Hybrid Power Generation Project Using Biogas and Solar Power

Implementing Entity: Next Energy & Resources Co., Ltd.

1. Project background

In spite of the fact that Palm Oil production is one of the major industries in Indonesian Agri Sector, Palm Oil Mill Effluent (POME) was kept underutilized and methane generation and diffusion is causing environmental issue.
Indonesian Government is targeting to increase utilization of renewable energy up to 51% by 2050, and offering attractive feed in tariff scale for biomass.
Since POME is an attractive feedstock for biomethane production, our Indonesia Partner, PT. Karya Mas Energi (KME) is planning to develop Biogas burned Power Plant within PTPN 4, in order to utilize POME.

2. Objective of the FS

By utilizing renewable biogas and solar energy for electricity generation, the project aims to contribute to the reduction of GHG emissison by reducing methane gas emissiosn from POME and CO2 emissions from fossile fuel based grid connected power plants.

3. Project description:

The Project involves installation of a combined biogas and PV power generation system. The biogas energy recovered from palm oil mill effluent (POME) will be used as energy source to generate electricity for the grid while the PV power will supply electricity for in-house use.

a. Project location

Jawa Maraja Bah Jambi, Simalungun Regency, North Sumatra

b. Indonesian partner(s)

PT KARYA MAS ENERGI

c. Description of the technology

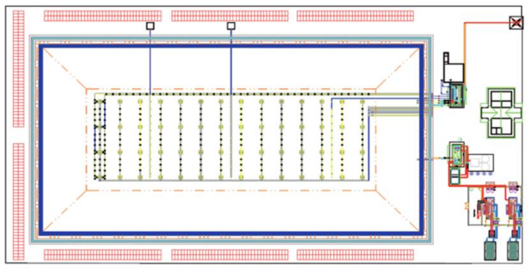
The project activity utilizes an effective and reliable technology to capture lagoon-produced biogas: installing sealed HDPE covers over new anaerobic POME lagoons to create an anaerobic digester system. Each cover will consist of a synthetic high-density polyethylene (HDPE) geo-membrane which is sealed by means of strip-to-strip welding and a peripheral anchor trench dug around the perimeter of the lagoon. The anaerobic digester will be equipped with feeding system, mixing system, sludge management system and treated effluent discharge system.

The produced biogas will be collected and distributed using blowers to biogas treatment system to remove the H2S and water content. The treated biogas will be utilized for a gainful use to generate electricity with biogas engine.

Excess biogas will be be flared in an enclosed flare operating at 500 deg.C to ensure destruction of methane.

State-of-the-art PV cells will be installed around the lagoon to generate electricity for in-house use.

For enhancing project, Next Energy, in collaboration with Japanese engineering services provider, to provide (i) engieering services for optimization and (ii) operation and monitoring support by using state of art remote monitoring and operation system.



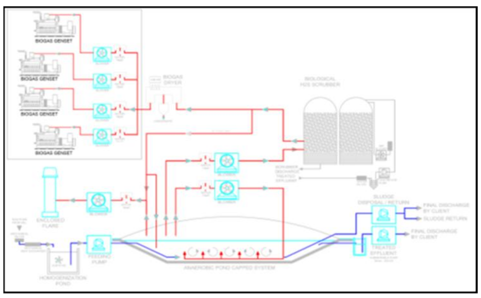
d. Project details

To capture lagoon-produced biogas made from POME.

The produced biogas will be collected and distributed using blowers to biogas treatment system to remove the H2S and water content.

The treated biogas will be utilized for a gainful use to generate electricity (2MW) with biogas engine.

By installing 150kW Solar PV System for self-consumption, maximizing the power supply to the grid.



4. The result of the study

a. Current condition in Indonesia

Although the Indonesian government is rigorously promoting utilization of renewable energy including biogas, its share in the overall energy generation is still small. According to Bioenergy Statistics 2014, the latest version published by Directorate General of New Energy, Renewable and Conservation Energy, Ministry of Energy and Mineral Resources, the accumulative installed capacity of biogas power plants only accounted for 10 MW, all of which is for off-grid use. Considering the total installed capacity in Indonesia is over 50GW, biogas comprises less than 1 %. Even though there are recent additions including on-grid installations of biogas power plants facilitated by the feed-in-tariff scheme that gives preferential price setting for biogas power generators, the biogas power generation is still far from common practice and vast amount of biogas sources, most notably palm oil mill effluents generated from the enormous palm oil sector of Indonesia remain untouched.

b. Regulation(s) and policy(ies) related to the project

As part of the plan to mitigate climate change, the Indonesian government has established a goal to increase the share of renewable energy and energy mix to 51% by 2050. Such action plan is laid out in the Presidential Regulation No. 61 Year 2011 on the National Action Plan for Greenhouse Gas Emission Reduction (RAN-GRK). Implementation of mitigation action plan at the local level is carried out under a Governor Regulation of Local Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK).

