Dynamic Governance: Utilization of Waste Methane Gas as Renewable Energy (Case Study at Puuwatu Kendari Landfill)

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Abstract. The use of new renewable energy (EBT) sources to meet the needs of electricity and gas in Indonesia is increasing but has not been optimally realized. Therefore, government support is needed in the use of NRE to help the community in the availability of electricity and gas. This study aims to find out the existing conditions and dynamic governance in the use of methane gas with waste energy sources at the Puuwatu Final Processing Site (TPA) Kendari City. The problem in utilizing methane gas from waste has not been optimal, so researchers want to know the existing conditions at the Puuwatu Kendari Landfill. This research uses Neo and Chen 2007 theory, that there are three capabilities in dynamic governance, namely: thinking ahead, thinking again and thinking across. This study uses post-positivist paradigm and qualitative method with data collection, namely observation, interview, and documentation. The results of this study show that the Kendari City government has been thinking long-term by preparing the Final Processing Site (TPA) land in Puuwatu, Kendari City. In addition, the government has also taken action by providing housing for waste pickers and the use of methane gas for people living in landfill areas. Not only that, the Kendari City Government has thought across borders by adopting ideas from other regions that have succeeded in synergizing with the private sector.

Keywords: Dynamic Governance, Renewable Energy, TPA Puuwatu Kendari

1. Introduction

The use of new renewable energy sources (EBT) to meet electricity and gas needs there are several alternatives, methane gas is expected to be one of the solutions for renewable electricity sources. According to the Gas Vision 2050 document, renewable technologies such as methane gas and hydrogen can replace conventional natural gas with the advantage of fewer carbon emissions. The good news is that methane gas is abundantly available around the world. Because, methane is produced from organic matter and agricultural waste, kitchen food, household waste treatment. Methane-producing countries such as Germany, Sweden and France use renewable gas more widely. A study shows that renewable natural gas such as methane could meet 76% of Europe's natural gas needs by 2050. Methane is known as a green gas that can be an alternative to conventional natural gas. If 60% methane gas is mixed with 40% carbon dioxide, it will produce a cleaner gas for the environment. One is to use certain types of bacteria to generate electricity from methane [1].

In Indonesia every year experiences population growth. This population increase will have an impact on the need for electricity consumption [2]. Similarly, the need for gas consumption, especially for households, has also increased. The increase in electricity and gas needs also has an impact on high air pollution if not followed by the selection of environmentally friendly fuel

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types [3]. One form of an environmentally friendly city concept by applying the concept of a green city. Green City aims to create a more sustainable environment by using renewable energy and reducing emissions [4].

The electricity in Indonesia based on data from the Ministry installed nationally in 2020 is as follows: PLTU 50.4%, PLTG 28.5%, PLTD 6.86%, PLTA 8.58%, PLTP 3.06%, and other PLT EBT 3.02% [5]. From this data, it can be seen that the supply of electricity still depends a lot on the supply of fossil fuels. Even though renewable energy such as solar, wind, water, and waste is very promising in Indonesia [6]. However, the utilization of renewable energy in Indonesia is still quite low. It is imperative to expand research to all forms of renewable energy sources in general [7]. In order to increase the supply of electricity to meet national electricity needs, opportunities are given to private business entities, which then sell their electricity to PT PLN [8].

In Kendari City, waste production per day is 250 tons. This landfill if not managed properly will have an adverse impact on humans and the environment. Thiswaste hasa content that varies depending on the level of progress of an area [9]. Improper waste management is worrisomeif adequate resources are not supported [10]. So it is important for stakeholders to create effective waste management policies [11] and an integrated program is needed [12]. The government needs to pay attention to waste utilization in connection with the energy crisis caused by fuel shortages[9].

Afew years ago, this landfill location became a regional reference in Indonesia for comparative studies of waste management into methane gas, but now it is difficult to materialize. The community around the landfill hopes that the government will immediately reorganize the landfill, so that it can be re-functioned as the use of waste waste into methane gas, thus helping the community around the landfill in alternative availability of electricity and gas [13]. Therefore, proper treatment is needed so that the landfill can be used to manage waste in a certain way, so that it benefits the community and does not have a negative impact on the environment. This landfill is located in Puuwatu Village, precisely located in Kendari City which has been pioneered since 1993 and began operating in 2009. This landfill is operated to manage waste from all sub-districts in Kendari City. Therefore, proper waste management is needed in this landfill.

