WtE technology is selected based on waste composition, season, socio-economic level of the community, local municipal policies, economic assessment, and environmental impact. WtE technologies are comparable in terms of energy output, environmental and economic impacts, and health consequences. Economic viability is one of the critical issues in deciding to invest in WtE development or not. In addition to waste management, WtE technology can play an essential role in addressing and managing energy problems, especially in developing Asian countries [11][12][13]. This article will present the plans and challenges of the WtE development plan in Sunter.

2. Method
This research was conducted with a literature study on WtE in several countries that have applied it to their waste management systems and literature related to the progress of waste to energy development in Indonesia especially ITF Sunter, and the challenges that must be done faced. It is located at Sunter Agung, Tanjung Priok, Jakarta Utara, Jakarta. ITF Sunter was chosen because this project was the first large-scale WtE project in Indonesia, considering the capacity to process 2200 tons of waste per day after previously there was a pilot project in the form of WtE Power Plant at Bantargebang landfills with the smaller scale of 100 tons per day.

WtE is a technology that can be applied to utilize energy from waste. This type of energy utilization can be done through biological processes or thermal processes. The characteristics of waste, the amount of generation and its composition impact on the selection of management strategies [14] and the availability of control technology [15]. So, it is necessary to analyze the composition and characteristics of the waste in advance determine the appropriate processing technology. The data used in this study were obtained from previous studies. The data source used and discussed in this study discusses the status and challenges of WtE development in Jakarta, Indonesia, to improve the planning of WtE system. Especially about the composition and characteristics of the waste.

3. Results and discussion

3.1. ITF Sunter Development Plan
The DKI Jakarta Provincial Government has issued Governor Regulation Number 33 of 2018 concerning Advanced Assignment to PT Jakarta Propertindo in implementing Intermediate Treatment Facility (ITF). The planned cooperation scheme is Build Operate Transfer (BOT) for 25 years. The
planned waste processing capacity at ITF Sunter is 2,200 tons per day. There are several regulations related to the Sunter ITF development plan, including:

1. Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management
2. Presidential Regulation Number 35 of 2018 concerning Acceleration of Construction of Waste Processing Installations into Electrical Energy Based on Environmentally Friendly Technology
3. Regulation of the Minister of Home Affairs Number 33 of 2010 concerning Guidelines for Waste Management
4. Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 3 of 2013 concerning the Implementation of Waste Infrastructure and Facilities in the Handling of Household Waste and Waste Similar to Household Waste
5. DKI Jakarta Provincial Regulation Number 3 of 2013 concerning Waste Management
6. Regulation of the Governor of DKI Jakarta Province Number 33 of 2018 concerning Further Assignment to PT Jakarta Propertindo in the Implementation of Waste Management Facilities in the City/ITF

ITF Sunter as a waste processing facility is the responsibility of the Regional Government as stated in Law Number 23 of 2014 that Regional Governments are given the mandate to carry out a regional waste management system. This is also stated in Law 18 of 2008 Article 6, which states that the tasks of local governments include facilitating, developing, and implementing efforts to reduce and handle and implement waste management and facilitate the provision of waste management infrastructure and facilities and Article 20, which states that in the context of reducing waste, local governments are obliged to facilitate the application of environmentally friendly technologies. The scheme for implementing the Sunter ITF project can be carried out in collaboration between the Regional Government and Waste Management Business Entities as stated in Article 27 of Law 18 of 2008, which states that local governments can partner with waste management business entities in the implementation of waste management in the form of partnerships with business entities.

Several large-scale alternatives to waste to energy have been implemented in some developed countries, such as Germany, Sweden, Japan, Netherlands, and the UK. For example, more than 80% of waste in Japan is burned; Japan has the highest number of incinerators globally (1900 waste incinerators), and 10% of the incinerators are equipped with power generation facilities [16]. Another WtE technology that can be used is Mechanical Biological Treatment with RDF recovery. MBT technology has been widely applied in several regions of the world, especially in Europe. However, for developing countries, there are differences in consumption levels and lifestyles, so the characteristics of the waste are different from other developed countries; this means that waste processing in developing countries is not necessarily compatible with the MBT technology used in developed countries [17][18]. Thus, it is essential to plan the technology of ITF Sunter based on the waste composition and characteristics in Jakarta.

3.2. The Challenges

In high-income countries and cities, packaging waste, such as paper, plastic, glass, and metal, dominates the amount of waste, while developing countries have a higher fraction of organic matter, ranging from 40-85% of total waste [14][19]. The calorific value is a laboratory test parameter to describe the heat contained in a material. The calorific value of a material is influenced by the organic content that depends on it. If the organic content is high, the material is more flammable, and the calorific value is high. For incinerator technology, the average calorific value of waste is at least 7 MJ/kg or 1,673 kCal/kg. As for MBT technology with RDF recovery, several relevant materials such as plastics, wood, paper and cardboard, leather and rubber, textiles are suitable for RDF production. Waste used as a substitute fuel (alternative) must have a calorific value of > 2,500 kCal/kg or the equivalent of 10.5 MJ/kg [20][21].
Table 1. Waste Calorific Value in DKI Jakarta [22].

| City         | Calorific Value (kCal/kg) |
|--------------|---------------------------|
| Central Jakarta | 1,340.46                  |
| North Jakarta   | 1,176.64                  |
| West Jakarta    | 1,219.43                  |
| South Jakarta   | 1,333.85                  |
| East Jakarta    | 1,245.41                  |

Based on the data in Table 1, the calorific value of waste in Jakarta tends to be lower than the minimum standard for processing waste with an incinerator or MBT with RDF Recovery. Mixed waste, which has a larger composition of organic waste, has a lower calorific value of waste [23]. Considering that the composition of waste has different heating values, one way to increase the heating value to be adequate for waste processing technology is to do pre-treatment. Following the European Commission [24], taking the organic, glass and metal waste can increase the calorific value. Organic waste is waste that has the most significant role in reducing the calorific value of waste. The calorific value has a positive relationship to the composition and calorific value of the components. The most significant component of the type of waste will be followed by the effect of the component calorific value of the mixed waste. This also applies to organic waste. The large composition of organic waste makes its calorific value very influential on the calorific value of mixed waste [25]. To be able to meet the required calorific value, ITF Sunter needs to use pre-treatment facilities.

4. Conclusion

This article will present the plans and challenges of the waste-to-energy development plan in Sunter. Based on the literature study, it can be concluded that The Jakarta Provincial Government has been trying to solve the problems regarding waste management by building an intermediate waste management facility or ITF. The calorific value of waste in Jakarta tends to be lower than the minimum standard for processing waste with an incinerator or MBT with RDF Recovery. Therefore, to meet the required heating value for WtE, ITF Sunter needs to use pre-treatment facilities. Future research is expected to analyze another technology or pre-treatment technology that can solve the waste management problem in Jakarta.

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