The development of waste to energy in Semarang, Indonesia

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Abstract. The volume of solid waste in Semarang City reached 1,300 tons per day consisting of 65 percent organic and 35 percent inorganic waste. 77.64 percent of waste was transported and disposed at Jatibarang landfill, 17.65 percent was managed by waste Bank and by temporary landfills (TPS) and 4.71 percent waste remain unmanaged. Jatibarang landfill is predicted to be exceeded its carrying capacity in 2021. To deal with this problem, through a public private partnership scheme, a PLTSa (waste to energy) has been developed. PLTSa would manage 70 percent of waste and produce 20 MW electricity sold to the State Electricity Company (PLN). The government of Semarang City must pay a tipping fee of 780,555 IDR per ton to the PLTSa Management. This paper analyses the development of PLTSa by comparing with another similar project. The research method was descriptive analysis, relied on secondary data, webinars, and informal interviews with relevant persons. This study found that waste to energy project will create dependency on the city government financially and operationally. To create sustainable waste management, it is recommended to utilize appropriated technology enabling the city government to operate by themselves and enjoy the benefit of electricity resulted from the process.

1. Introduction

One driving factor of a municipal solid waste problem in Indonesia is the increasing quantity of waste [1]. At the national level, the volume of solid waste reached 66.5 million tons per day, it is predicted to be 70.8 million tons per day in 2025. The volume of waste per capita is 1.2 kg per person per day in urban areas. From that volume, 69 percent is managed, 7 percent recycled, and 24 percent unmanaged. Semarang City, the capital of Central Java province, has 1,788,154 million people, in which the volume of solid waste is 1,252.7 tons/day [2]. From that volume, 77.64 percent is transported and disposed at Jatibarang, the only landfill managed by the government City of Semarang, 17.65 percent managed by waste Bank and temporary landfills (TPS), and 4.71 percent of waste remain unmanaged. This fact is similar to other municipal solid waste in Indonesia [1].

Act 18 of 2008 on waste management obligates the Regency and city government to manage its landfill based on sanitary. However, not all landfill has been managed in such a way. The basic approach stipulated by Waste Management Act is waste reduction through 3Rs as the first priority, followed by proper waste handling [3]. The implementation of 3R program should gives two benefit, which are economic and environmental benefits [4]. However, the contribution of the waste recycled program is still low. Solid waste bank activity in Padang, West Sumatera only contributed to a 0.05 percent
reduction of total municipal solid waste generation [5]. Consequently, most landfill bear the heavy burden of solid waste. Most landfills in the big city including Semarang has been exceeded the carrying capacity [2]. Government has difficulty in finding alternative landfills because the resistance from local people. This is the fact that the area surrounding landfill is not a good place to live characterized by slum, odor, dusty and potentially adversely affected by lindy (land contamination). All of the negative impacts reduce the property value surrounding the area of the landfill. The resistance of local people causes a syndrome NIMBY (not in my backyard), a social movement to oppose projects considered causing adverse impacts. This fact is in contrast to a number of successful municipal waste management, such as in Lamongan, East Java [6] and Cirebon, West Java [7]. In both areas, the success of waste management is influenced by the participation and involvement of the community both formally and informally, hence there is a reduction in waste generation and in turn reduces the burden on landfills.

Studies related to PLTSa have been carried out such as in Kota Bogor that plans to process 250 tons of electricity to produce 1,600 kWh of electricity per day with financing from PLN CSR, PDAM Tirta Pakuan, and Bogor City DLHK [8]. The PLTSa has been implemented in Bantargebang that in 2020 it has produced 783.63 MWh of electricity from 9,879 tons of waste. This study focuses on the implications to the government of Semarang City stimulated by the decision to develop PLTSa.

2. Literature review
Waste has become a classic problem worldwide, especially in developing countries along with the trend of industrialization and urbanization [9], which still have limited resources, namely technology, expertise, and capital [11]. The problem of waste is increasingly complex which includes, such as, storage, collection, transferring, and transporting [1]. The policy has changed from waste dumping to 3R waste, management is no longer merely government-centered but is community participation through for example waste banks [5]. Meanwhile, the volume of waste with an increasing trend has prompted the government to innovate by converting waste into energy through landfill gas (LFG) production which has been built in 7 cities in Indonesia and generates 54.142 MW electricity/year [1].