The main essence in this study is to know the existing conditions and dynamic governance or dynamic governance [14]. Dynamic governance is able to provide input in the use of methane gas sourced from waste energy. Because the content of biogas, methane gas has a higher global heating potential than CO2 [15]. So that there needs to be a waste management system policy so that this area can become a comfortable green city and environmental sustainabilityis maintained. This study is expected to be able to explain what are the inhibiting factors in the application of dynamic governance in the waste management system in this area.

Based on the background description above, the formulation of the problem to be studied is as follows: (a) what is the existing condition of the waste treatment system in the utilization of methane gas at the Puuwatu Kendari landfill, and (b) how is the implementation of dynamic governance of the waste treatment system in the utilization of methane gas at the Puuwatu Kendari landfill? While the purpose of the study is to determine the existing conditions and implementation of dynamic governance of the waste treatment system in the utilization of methane gas at the Puuwatu Kendari landfill.

2 Literature Review

2.1 Governance

The paradigm of " governance" already exists in line with the emergence of human civilization [16]. The government is one of the actors in the organization of government. Good organizational performance is related to good organizational management and cannot be separated from the intervention of organizational leaders[17]. The parties involved in government vary depending on the level of government being discussed. Theintegration and interdependence of natural resource management across sectors and actors must be accompanied by strengthening regulatory implementation, raising public awareness and public partnerships[18]. In rural areas, the actors involved will be different from urban areas. The situation in urban areas is much more complex. Good governance is needed as a policy initiative through traditional approaches and local wisdom [19]. Policymaking should focus on improving governance in a way that is systematic, inclusive, representative, and accountable to the various social interests of the populations served [20].

2.2. Good governance

The administration of government in the provision of public services is called governance), while best practices are called good governance [21]. Good governance helps increase openness, potential, and efficiency of governance[22]. Good governance will be as expected if there is commitment from the government, and the community. The commitment of several parties requires cooperation and good will. Good governance will have a positive effect on organizational stability [23]. Good governance is a requirement to realize the wishes of the community in the life of the nation. Good governance has eight characteristics, namely: accountability, transparency, participation, responsiveness, effective and efficient, consensus-oriented, equity and inclusiveness and fair law [16].

2.3. Dynamic Governance

The emergence of the concept of dynamic governance is the result of the development of government management which is faced with changes to respond to the needs of the community. Dynamic governance is a combination of the terms dynamism and governance. Dynamism is a new, flexible idea, innovation and continuous improvement. Such conditions are also experienced in the governance system to make policies. Policies made must be responsive to dynamic problems faced by society [24]. Neo dan Chan [25] Describe that the concept of dynamic governance describes three government capabilities, namely: i) Think ahead, by looking at opportunities, potentials, and existing threats. The principle of think ahead is needed to make long-term decisions, (ii) think again, a process to assess the relevance of long-term policies with the needs of the community, so that the programs implemented run effectively, (iii) think across, that the government needs to think across borders in finding innovations that can be adopted into the policies made. At this stage, you can exchange knowledge with other regions, but still consider local wisdom.

2.4. Garbage Concept

According to Law-18/2008 on waste management, the definition of waste is the rest of human daily activities and/or natural processes in solid form. Any person or group of persons or legal entities that generate garbage generation. Waste regulated in Law-18/2008 is household waste, similar waste household waste and specific waste [26]. Meanwhile, the efficiency of the Final Processing Site (TPA) is according to the Regulation of the Minister of Public Works Number 03 / PRT / M of 2013 that the landfill is a place to process and return waste to environmental media. To plan the required landfill infrastructure/facilities based on technical, economical and environmental feasibility [27]. While the types of landfill based on the type of land urug there are 3 final waste disposal systems, namely: i) open dumping, ii) controlled landfill, 3) sanitary landfill, this is the most recommended for final waste management [28].

2.5. Utilization of Waste into Methane Gas

Utilizing landfill gas into electric power broadly there are three stages, including; (i) gas capture systems, i.e. by configuring with vertical wells, horizontal trenches or a combination of both. The usual method in gas capture systems is castration of vertical wells into landfills and connecting pipes to drain gas to reservoirs using blowers, (ii) landfill gas treatment systems, namely by means of conversion processes. This gas must be cleaned to remove condensate, particulates and other impurities, because landfill gas sometimes contains siloxes and sulfur compounds derived from waste, (iii) power plants, used in landfill gas energy projects to generate electricity that can accommodate various sizes, namely internal combustion engines, gas turbines and microturbines [29].

