



Analysis of the Potential Development of Waste Power Generation (PLTSa) Program in the Long Term

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Abstract. The inconsistency between the idea of accelerating PLTSa development and the operations in the field means that the government has various problems that must be resolved immediately. The PLTSa development acceleration program is a renewable energy program as a solution to dealing with waste problems. Through qualitative research methods, the researcher describes several aspects that are problems and potential for PLTSa development in the long term. As a result, the government, in implementing the PLTSa program, must review policies regarding budget regulations and operating costs for buying and selling electricity, the choice of technology that is limited by the budget, and the threat of environmental damage in the operation of burning waste.

Keywords: Waste, PLTSa, Government.

1 Introduction

In 2018, the Indonesian government officially issued Presidential Regulation Number 35 of 2018 concerning the Acceleration of the Development of Waste-to-Energy Processing Installations Based on Environmentally Friendly Technology. The Indonesian government has previously issued policies related to energy-based waste management, including Law Number 30 of 2007 concerning Energy (Energy Law) which is used as a legal umbrella for renewable energy development and is followed up through Government Regulation Number 79 of 2014 concerning the National Energy Policy (KEN) and Minister of Energy and Mineral Resources (ESDM) Regulation Number 44 of 2015 concerning the Purchase of Electricity by PT Perusahaan Listrik Negara (Persero) from Municipal Waste-Based Power Plants. PP No. 35 of 2018 makes the regulation the most recent policy in becoming the basis for developing PLTSa in Indonesia. However, based on the results of Sri Qodriyatun's research (Qodriyatun, 2021), In its current condition, only Surabaya City has successfully commercially operated PLTSa out of 12 major cities targeted by the central government. Meanwhile, two other PLTSa are in the construction stage (in Surakarta and DKI Jakarta), two PLTSa are in the location where there are already

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developers (in Palembang and Tangerang), and the rest are still in the auction, PreFeasibility Study, Outline Business Case, or Final Business Case stages. Qodriyatun continued that the slow development of PLTSa occurred due to the high tipping fee, limited local government budgets, the high selling price of PLTSa electricity, the absence of incentives for developers, and the absence of bankable guarantees for investment. [1]

Meanwhile, from the aspect of environmental technology, PLTSa is still being debated to date in several cities. This is due to the provisions of government policy on the selection and use of technology in PLTSa adjusted to the budget agreed upon by third parties, in this case, investors. Meanwhile, in the type of PLTSa technology, that is the choice of only one with minimal environmental weaknesses but is very costly in operation. This will make the local government prioritize profit and loss in the construction of PLTSa, even though if it is re-examined, the emergence of the PLTSa program is a solution to the waste problem that has dramatically polluted the environment. This paradox cannot be avoided if the technology used adds to environmental losses for the local community.

Technology is an important aspect of culture in the interaction between humans and the environment. Unlike the organs of other animals that were created entirely due to adaptation to natural environmental conditions, technology was developed precisely in an effort by humans to change the physical environment to suit their needs. [2] In essence, technology is just a tool for humans to explore materials and utilize natural energy. However, because technology is not separated from the society that creates and utilizes it, technology can become a destroyer of nature due to the conception of a group in society that acts only based on their interests. [2] Dobson mentions three critical arguments in the study of environmental politics. The first argument is that technological solutions cannot solve ecological problems. Technical solutions are not able to solve the existing crisis but are only able to delay the situation. This contradicts the modernist view that knowledge and technology are the answer to environmental problems. The second argument is that increased growth means an accumulation of hazards that can end in disaster. The faster the growth, the less space and ability to accommodate the increasing growth. The third argument is that problems related to the environment are interconnected. [3]

Based on this, there is a misalignment between the idea of accelerating the development of PLTSa and the operations that have occurred in the field. The problems described above will lead this research to analyze more broadly how much potential the development of PLTSa has when viewed in the long term. This analysis will explain the extent to which PLTSa can be a solution for environmental technology in dealing with waste problems in Indonesia.

2 Research Methods

This study research uses descriptive qualitative methods. According to Deddy Mulyana, qualitative research uses many methods of analysis to understand the problem. [4] The research will focus on two aspects of analysis in looking at the

potential development of PLTSa. Data collection will use primary and secondary data, namely analyzing theories and data obtained from various sources, including scientific journals, previous research, and scientific interview archives of earlier studies. This analysis is carried out with descriptions and provides data in the form of explanations.

3 Result and Discussion

3.1 Waste Power Plant (PLTSa)

Waste is a problem that is relatively difficult to overcome, especially in big cities. As a result, waste will become an environmental problem experienced by all countries worldwide if not appropriately addressed [5]. The majority of Indonesian people have a low awareness of the waste problem. Factors that cause low awareness of the importance of waste problems include the lifestyle or habit patterns (behavior) of the population and the uneven level of education [6]. An example of an action that reflects low public awareness of the waste problem is littering, which can disturb comfort. If left unchecked, this problem will cause new problems in the form of flooding and others, causing social problems that impact people's lives.

