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Sustainable Environmental Management to Support Operational Excellence and Provide Added Values to Communities and Environment in PGE Area Lahendong

Arie Fandya Nugraha Eltassa, Hendrik Kurniawan Sinaga, and Ramadoni Febriandinata

Jl. Raya Tomohon no.420 Tomohon, Sulawesi Utara

arie.fandya@pertamina.com. hendrik.sinaga@pertamina.com, ramadoni.febriandina@pertamina.com

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ABSTRACT

Pertamina Geothermal Energy (PGE) Area Lahendong is the only geothermal company in North Sulawesi Province that conducts business from upstream and downstream. Currently PGE Area Lahendong producing 120 MW from 4 x 20 MW units in the form of steam supply to PLTP owned by PT PLN (Indonesian national electrical company) and 2 x 20 MW in the form of electricity supply (PLTP is owned and operated by PGE Area Lahendong).

In managing the geothermal energy system, PGE Area Lahendong implements an Environmental Management System based on ISO 14001: 2015 international standards and the 7th edition of the International Security Rating System (ISRS). The PGE Area Lahendong performances proven by its company achievement as the first geothermal company to get Level 5 based on an assessment conducted directly by DNV GL as the ISRS license holder.

In addition, according to regulatory requirements in Indonesia, PGE Area Lahendong was assessed for its environmental management performance by the Indonesian government through the PROPER (Program Penilaian Kinerja Lingkungan) program that is conducted annually by the Ministry of Environment and Forestry, Republic of Indonesia. Since 2015, PGE Area Lahendong performance continues to increase for each parameter and aspect assessed through the implemented programs. The performance in 2017 is shown by the success of energy efficiency up to 6,539.38 GJ, reduction of emissions and greenhouse gases reaching 221.61 tCO_2, hazardous and toxic (LB3) waste management of 35.81 tons, non-hazardous and toxic waste management of 0.28 tons, and water efficiency of 39.061,19 m^3.

Besides that, while implementing close system reinjection, all produced water (brine and condensate) is re-injected into reinjection wells. Community development is also carried out optimally in order to create harmony and increase the independence of the community around the location. So the presence of PGE Area Lahendong brings more benefits to the surrounding community and maintains and even improves the quality of the environment.

1.Sustainable Environmental Management to Support Operational Excellence and Provide Added Values to Communities and Environment in PGE Area Lahendong

Pertamina Geothermal Energy (PGE) Area Lahendong is the only geothermal company in North Sulawesi Province that conducts business from upstream and downstream. Currently PGE Area Lahendong produces 120 MWfrom 4 x 20 MW units in the form of steam supply and 2 x 20 MW in the form of electricity supply (PLTP is owned and operated by PGE Area Lahendong). PGE Area Lahendong contributes around 22.5% of the total installed capacity (of power plant) in North Sulawesi Province (Directorate General of Electricity, Ministry of Energy and Mineral Resources, 2017 Electricity Statistic).

2. EXCELLENCE AND UNIQUENESS OF THE COMPANY

PGE Lahendong Area is the first geothermal field in Indonesia that achieves 7th edition of the International Security Rating System (ISRS) level 5 based on an assessment conducted directly by DNV GL as the ISRS license holder. It shows that the HSSE management standard carried out by PGE Lahendong Area is one of the best in Indonesia. PGE Lahendong Area is the only geothermal company that provides geothermal energy from upstream to downstream (PLTP) on Sulawesi Island.

3. SUSTAINABLE ENVIRONMENTAL MANAGEMENT SYTEM

PGE Lahendong Area has a sustainable environmental management system that is assessed by Indonesian Government through the PROPER (Program Penilaian Kinerja Lingkungan) program conducted annually by Ministry of Environment and Forestry, Republic of Indonesia. The PROPER assessment consist of various aspects such as Environmental Management System, Energy Efficiency, Emission Reduction, 3R for Hardous and Toxic Waste and Solid non Hazardous and Toxic Waste, Water Conservation and Waste Water Pollution Load Reduction, Biodiversity Protection and Community Development.
All of these aspects have been carried out by PGE Lahendong Area through the sustainable environmental management system to provide benefits to the community and the environment.

3.1. Environmental Management System

PGE Lahendong Area is committed to and implements an Environmental Management System based on ISO 14001: 2015. The environmental management system of PGE Lahendong Area has been certified by PT. BSI as an independent certification company in 2015 for ISO 14001: 2004.

The scope of certification is the activities of geothermal steam exploitation and distribution for electricity generation, including energy efficiency, reduction of emissions from conventional air pollution and greenhouse gases, 3R for hazardous and toxic waste, 3R solid non-hazardous and toxic waste, water conservation and waste water pollution load reduction, biodiversity protection and community development program.

3.2. Energy Efficiency

In 2017, PT PGE Lahendong area's energy efficiency absolute results increased significantly to 6,539.38 GJ. The energy value consumption is 82,433.63 GJ, intensity of Energy Consumption is 0.0217 GJ / GJ, and Energy Efficiency Ratio is 0.0793.

