PESTEL Analysis of Waste-to-Energy at TPPAS Regional Nambo

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Abstract. Urbanization and urban development are unavoidable along with the socio-economic development. impact that is a challenge for cities with rapid urbanization, booming economy, the rise in community living standards have increase the amount of waste generation. Solutions are needed that can reduce the impact and the amount of waste produced. Developing countries such as China, Malaysia, India, Thailand and Indonesia began to see waste-to-energy as one of the solutions. Indonesia has begun to build a waste treatment plant that converts waste into power generation, RDF, or other products that have value. In Indonesia the processing of waste into energy in this case RDF was built in Nambo. However, in the process there are variety issues such as political, economic, social, technological, environmental and legal. The difficulty often faced such as public opposition, poor decision making, financing and others. This research aims to find out what challenges faced in the development and sustainablity of WTE at TPPAS Regional Nambo using analysis PESTEL. WTE project is one of solution to faced the amount of waste that keep increasing every year, because the amount of waste isn't balance with landfill area. Besides the processing process produces products that have a sale value.

Keyword. waste-to-energy; PESTEL; RDF

Article history. Received January, 2021. Revised March, 2021. Accepted June, 2021

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INTRODUCTION

Urbanization and urban development are unavoidable along with the socio-economic development that have and will be the past and future of this century. The impact of urbanization will be different between developed and developing countries. In developing countries, cities will lead to poor and slum dwellings, whereas in developed countries cities will develop with the creation of elite housing in the suburbs, offset by advanced technology (Dewi, 2017; Harahap, 2013; No et al., 2013). Another impact that is a challenge for cities with rapid urbanization, booming economy, the rise in community living standards have increase the amount of waste generation. The amount of waste generated will be different in each income economic group (Minghua et al., 2009; The Worldbank, 2012).

Quoted from geotimes.co.id states that Indonesia produces 175,000 tons of waste per day or 0.7 kilograms per person. The amount of waste generation keep increase every year along with growth population. Waste problem is getting more complicated in highly populated area that produce municipal and industrial waste at high rate (den Boer et al., 2007; Tng et al., 2016). Solid waste generation will be a source of methane and greenhouse gases, which have an impact in the short term and the accumulation of waste will cause flooding, air pollution, and health problem (The Worldbank, 2012). In addition, poorly managed waste is clogging drains, causing floods during rainy season, air pollution from burning of waste, social economic impact and currently start contaminating the ocean (Bernardo et al., 2017; Kaza et al., 2018).

Globally, almost 40% of waste is disposed of in landfills. In Indonesia itself, only 69% of waste is transported to landfill, the remaining is 9.6% are buried, 7,15% composted, 4,8% burned, 2,9% disposed to the river and others 6,55% (Meidiana & Gamse, 2010). Besides that almost 100% of solid waste in Indonesia is disposed without any sanitation facility that contaminating ground water and surface water, air quality affected by dust, odors and gas emissions. Around 43% of landfills in Indonesia are considered as open dumping. At the same time landfills require land availability and often opposed by neighboring resident (Kristanto et al., 2015; The Worldbank, 2012).

Solutions are needed that can reduce the impact and the amount of waste produced. We should move away from open dumping which has many negative impacts. Some countries have started to convert waste-to-energy such as electricity, RDF, Compost, and other product that have value. However, waste management is an expensive service and requires large investments in physical infrastructure and long-term operations (The Worldbank, 2012). Currently almost 8000 thermal WTE plants are operated in nearly 40 countries, process approximately 11% of MSW and produces about 429 TWh of power. Asian countries that successfully implemented WTE is Japan with the largest number of incineration plants in the world (1900 waste incineration plants) and 10% are equipped with power generation (Tan et al., 2015). Some developing countries such as China, Malaysia, India, Thailand and Indonesia began to see waste-to-energy as one of the solutions (Dhokhikah & Trihadiningrum, 2012). But in developing countries the challenges faced are public rejection, poor decision making, technological difficulties and other issues (Song et al., 2017).

Indonesia has begun to build a waste treatment plant that converts waste into power generation, RDF, or other products that have value. Based on *peraturan presiden no. 35 tahun* 2018 concerning the Acceleration of the Construction of Waste Processing Installations into Electrical Energy Based on Environment-Friendly Technology which will be established in 11 cities and 1 province. Other regions are build waste processing into RDF such as waste processing such as Nambo Bogor and Cilacap. However, in the process there are variety issues such as political, economic, social, technological, environmental and legal. The difficulty often faced such as public opposition, poor decision making, financing and others.