The relationship between population and the amount of waste generated is directly proportional [7]. So, the greater the population in Indonesia, the greater the waste produced. This is evidenced by the data on waste production in Indonesia, which has increased production and the increasing population. Based on data from the Central Statistics Agency (BPS) and the Ministry of Environment (KLHK), waste generation in 2015 was 65.20 million tons. This generation reached 65.80 million tons in 2017 and decreased on a small scale to 65.79 million tons in 2018. One year later, the waste generation significantly increased to 67.10 million tons, and in 2020, it reached 67.80 tons. All types of organic and inorganic waste can cause ecological environmental damage. The negative impacts caused by destruction are felt directly in various aspects, ranging from the environment, health, and society to the economy. Poor waste management can damage the sustainability of the environment and disrupt public health. [8]



Source: BPS and MoEF data

PLTSa is one of the programs that utilizing waste to become energy (Waste to Energy [WtE]) as a form of strategy for handling waste to be more efficient and sustainable. Waste power plants are known as PLTSa. Conceptually, debris will be converted into electrical energy through direct combustion or indirect combustion (conversion process).

There are three waste-to-energy conversion processes: through thermochemical, physicochemical, or biochemical. [9]. This fuel is later used to produce heat energy that will drive a turbine generator. Of the three waste conversion processes, each process uses various technologies that can be selected for use. From these technologies, the conversion process can produce energy in the form of electricity. In Indonesia, the recommended technologies for the 12 cities implementing PLTSa include incineration, pyrolysis, gasification, RDF, and AD.

Table 1. Comparison of Strengths and Weaknesses of PLTSa Technology

| Incineration | Pyrolysis | Gasification | RDF | AD |
|---|---|--|---|---|
| Suitable Garbage | | | | |
| All types of waste | Organic and inorganic waste | Organic and inorganic waste | All garbage except those with high protein content | Organic waste |
| Strengths | | | | |
| <ul style="list-style-type: none"> - Reduce waste volume by 80%. - Reduce waste mass by 70%. - Most municipal solid waste is treated. - Easy setup and quick maintenance. | <ul style="list-style-type: none"> - Up to 80% of energy is derived from waste. - Land acquisition is reduced. - High energy products. - Gaseous and liquid products are easily separated. - Municipal solid waste volume reduced by 50-90% | <ul style="list-style-type: none"> - No GRK emissions. - All waste is processed. - The technology is easy to develop. | <ul style="list-style-type: none"> - Trash is stable. - The size of the garbage is reduced. - High energy value of RDF. | <ul style="list-style-type: none"> - Solid waste reduced. - Produces high-energy biogas - The resulting organic fertilizer is rich in nutrients. - The technology is cheap. |
| Weakness | | | | |
| <ul style="list-style-type: none"> - Air pollution. - Releases dioxin. - Big capital. - Public rejection. - Generates hazardous solid waste (slag). | <ul style="list-style-type: none"> - The product needs to be cleaner. - Low yield of liquid products. - Leaves coke (residual charcoal). - Need product cleaning. - Tube corrosion. - High energy input. - Operational and maintenance | <ul style="list-style-type: none"> - High energy input. - Large capital and operations. | <ul style="list-style-type: none"> - RDF pellets cause air pollution when used in power plants. - Handling the ash generated at the plant is expensive. - Requires land with certain conditions (expensive). | <ul style="list-style-type: none"> - Gross. - Not for large-scale plants. - Low system stability. - Requires extra space. |

Source: Own elaboration [9]

Based on the table above, gasification technology is the only environmentally friendly and ideal to implement. However, this technology requires enormous costs. Of the various waste-to-energy utilization technologies developed, according to Gomez et al., incineration is the recommended technology for power generation compared to other technologies. However, additional technology is needed to control the resulting pollution (bottom ash and fly ash). [9] In the process of heating water, the boiler's efficiency is very important to note. The greater the boiler's efficiency, the greater the electrical energy produced. In addition, if the efficiency of the boiler is significant, it will impact the effort to be spent so that the power plant's operating costs will be more affordable and economical [10]. Therefore, investment in renewable energy power generation infrastructure, especially boilers in waste power plants (PLTSa), is very important [11]. This will affect the process of solving problems that occur in the environment and social community.

3.2 Problems in the Construction of PLTSA

There are several main problems that have prevented the development of PLTSA to date, including the lack of political will from the local government, which is reflected in the low provincial budget for waste management and the perception that electricity sales replace the provincial government's obligation to manage its waste in the region through the provision of Waste Management Service Fees (BLPS). In the perception of the local government, when the PLTSA is already operating, and the local government has paid the tipping fee, waste management becomes the responsibility of the PLTSA developer [12]. The construction of PLTSA in an area needs to release the responsibility of the local government to conduct waste management in its place, as mandated in the Waste Management Law. [1]