Utilization: The Heat Waste Program on Hot Brine LHD-05 for Geothermal Power Plant Binary Cycle is a PT. PGE Lahendong Area programme that optimises the use of waste heat to generate electricity to PT. PLN electric network providing electricity residents around the PLTP location. This program has an important impact in the form of additional electricity supply of 500 kW. The big impact is that the generation provides for the electricity needs of 250 houses and the operation of the reinjection pump in the LHD-37 PGE Cluster in Lahendong Area. This program has an absolute energy efficiency value of 2,277.65 GJ (per June 2018).

Program for Utilizing Hot Brine for Geothermal Power Plant Binary Cycles (Non-Conventional) in PGE Lahendong Area is the first Binary Cycle PLTP operating in Indonesia. Innovation in Utilizing Waste Heat in Hot Brine at the LHD-05 wellhead for Geothermal Power Plant Binary Cycle can substitute the use of electricity from PLN.

This program is one of the system-level innovations where conventional geothermal power plants only utilize heat energy in geothermal steam fuels, while heat energy in brine fluid is not utilized, while Geothermal Innovation Power Plant Binary Cycle is able to create new geothermal system utilization by utilizing heat energy from both steam and geothermal brine.

Value Chain: With this innovation, the production value chain is able to supply the electricity needs for reinjecting the hot brine, as well as for operational use and meeting the electricity needs of the community (± 250 houses around the activity area) or equivalent to 243,360,000 IDR per month.

3.3. Emission Reduction

PT PGE Lahendong Area emission reduction in 2017 amounted to 5767.4 tons of CO2-e, 4 tons of CH4 and 250.4 tons of H2S. An emission reduction program that fulfills optionality is Bleeding Steam Utilization which is wasted as a Turbo Pump Drive to drain the cellar of the well. This program has a significant impact on the surrounding community. This program has a significant impact on the surrounding community by reducing the absolute value of Greenhouse Gas Emissions by 0.011 tons CO which contributes to ambient air quality around (PT ITS Tekno Sains Benchmarking, 2018). The major impact of this program is to eliminate the potential for corrosion that occurs in the casing due to the presence of puddles in the well cellar. If there is a leak in the production well due to corrosion, it can potentially cause a leak which will result in the loss of electricity production of 0.5 - 1 MW-e to supply approximately the equivalent of 500-1000 homes in the area assuming 1000 Watts per house (worth 389,752,372.25 IDR per month).

PT PGE Lahendong Area is a pioneer of Bleeding Steam Utilization. Previously, the steam was wasted. Now, the first and only use of a Turbo Pump drive to drain well cellar in the world has succeeded in reducing 0.011 tons of CO. This program has been registered with a patent at the Director General of Intellectual Property Rights under the registration number S00201807732 on September 28, 2018. Previously, cellar draining used diesel-powered pumps that caused emissions to pump stagnant water, PGE Lahendong area redesigned the cellar dewatering system with a bleeding Turbo pump system.

This Value Chain innovation program maintains the continuity of steam supply to PT. PLN (Persero) because it can reduce the potential for disruption in the well cellar. In addition, this program also supports GHG reduction (reduction of 0.011 tons CO), improves ambient air quality, also reduces operational costs for the purchase of diesel fuel.

3.4. 3R for Hardous and Toxic Waste

The total Hazardous and Toxic Solid Waste produced by PT. PGE Lahendong Area in 2017 amounted to 2.75 tons. Hazardous and Toxic Solid Waste Intensity value produced in 2017 has decreased to 0.724 g Ton / GJ, equivalent to a decrease of 63.6% when compared to 2016. While the value of the reduction ratio and / or utilization of Hazardous and Toxic Solid Waste in 2017 has a fairly good value of 0.9287.

Optimization of using NaOH Storage to Reduce Hazardous and Toxic Waste replaces NaOH supply patterns to LHD-23 and LHD-28 wells from the beginning using drums to be accommodated in Policarbonate NaOH Storage, but this storage still has potential damage so NaOH is still purchased in drum shape. To guarantee the storage strength and continuity of NaOH supply, a sub-system for storing NaOH storage is made into SS 316 L material.

Value Chain from Optimization: The use of NaOH Storage encourages NaOH producers not to produce Hazardous and Toxic Waste packets in the form of drums. This innovation will make it easier for operators in the NaOH loading process to be done manually to use pumps from NaOH transport vehicles, thereby reducing potential NaOH losses and spills, which cause reduced volume in NaOH storage and environmental pollution. In addition, this innovation can reduce the potential of operators to be exposed to chemicals directly when loading NaOH. In 2017 this innovation reduced the generation of Hazardous and Toxic Waste by 15.69 tons, equivalent to 117,675,000 IDR.

3.5. 3R Solid non Hazardous and Toxic Waste

Total Non-Hazardous and Toxic Solid Waste produced by PT. PGE Lahendong Area in 2017 amounted to 2.23 tons. The value of Non-Hazardous and Toxic Solid Waste Intensity produced in 2017 has decreased to 0.587 g Ton / GJ, equivalent to a decrease of 53.04%. The Value of Reduction Ratio or Utilization of 2017 Non-Hazardous and Toxic Solid Waste has a value of 0.12485.