In order to promote development of renewable energy, the government has set in place feed-in-tariff (FIT) scheme to provide preferential price setting for various renewable sources including biogas, which is the main source of energy under the proposed project.

c. Role of each participant

Indonesian Participant:
PT KARYA MAS ENERGI: Project developer and owner

Japanese Participants:
Next Energy and Resources Co., Ltd.: Provider of solar PV technology, coordinator of the FS.
Mitsubishi UFJ Morgan Stanley Securities: JCM/MRV consultant

d. Reference scenario setting

As previously mentioned, biogas utilization for electricity generation for grid is not common practice in Indonesia and accordingly, the reference scenario of the methodology that applies to solar-biogas hybrid power generation for grid is CH4 emissions from POME that is left to decay anaerobically in open lagoon system and CO2 emissions from grid-connected power plants.

Reference emissions are calculated as CH4 emissions from POME treatment systems affected by the project activity and CO2 emissions from grid electricity displaced by renewable power generation by the proejct. CH4 emissions from wastewater discharged into river, sea or lake are excluded for the sake of conservativeness in order to secure net emissions reduction.

e. Monitoring methods

The monitoring items and their measurement methods are as follows. An advanced remote monitoring system is being considered for installation.

	Monitoring item	Measurement method
1	Concentration of COD in the wastewater flows in to the system *i* in period *p*	Monthly sampling analysis will be carried out by an external accredited laboratory in accordance to national or international standards through representative samplings. Monthly value will be recorded and annual average will be used for calculation
2	Concentration of COD in the wastewater flows out of the system *i* in the period *p*	Monthly sampling analysis will be carried out by an external accredited laboratory in accordance to national or international standards through representative samplings. Monthly value will be recorded and annual average will be used for calculation
3	Volume of wastewater treated in project wastewater treatment system *i* in period *p*.	Measured continuously (at least hourly measurements are undertaken, if less, confidence /precision level of 90/10 shall be attained). The measured data will be recorded continuously and aggregated monthly for emission calculation.
4	Amount of electricity supplied to grid in period *p*	continuously measurement by project participant
5	Concentration of COD in the wastewater leaving the treatment system in period *p*	Monthly sampling analysis will be carried out by an external accredited laboratory in accordance to national or international standards through representative samplings. Monthly value will be recorded and annual average will be used for calculation

6	Amount of biogas captured by project activity in period *p*	Continuous measurement using an appropriate gas flow meter that includes measurements of temperature and pressure and records values in N m3. Values will be measured continuously and recorded as daily aggregates
7	Amount of biogas recovered in dry basis at normal conditions in period *p*	Continuous measurement using an appropriate gas flow meter that includes measurements of temperature and pressure and records values in N m3. Values will be measured continuously and recorded as daily aggregates
8	Amount of biogas flared in period *p*	Continuous measurement using an appropriate gas flow meter that includes measurements of temperature and pressure and records values in N m3. Values will be measured continuously and recorded as daily aggregates

f. Quantification of GHG emissions and their reductions

Eligibility criteria of the proposed methodology are as follows.

Criterion 1	Biogas is captured through anaerobic digestion of POME which, in the absence of the project activity, is treated by open lagoon system of depth of more than 2 meters.
Criterion 2	Solar-biogas hybrid power generation system is installed to supply electricity to grid and meet in-house electricity demand.
Criterion 3	Final sludge produced by POME treatment is applied to soil.
Criterion 4	Full operation and maintenance service is provided by an engineering company.

GHG emissions are calculated as the difference between reference emissions and project emissions.

Reference emissions calculation

Reference emissions consist of emissions from treatment of POME and electricity generation by grid connected power plants. Emissions from wastewater discharged into sea, lake or river is very minimal in the proposed project and is excluded for the sake of simplicity and conservativeness.