Furthermore, the sale and purchase of electricity to PLN has, in fact, caused new problems, especially in the Bekasi Government. The high purchase price of PLTSA electricity compared to the purchase price from coal-fired power plants makes the process towards the PJBL between the developer and PLN require a long process. The long, complicated, and unclear process towards the PPA is an obstacle for the Bekasi City Government in building PLTSA. The long, complex, and unclear process is an obstacle for the Bekasi City Government in building PLTSA, making it unattractive to investors. The long and indefinite process is detrimental to developers. [1] Compared to power generation from other renewable energy sources, the contribution of electricity provided by PLTSA is a manageable size. Its capacity tends to remain the same. PLTSA's contribution to national electricity is also tiny so that PLTSA can be said to be difficult if it is expected to help achieve the target of 23% of the generation mix from renewable energy in 2025. [1]

Third, although it has a good impact on waste management as an effort to preserve the environment, PLTSA as a power plant can also have an impact on the occurrence of other environmental problems where efforts to burn waste through an insulator to convert it into high-power steam which will then be converted into electric power in the implementation of PLTSA will have an impact on the generation of electric heat in the combustion cycle which will also produce other pollutants that have a high level of danger both for health or the environment. [13]

In the PPLH Law, it is emphasized that energy management efforts must be followed by a guarantee of the fulfillment of the right to a good and healthy environment for the community around the PLTSA construction site; new renewable energy development efforts must pay attention to the preservation of environmental functions to ensure the availability of good ecological quality and function. Energy utilization must give all attention to technological, social, economic, conservation, and environmental aspects, meet the community's needs, and maintain environmental sustainability. Efforts to provide electricity by utilizing new renewable energy must pay attention to the preservation of ecological functions and the function of the surrounding environment. [13]

3.3 Long-Term Potential Of Indonesia's Waste-To-Energy Plant

Looking at the various problems experienced by Indonesia in developing PLTSA, it can be a long-term development if it pays attention to several aspects for further

study, including the reconstruction of regulations related to electricity sales prices, tipping fees, bankable guarantees, and developer incentives. This must be considered in detail to avoid long-term problems in the future. Renewable energy policies, in this case PLTSa, need to pay attention to the maintenance budget and pre-treatment for the technology used to minimize long-term environmental damage as well as massive socialization for the community the importance of processing waste properly and correctly so that it can help in sorting waste to make it electrical energy.

The government needs to campaign for a recycling culture and waste diet. Various community organizations have adapted the circular economy and needs to be replicated more widely. So much waste can be reused to meet people's needs. For example, organic waste can be reprocessed into compost, or electronic manure can be reprocessed into reusable electronic devices. This is called the circular economy. The utilization of organic or electronic waste can reduce the amount of waste sent for incineration. [14]

Environmental concerns about the construction of PLTSa and its waste combustion process refer to the environmental pollution that the surrounding environment will experience. When referring to the previous table, number 1, it can be seen that there is only one type of waste combustion technology that can minimize environmental pollution, namely gasification technology. However, gasification technology will also become an environmental threat if the government carries out no pre-treatment in the implementation process. The Surabaya PLTSa program, in its application, uses gasification technology, which is considered more effective based on the characteristics of the city of Surabaya itself. Since its inauguration in May 2021, the PLTSa process has been optimized to minimize the weaknesses of the technology. In reducing the defects of the PLTSa implementation process, the Surabaya city government is considered to need to study more deeply regarding policies for the development of PLTSa so that the implementation process can be long-term and can be a good foundation for other big cities that are currently in the feasibility study stage of the program.

Burning waste through PLTSa does not simply burn waste, resulting in more significant emissions. Incinerators have been used for over 30 years, burning at temperatures above 850°C and equipped with toxic gas treatment so that the levels of dioxins and other poisonous gases emitted into the air are lower than coal-fired power plants. Waste will burn without the help of additional fuel. However, the furnace is equipped with an oil-fired burner. Under normal circumstances, the burner only operates during start-up and shutdown. After being used for more than 20 years worldwide, there have been no victims of dioxin pollution and other toxic gases. [15] In this case, it can be explained that the technology in the use of PLTSa has not yet shown the effectiveness of its use and the benefits caused to the local environment. This is because the use of this technology is still relatively new in Indonesia so it takes a long time to see its effectiveness. However, based on the results of the research described by Qodriyatun in the policy aspect, the government should make environmental issues one of the main focuses in running the PLTSa program to measure the extent to which the technology used is one of the environmentally friendly technologies. So that in determining the type of technology that the city government wants to use, it does not see how profitable the technology is for the

budget provided, but sees the extent to which the technology will survive not to damage the environment and become a long-term answer in the process of handling waste in Indonesia.

4 Conclusion

The PLTSa program in Indonesia is trying to find a solution to the current waste problem. However, only one city has commercially operated a PLTSa until now. Against the backdrop of existing obstacles and issues, including budget regulations and handling costs for buying and selling electricity, technology selection that is limited by the budget, the threat of environmental damage, and the government's unpreparedness in making PLTSa a long-term program, there is much homework that the Indonesian government must address. So that in the future, PLTSa can be an honest answer to the threat of a waste management crisis in various regions.

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