3 Method

This research is qualitative with a descriptive method, namely collecting, describing and analyzing a phenomenon so that an objective picture and sufficient understanding of the topic of the government's dynamic role in waste management into methane gas are obtained. In addition to the waste management process, this study is also to see about the process of empowering waste pickers and government involvement in implementing waste picker empowerment as part of community groups living around the Puuwatu Kendari landfill. Data collection techniques that will be used in this study include three ways, namely, Observation, Interview and Documentation.

4 Findings and Discussion

4.1. Existing conditions of Waste Management at the Final Processing Site (TPA) Puuwatu Kendari

This landfill is located in the limits of Kendari City, precisely in Puuwatu Village, Puuwatu District, Kendari City. The land area ranges from 122,269 m2 or 12.23 Ha. This landfill was previously a vacant land surrounded by forest. This land is a former garden that has been covered with cashew and teak plants. Then this lahan was released by the Kendari city government. The existing conditions at the Puuwatu Landfill site and owned by the Kendari

City Government are in the form of land and buildings as well as equipment to support landfill operations. Landfill facilities as shown in table 1, sourced from DLHK Kendari City in 2021.

Table 1: Puuwatu Kendari Landfill Facility

No	Current Tread Usage	Luas (m^2)
1	Landfill Office Building	50,24
2	Tera bridge	27,72
3	Security guard post	5,91
4	Supervisory post	27,52
5	Equipment building	34,02
6	Methane gas engine housing	28,62
7	Workshop	71,4
8	Composter building	484,4
9	Gazebo tops	94,62
10	Gazebo KM/WC	5,27
11	RTH	40094, 18
12	Leachate pool 1	157
13	Leachate pool 2	339,9
14	Garbage shelter (landfill area)	50000
15	Drainage	748,2
16	Access roads	3100
17	Vacant land (landfill collection site)	27000
	Total	122269

Source: Dinas Lingkungan Hidup dan Kehutanan, 2021

The waste management policy at the Puuwatu Final Processing Site (TPA) covers from the transportation process from garbage trucks to the unloading of waste at the shelter. Waste management starts from the establishment, sorting, management of organic and non-organic waste. In addition, based on the results of observations in the field, waste management at the Final Processing Site (TPA) uses a controlled landfill system. In 2011 began trials of the use of methane gas derived from landfills and the results were used to meet the needs of electrical energy and fuel. In 2013 the Kendari City Government built an energy-independent village area in this landfill area. The need for electrical energy and gas fuel is sourced from methane gas produced from waste management. Previously there were 120 households that used for electric lighting and cooking needs, but currently it is not optimal. This is due to technical controls that require serious handling from the government. According to the Landfill Supervisor said: "waste management in this landfill must at least provide one unit of D6 heavy equipment, two units of D3 heavy equipment and a competrator to compact waste. The compactor for compacting waste is old, so it must be equipped with all that so that waste management returns to what it was 10 years ago."

The waste management paradigm that still occurs in most regions in Indonesia is collection-transport-disposal, resulting in waste piling up in the Final Processing Site (TPA) or landfill. This landfill contains organic waste dominated by methane gas (CH4). Methane gas produced by the waste sector is a source of Greenhouse Gas (GHG) emissions. Methane gas

that is not managed properly will be released into the atmosphere and contribute to global warming. The use of methane gas as an alternative energy source has been carried out in this landfill. The utilization of methane gas in this landfill is carried out through stages: gas collection, gas distribution, gas purification and gas utilization. The collection or capture of methane gas is carried out by installing vertical and horizontal gas collection pipes at landfill locations (urug land). Methane gas produced from landfills is still mixed with other gases, so it must be flowed to the gas purification reactor.

The gas purification facility will produce methane gas of a certain desired quality, in accordance with the specifications of the gas purifying installation. The gas produced is gas that is ready to use to be converted into electrical energy or fuel. Methane gas in this landfill is used as a source of combustion energy as a substitute for LPG. Inaddition to the needs of gas stoves or for cooking for local residents, methane gas is also used as generator fuel for lighting around TPA. Management and utilization of methane gas in landfill is very important as an effort to mitigate GHG emission reduction as well as an environmentally friendly alternative energy source.

2. Dynamic Governance in Waste Management into Methane Gas

The Kendari City Government has taken several steps, including:

1. Thinking ahead in Waste Management into Methane Gas
   Part is by looking at opportunities, potentials, and threats that exist. The principle of think ahead is necessary to make decisions that are long-term. Based on the Kendari City Regional Spatial Plan (RTRW) for 2010-2030, the location of the Puuwatu Final Processing Site (TPA) Operation in Kendari City is intended for the Landfill Area. This is in accordance with the City Plan Information issued by the Investment and One-Stop Integrated Services Office of Kendari City number: 653/647/KRK/XI/2021 dated November 11, 2021. The process of thinking ahead helps organizations and their leaders build perspectives on a set of futures that make sense, recognize limitations and create strategies for the future.