$RE_p = RE_{treament,p} + RE_{elec,p}$

Where:

RE_p	=	Reference emissions in period *p* (t CO_2e)
$RE_{treatment,p}$	=	Reference emissions of the wastewater treatment systems affected by the project activity in period *p* (t CO_2e)
$RE_{elec,p}$	=	Reference emissions from electricity or fuel consumption in period *p* (t CO_2e)

<u>Project emissions calculation</u>

Project emissions consist of the emissions from the POME treatment system not equipped with biogas recover system, emissions from wastewater discharged into sea, lake or river, emissions biogas leaks from the capture system and emissions from incomplete flaring, if any.

$$\mathrm{PE_p} = \mathrm{PE_{treament,p}} + \mathrm{PE_{discharge,p}} + \mathrm{PE_{fugitive,p}} + \mathrm{PE_{flare,p}}$$

Where;

PE_y	=	Project emissions in period *p* (t CO_2e)
$PE_{treatment,p}$	=	Project emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in period *p* (t CO_2e)
$PE_{discharge,p}$	=	Project emissions from effluent discharged into river/sea/lake in period *p* (t CO2e). These emissions shall be calculated uncertainty factor of 1.12
$PE_{fugitive,p}$	=	Project emissions from biogas release in capture systems in period *p* (t CO2e)
$PE_{flare,p}$	=	Project emissions from flaring in period *p* (t CO2e)

Use of default and ex-ante values

The following values will be fixed ex-ante under the proposed methodology.

Parameter	Description of data	Source
$COD_{inflow,i,RS}$	Chemical oxygen demand of the wastewater inflow to the reference treatment system *i* in period *p* (t/m^3).	Measured value
$COD_{outflow,i,RS}$	Chemical oxygen demand of the wastewater outflow to the reference treatment system *i* in period *p* (t/m^3).	Measured value
$MCF_{treatment,RS,i}$	Methane correction factor for reference wastewater treatment systems *i*. (0.8)	Default value based on IPCC 2006
B_o	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)	Default value based on IPCC 2006
UF_{RS}	Model correction factor to account for model uncertainties (0.89)	Default value based on SBSTA2003
GWP_{CH4}	Global Warming Potential of methane (21)	Default value based on IPCC Fourth Assessment Report: Climate Change 2007
$EF_{grid,p}$	CO2 emission factor of grid in period *p* (tCO2/MWh) (0.698)	Default value based on official informaitno of Directorate General of Electricity, MEMR Indonesia, 2015
$MCF_{treatment,PJ}$	Methane correction factor for wastewater treatment systems *i* affected by project activity not equipped with biogas recovery. (0.1)	Default value based on IPCC 2006
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)	Default value based on SBSTA2003
$MCF_{discharge,PJ}$	Methane correction factor for reference wastewater treatment systems *i*. (0.1)	Default value based on IPCC 2006

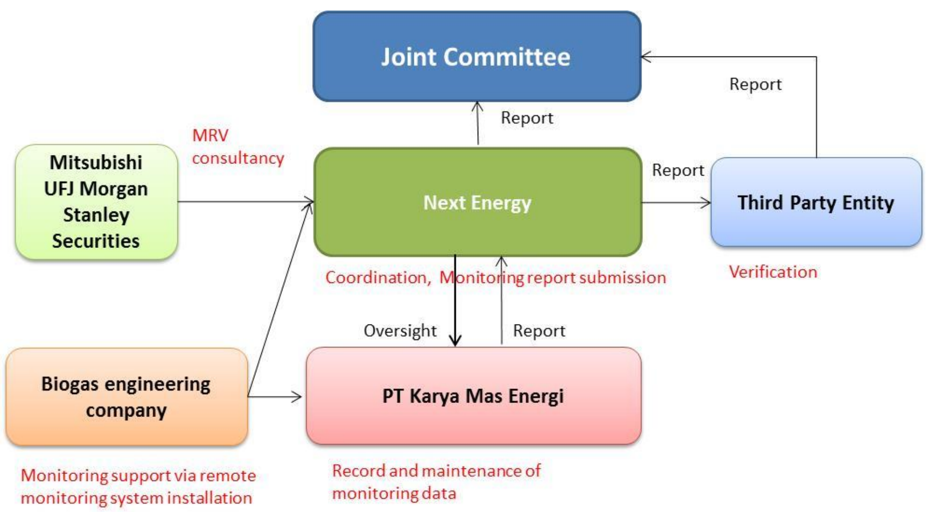
CFE	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (0.9)	Default value based on AMS.III-H
$\eta_{flare,m}$	Flaring efficiency (0.9)	Default value based on CDM Methodological Tool "Project emission from flaring (Version 2.0.0)"
$fv_{CH4,RG}$	fraction of methane in the residual gas on a dry basis (0.55)	Supplier's information
$\rho_{CH4,n}$	Density of methane at normal conditions (0.716kg/m3)	Default value based on CDM Methodological Tool "Project emission from flaring (Version 2.0.0)"
$SPEC_{flare}$	Manufacturer's flare specifications for temperature and flow rate	Flare manufacturer