The Reduced Use of Bottled Water Program to replace the plastic waste produced by the Drinking Water Packaging (Plastic Bottles) was pioneered by PGE Lahendong Area along with management's commitment to increase the level of concern for environmentally friendly Geothermal business. This innovation is a change in the sub-system in which a bottle that is normally discarded after use is instead reused for drinking wate. reducing waste from bottled water.

The Value Chain of this program encourages PGE Lahendong Area to change the drinking water supply from using Bottles and Glass to refill-gallons. This innovation reduces the frequency of water delivery / supply and increases the awareness of workers, business partners and company guests on the 3R aspects (Reuse, Reduce, Recycle) of Non-Hazardous and Toxic Solid Waste Waste. This innovation does not cause bottle and glass packaging waste (a reduction of 0.0288 tons).

3.6. Water Conservation and Waste Water Pollution Load Reduction

The value of water usage intensity in 2017 has decreased significantly when compared to 2016 with a difference of 0.0026 m3 / GJ (53%). The water efficiency ratio in 2017 has increased compared to 2016 with a difference of 0.0577.

3.7. The program to use produced wastewater as a substitute for fresh water for drilling fluids is capable of producing water conservation of 50,973 m^3 (2014), 53,557 m^3 (2015), 29,799 m^3 (2016), 38,161 m^3 (2017) and 17,792 m^3 (2018). Considering the PGE Lahendong area drilling location is close to community settlements and paddy fields, as well as the limited water resources available, the important impact of this program is that the water supply for agricultural activities and the surrounding community's domestic activities are undisturbed. In 2017, PGE Lahendong area used 38,161 m^3 of produced wastewater. This amount is equivalent to the need for irrigation of around 1.07 ha of rice per day, or equivalent to the removal of potential harvest losses of 70,854,137 IDR / ha / year. While the big impact of this program is that besides not disrupting fresh water supply for the community,it also supports the maintenance of the level of agricultural production. Community Development

The program of strengthening palm sugar farmers here is one of the efforts to increase the production of palm juice. The palm farmer empowerment program is a long-term program with a small program implemented every year. In 2018 (third year) a Rocket Stove making program was implemented as an effort to support fuel savings in the process of Nira water extraction. Nira water is derived from coconut flowers. A rocket stove is an efficient and hot burning stove using small-diameter wood fuel.Making a Rocket Stove, an area farmer empowerment program carried out by PT PGE Lahendong Area, is unique: Firstly, it has never been done by other geothermal energy management companies in the world. Secondly, in other regions, palm sugar production is still in the scale of home industries. Here, for assisted farmers, the Company can supply raw materials to produce export quality products. Thirdly, the yield of palm trees in North Sulawesi is generally used in producing traditional alcoholic beverages, which are called "bag-ate" (*Cap Tikus* – Local brands).

For farmers assisted by PGE Lahendong Area, this activity can divert the final product so that it does not become an alcoholic beverage, but it can still create income for the palm sugar farmers. In other regions, cooking water for Nira water still uses traditional stoves, while in the PT PGE Lahendong area, before sending it to the factory, palm farmers maintain the quality of the sap water (pH level and sugar content) by cooking it together in one furnace using a rocket stove, a more fuel-efficient stove innovation.

Using the SROI method (Social Return on Investment) The farmer’s empowerment program in the second year has a 1: 4.6 ratio. That is, with the assistance of a total 1,000,000.00 IDR, the beneficiary group is able to generate income of 4,600,000.00 IDR

There is a reduction in the time to cook the sap water. Previously, to cook 170 liters of palm juice it took 180 minutes, but using a rocket stove, it only takes 60 minutes. In addition, the impact on farmers' income from the previous method ranged from 50,000.00 IDR per day, to 200,000.00 IDR per day or 6,000,000.00 IDR per month.

This program changes the working system of the sugar palm farmers. Previously, before being distributed to the factory, nira water cooked by using traditional stoves consumed a lot of time and fuel. Using Rocket Stoves from PT PGE Lahendong Area, cooking time and firewood use arereduced so that farmers can increase the amount of tree tapping, and the cooking water results in better pH levels and sugar content.

4. CONCLUSION

PGE is the only renewable energy development company in North Sulawesi that contributes around 22,5% of total installed capacity (electric power plant) in the North Sulawesi Province. It conducts programs that support environmental management systems such as Utilization The Heat Waste Program on Hot Brine LHD-05 for Geothermal Power Plant Binary Cycle, Bleeding Steam Utilization which uses a Turbo Pump Drive to drain the cellar of the well, Optimization of using NaOH Storage to Reduce Hazardous and Toxic Waste, The Reduced Use of Bottled Water Program, Use produced wastewater as a substitute for fresh water for drilling fluids, and strengthening palm sugar farmers program. These programs create good

synergies to support PGE's business, fulfill electricity needs, bring more benefits to the surrounding community and maintain and even improve the quality of the environment.