The political, economic, Social, technological, environment, and legal (PESTEL) tool provide an overview factors to consider in its decision making (Song et al., 2017). Song et al (Song et al., 2017) to identify and overcome the obstacle the development WTE inceneration in China use PESTEL framework to analyze the macro-environment of the WTE incineration industry. Quiceno et al (Quiceno et al., 2019) using SWOT and PESTEL analysis to explore potential strategies for electricity companies to grasp the opportunities and offset threats, by focusing on the formulation process for a broad, innovative strategy for the transition in the power business. Zalengera et al (Zalengera et al., 2014) reviewing the renewable energy resource that are available, and to analyze challenges to the development of energy infrastructure with PESTLE as a novel contribution of this work. Srdjevic et al (Srdjevic et al., 2012) defining criteria set required for multicriteria decision making, SWOT/PESTLE analysis is recommended for identifying the internal and external factors that influence a given water system.

This research aims to find out what challenges faced in the development and sustainablity of WTE at TPPAS Regional Nambo using analysis PESTEL.

Sustainability

Sustainability refers to meeting current needs without damaging the ability of future generations (Heizer et al., 2017). The term sustainability is often mentioned in the context of

the three pillars of sustainability, namely social, economic and environmental. The sustainability of the WTE system can be described by indicators scattered across the three pillars. A scope of research has implemented indicators with three pillars to consider the sustainability of waste-to-energy more holistically as shown in the Table 1 (Tng et al., 2016).

Table 1. Sustainabilty Indicator

Studies	Sustainability Indicators		
	Environmental	Economic	Social
Bastin and Long- den	Air emission; land emission; sewage emission; site footprint; site visual impact; displaced CO2 emissions; total external costs of waste road transport	Net cost per tonne processed; cost of waste transfer stations and road transport of waste; technical maturity; flexibility and strategic value	Lorry traffic impact on local communities; jobs created; health of local community; community ownership
Genoud and Lesourd	Emissions of several pollutants (CO2, VOC, SO2, NOx, particles; cadmium; CH4); radioactivity; BOD; noise pollution	Technical efficiency; renewability; production capacity upon demand; possibility of growth of the technology; production cost	Notion of public good; land area requirement; energy payback; number of persons working in each energy technology; supply risk; use of local energy resources
Menikpura et al.	Global warming potential; acidification poten- tial; eutrophication potential; fossil fuel consumption	Capital cost; operation cost; maintenance cost; environmental cost (externalities)	Land occupation; damage to human health; employment opportunities

PESTEL

Political, Economic, Social, Technological, Environment, and Legal (PESTEL) analyze is a popular tool that helps to analyze the macro-environment that influence organization. The PESTEL framework can encourage companies to consider long-term goals. Aguilar identified four types: Political, economic, social and technology. Then the four original factors are added by two other factors namely environmental and legal by current researchers. The factor and analysis itself is known as the acronym PESTEL. PESTEL analysis allows managers to collect, unite, and publish information relating to every macro-environmental factor that affects the organization (Barrows & Neely, 2012).

Political aspect analyze it is likely that a company will engage in strategies that will influence the political environment for their benefit. It is strongly recommended to follow potential policy changes in any government, even when politics are relatively stable there may be policy changes at the highest level which can have serious implications. Economical aspect see whether the economic growth or not that cause a company make a different approach. This aspect including assessing the potential for changes in economic inflation, taxes, interest rates, exchange rates, trade regulations and customs. When trying to determine economic viability, you will also look at issues such as the current cost of living for your target market and the availability of credit or finance. Social factors that need to be considered are those that have an influence on the market including age distribution, population growth rate, employee level, income statistics, education and career trends, trust, conventions and social culture. In addition it is necessary to consider attitudes towards matters such as health, career, and environmental issues. Technology is a key factor for organizations in assessing and registering issues that have the potential to affect their operations and which may be critical in the long run. The technological aspects can be broadly divided into two fields namely manufacturing and infrastructure. Environment

aspect related to contributes to pollution that triggers a legal response. Legal aspects that must be considered include current and future laws that can affect the industry in areas such as employment, competition, and health and safety.