Emissions reduction of the project activity

	Reference emissions	Project emissions	Emissions reduction
Annual (tCO2/year)	64,617	6,877	57,739
15 year project period (tCO2/15-years)	969,255	103,155	s866,085

g. MRV methods

The proposed MRV structure is as follows.

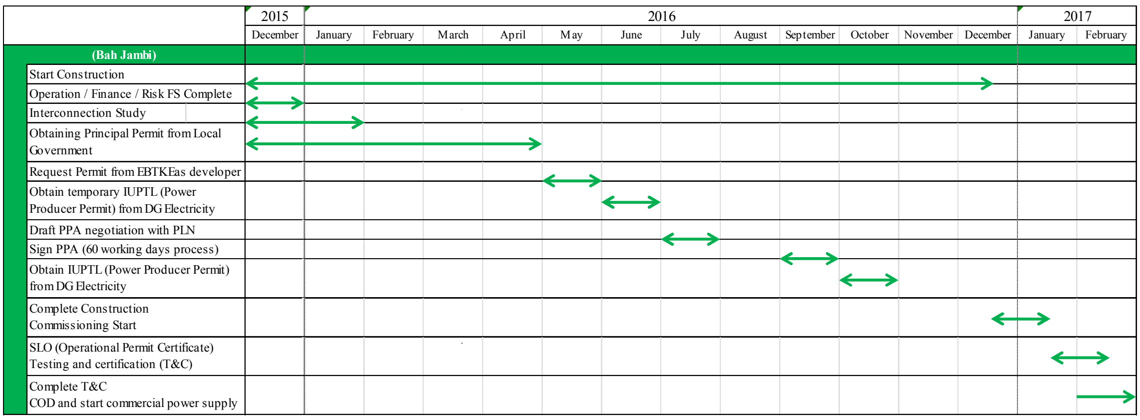


h. Scale of investment & financial viability

i. Contribution to Indonesian Sustainable Development

Wastewater from palm oil mill is commonly treated by the anaerobic lagoon system where methane gas releases greenhouse gas into atmosphere with no recovery of energy. The proposed project will greatly contribute the sustainable development of Indonesia by two ways. Firstly, the treatment of wastewater from one of Indonesia's most important economic sectors by the state-of-art technology leads to reduction of not only greenhouse gas emissions but also odor and other environmental hazards. Secondly, by recovering biogas for energy use, it creates renewable source of energy for grid that is currently largely dependent on fossil fuel.

j. Proposed implementation schedule



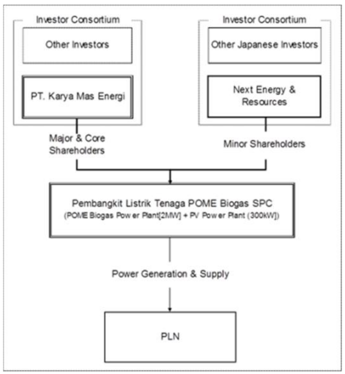
k. Capacity building to the host country

Next Energy, in collaboration with Japanese engineering services provider, will keep involving the operation and maintenance, through implementation of Remote Monitoring System.

Next Energy will also transfer its knowledge for PV Plant construction as well as necessary operation and maintenance to the Indonesian partner.

5. Conclusion and Next Steps

We are proposing contribution from Japan, not only for the Engineering point of view, but also Financial point of view, including possible equity investment by ourselves.



We are aiming to finalize negotiation with KME by the end of March, in order to be prepared for application of JCM subsidy in coming fiscal year.