2. Thinking again in Waste Management into Methane Gas
   This section is a process to assess the relevance of long-term policies to the needs of the community, so that the programs implemented run effectively. By interview that Waste Management into Methane Gas, initially this program was under the Kendari City Hygiene Office. Over time, then its management was under the Environment and Forestry Service. Technicalfield monitoring is carried out by involving scavengers, garbage handlers and local area administrators (RT and RW). The team in the field that has been formed will coordinate with the Environment and Forestry Service of Kendari City. Based on the results of an interview with the RT Chairman, said: "We in the field always coordinate with the leadership. Because our duty in the field is to carry out tasks according to the direction of the leadership".

3. Thinking across in Waste Management into Methane Gas
   That the government needs to think across borders in finding innovations that can be adopted into the policies made. At this stage, you can exchange knowledge with other regions, but still consider local wisdom. Around this landfill live several families who come from other areas and occupy houses because some work as waste pickers or garbage transport drivers. Based on interviews with local communities , it can be seen that differences in characteristics are highly considered in the preparation of the

program. One respondent said: "We came from Konawe Regency and migrated to Kendari City. We made housing by the government in the landfill area and there was help from the private sector by making musolla around the housing". The success of the program in certain regions will not necessarily be successful if it is implemented as a whole in other areas. The management of waste into methane gas has been successfully carried out in the Metro City of Lampung Province by involving private parties. The Kendari City Government is also planned to collaborate with the Hotel and Restaurant Association (PHRI) in Kendari City in the future. Because one of the biggest sources of waste in Kendari City comes from hotels and restaurants. The right policy is needed so that waste from hotels and restaurants can be used as a basic material for composting.

5 Conclusion and Recommendation

5.1 Conclusion

Based on the research that has been done, the following conclusions are obtained:

1. The utilization of methane gas in the Puuwatu landfill by collecting or capturing methane gas is carried out by installing vertical and horizontal gas collection pipes at landfill locations (urug land). Methane gas produced from landfills is still mixed with other gases, so it must be flowed to the gas purification reactor. The gas purification facility will produce methane gas of a certain desired quality, in accordance with the specifications of the gas purifying installation. The gas produced is gas that is ready to use to be converted into electrical energy or fuel. Methane gas in this landfill is used as a source of combustion energy as a substitute for LPG. Inaddition to the needs of gas stoves or for cooking for local residents, methane gas is also used as generator fuel for lighting around the landfill. The obstacles found in waste management at this landfill are the need to provide one unit of D6 heavy equipment, two units of D3 heavy equipment and a compiler to compact waste.
2. Dinamyc Governance in Waste Management into Methane Gas includes; (i) thinking ahead, namely there is a Kendari City Regional Spatial Plan (RTRW) for 2010-2030, the location of the Puuwatu Final Processing Site Operation (TPA) of Kendari City is intended for the Landfill Area. This is in accordance with the City Plan Information issued by the Investment and One-Stop Integrated Services Office of Kendari City number: 653/647/KRK/XI/2021 dated November 11, 2021, (ii) thinking again, namely that themanagement of waste into methane gas, initially this program was under the Kendari City Hygiene Office. Over time, then its management was under the Environment and Forestry Service. The Environment and Forestry Service of Kendari City is indeed the holder of the Waste Management to Methane Gas program, but technically the field is carried out by involving scavengers, waste collector drivers and local area administrators (RT and RW). The team in the field that has been formed will coordinate with the Kendari City Environment and Forestry Service, (iii) thinking across, and the Kendari City government plans to collaborate with the Hotel and Restaurant Association (PHRI) in Kendari City so that waste from hotels and restaurants can be used as basic material for composting.

5.2. Recommendation

Efforts need to be made so that waste management is the government's main concern. Because proper waste management will produce positive impacts for the government,

society and the environment. The suggestions given by the authors in this study include: 1. The government must immediately revitalize so that the Puuwatu landfill returns to what it was ten years ago which became a reference for other regions in proper waste management. 2. Dynamic Governance in waste management needs to synergize with the private sector so that the volume of waste produced every day can be found solutions that are beneficial for the government, private sector and community.

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