The success of MSW requires public policies, disposal techniques, legal aspects, public-private partnerships (PPP), and energy recovery. Public policy should involve public consultation and concrete action through adequate logistical support. The disposal technique is related to the use of technology. The legal aspect requires supportive regulation and soft agreement. Public-private partnerships are useful for increasing resource capacity and energy recovery in the form of technical technology and investment [9].

3. Methodology
The method is descriptive research that involved mainly secondary data from sharing sessions on waste to energy organized by Bintari Foundation dated August 6, 2020 and media publications, i.e. Tribun Jateng, Kumparan, Media Indonesia, also webpages of Local Government and Coal Mining Association. This study also included primary data from informal interviews with two officials from the Development Planning Agency of Semarang City. This approach was used to analyze the development of PLTSa in Jatibarang, Semarang City. In addition, analysis of similar projects based on local initiatives in Klungkung Regency, Bali was taken to compare which one is more sustained.

4. Result and discussion
One alternative to manage solid waste is utilizing waste to energy called waste biomass power plant or in Indonesia abbreviated as PLTSa. The PLTSa is developed through a public-private partnership scheme. Based on Presidential Decree 56 of 2018 [12], the PLTSa is a strategic national project along with 11 other cities in Indonesia. The estimated investment is 1.8 Trillion IDR. PLTSa should manage 70 percent of waste, while the other 30 percent of waste should be managed by a waste bank and temporary landfill. Semarang PLTSa will produce 20 MW electric that would be sold to the State Electricity Company (PLN) for USD 13.35 cents/kWh [13]. PLTSa will be managed by a business entity. Civil construction will be started in 2022 and the operation will be planned in 2024. After 20
years of operation, PLTSa will be handed over to the city government of Semarang. However, the government of Semarang City has to pay a tipping fee of 780,555 IDR per ton for waste processing costs. It can be reduced to 318,00 IDR per ton. However, the ability to pay from the City Government is 274,000 IDR per ton, so there is still a gap at the amount of 44,000 IDR per ton or 16 billion per year. In addition to the tipping fee, the investor also benefits from selling electricity to PLN at a price of 13.35 cents/kWh. Another issue is that build operating transfer (BOT) to the city government of Semarang will be 20 years after being operated in 2024 meaning that by that time the government has to provide a tipping fee and could enjoy the electricity resulted from the process. Moreover, the technology utilized is determined merely by the investor.

Comparing with the waste management in Klungkung, Bali, the Klungkung’s waste management is more independent and profitable to the Klungkung Regency Government thus the Local Government awarded as top 99 public service innovation in 2018 [14] and raised to be the top 40 [15]. The regency government initiated to manage their solid waste through TOSS (Tempat Olah Sampah Setempat or Place for Processing Waste at Place). TOSS is a simple technology produced by the High School of PLN (Electric State Owned Company), processes organic and inorganic waste to be bricked. The bricked is provided for local people supplying their domestic waste to TOSS and also sold to PLTG (Gas electric power plant) as co-firing. The government only provides the TOSS machine. The TOSS itself is managed by BUMDES (Village Enterprise), empowering and creating prosperity for local people. In addition, the productivity of Semarang PLTSa needs to be improved because as a comparison, Bantargebang PLTSa is able to produce 783.63 MW of electricity from 9,879 tons of waste, so at least Semarang PLTSa must be able to produce 103.11 MW from 1300 tons of waste.

5. Conclusion
Waste to energy as a strategy to deal with the problem of solid waste creates dependent of the city government to the investor. The city government has obligation to pay tipping fee as waste processing cost. The investor even obtains benefit from selling electricity to State Electric company. There is no agreement stipulating when the city government is eligible to take over the technology. It is recommended that the city government is given the authority to choose the appropriated technology enabling them to operate by themselves and benefit from selling the electricity.

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