METHOD

The object of this research is a waste processing and final processing facilities located in Nambo, Bogor. This type of research is descriptive research, where descriptive research is research that is expected to obtain complete and accurate data from a situation. By using descriptive research in this study it is hoped that complete and accurate data can be obtained regarding the analysis of strategies using PESTLE. Then the data can be used to solve problems faced and will be faced by Lulut Nambo Regional TPPAS.

RESULT AND DISCUSSION

TPPAS Regional Nambo is currently under construction. The following results of the PESTEL analysis conducted by collecting secondary data as academic literature, government documents, reports, etc.

Political issues affecting this project such as policies regarding waste management are regulated by undang-undang no. 18 tahun 2008, before that there were no laws governing waste management. In 2002 the Bogor district government prepared a 5 Ha land in Nambo initially for the Final Waste Disposal Site. Subsequently in 2005 a Jabodetabek Waste Management Corporation (JWMC) study was conducted which examined the regional waste management scheme. Of the area division, the only region that continues the project is the southern region. But in its journey DKI Jakarta decided not to participate in this project. In 2009 the West Java provincial government began to facilitate the construction of the Nambo Regional Landfill, by expanding the surrounding land. Seeing the existence of a cement factory that is not far from the landfill, resulted in a proposal to manage waste into RDF.

Economically TPPAS project which processes waste into power generation requires substantial funds, so that in accommodating the project the PPP scheme was used. Based on the results of the study obtained an analysis of social benefit costs of 460.45 billion with an EIRR of 295.36% and a 7 year 6 month payback period.

In relation to the social aspect, population growth and urbanization rates in many areas have influence increased waste generation. Based on statistical data total population of Bogor city, Depok city, and Bogor regency for 2019 based on forecasting is 9,248 million and keep increase every year. Residents around the Nambo Regional TPPAS are familiar with the construction and operation of the factory because it is an industrial area. Socially positive impacts obtained from the Lulut Nambo Regional TPPAS project can open up employment opportunities especially for local residents, so as to reduce poverty.

Based on the results of the study, the technology that will be used for the Nambo Regional TPPAS service is Mechanical Biological Treatment (MBT) or processing mechanically and biologically to treat waste consisting of 70% organic and easily decomposed by microbes. The processing process that is done produces 1/3 refuse derived fuel which is processed with calorie values reaching 3000 calories.

The processes carried out and the products produced can affect the environment positively or negatively. Waste processing with MBT produces the following products; Refuse Derived Fuel (RDF), with high calorific value; Stabilized organic waste (SOW), which is produced from biological treatment from the organic waste section; ferrous and non-ferrous steel which has potential for recycling; inert wastes (scarps) that are disposed of in landfills. Some perceived benefits refer to DG Khan Cement Plant in Pakistan to reduce contamination of greenhouse gas emissions, improvement of the local environment by

reducing emissions of particles to the atmosphere, water pollution, air pollution, and odor pollution, as well as conservation of local resources of fossil fuels by avoiding power generation from fossil fuels.

Legal aspects affecting this project is the investment scheme used in this project. PPP scheme in which the government in its construction and operation collaborates with the private sector regulated in PPN / Bappenas Permen 3 of 2012. there is no standard form in making cooperation agreement regulated in article 1320 of kitab undang-undang hukum perdata (KUHP).

CONCLUSION

From the results of the pestle analysis, various issues were encountered in the development of the Nambo Regional TPPAS. On the political aspects of the policies issued affect who will manage them. This project is economically feasible because it generates a high cost of social benefits with a payback period of 7 years and 6 months, but to make this project feasible it requires help from the central government. The existence of this project will open up employment opportunities for local residents. technology used are environmentally friendly and provide value to the products. investment used in the PPP scheme because the funds needed are quite large based on the Permen Bappenas no. 3 2012.

WTE project is one of solution to faced the amount of waste that keep increasing every year, because the amount of waste isn't balance with landfill area. Besides the processing process produces products that have a sale value. The product produced in this project is RDF which can be used as a substitute for coal, which is can used in cement factory. Other products produced from WTE are power generation.

However, WTE requires a lot of funds, so the participation of the central government and investors is needed. PPP scheme can be one of the solutions in infrastructure funding, one of which is waste to energy. The selection of private companies as an investor and operator needs to be done carefully, so that it will not interfere with the future construction and operational process.

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