CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

PT. BUDI ACID JAYA Tapioca Starch Production Facilities Effluent Methane Extraction And On-site Power Generation Project in Lampung Province, Republic of Indonesia ("The Project" or "the Project activity")

Version 02

27 April 2007

A.2. Description of the project activity:

The Project activity involves the installation of a closed anaerobic wastewater treatment and biogas extraction system at an existing tapioca starch manufacturing plant and its auxiliary facilities for treatment of organic wastewater, which is currently treated at an open lagoon based system. The collected biogas will be utilized for electricity generation which will be used on-site. By extracting and utilizing biogas, the Project activity will reduce the CH_4 emissions that would have otherwise been emitted from the existing open lagoons. The electricity generated with biogas by the Project activity will displace carbon intensive electricity of the South Sumatran grid as well as the diesel based captive generation and will additionally reduce GHG emissions.

The project developer PT. BUDI ACID JAYA (hereafter referred to as BAJ) is the largest tapioca starch producer in Indonesia. BAJ plans to install Upflow Anaerobic Sludge Blanket (UASB) digesters, a high rate anaerobic digestion technology for wastewater treatment, at WAY ABUNG, which is one of its sixteen tapioca starch facilities located in Lampung Province in the southern part of the Sumatra Island in Indonesia. WAY ABUNG plant produces tapioca starch and associated products (i.e. glucose and citric acid) from tapioca residues. The facilities are currently capable of producing 450 tons of tapioca starch, 60 tons of glucose, and 30 tons of citric acid daily. The operation of these facilities results in approximately 16,900 m^3/day of wastewater with high organic content. All wastewater from the production processes is currently treated at an open anaerobic lagoon system prior to its release into the adjacent river system. The existing system meets the effluent regulatory standards for the tapioca industry in Indonesia.

In the Project activity, the organic wastewater from WAY ABUNG plant is sent to anaerobic digesters prior to being discharged into the existing open anaerobic lagoon treatment system. Anaerobic digestion consistently generates methane-rich biogas. Generated biogas is collected and utilized as fuel for electricity generation and surplus biogas is flared in the Project. The generated electricity will supply WAY ABUNG plant's electricity demand, replacing carbon intensive electricity imported from the grid[1] as well as the diesel based captive power generation. The Project initially plans to install five biogas engine generators with capacity of 1.0 MW each or total generation capacity of 5.0 MW. Depending on the actual biogas generation, the project developer may expand the generation capacity up to 8.0 MW by installing three additional 1.0 MW generators.

[1] The project activity replaces electricity imported from South Sumatra, West Sumatra and Riau electricity grid (SSWSR grid).

The amount of greenhouse gases (GHGs) emission reductions resulting from the Project activity is expected to be approximately 270,000 tCO_2e per annum.

The Project activity will directly contribute to sustainable development of Indonesia in several ways as shown below.

Environmental benefits
- Mitigation of uncontrolled GHG emission from the lagoons.
- Mitigation of unpleasant odor caused by treatment of high strength organic wastewater at open lagoons.

Economical benefits
- Utilization of biogas as a new indigenous fuel source in Indonesia.
- Access to foreign expertise and training to facilitate smooth technology transfer.
- Access to overseas capital through the sale of CERs.

Social benefits
- Creation of new jobs for local population.
- Staff training to improve their technical skills.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party/country: Indonesia (host)	**PT. BUDI ACID JAYA (BAJ)**	**No**
Party/country: Japan	**SUMITOMO Corp.**	**No**
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

SUMITOMO Corp, who is a project participant, is the contact for this Project activity (See Annex 1 for contact details).

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Indonesia

A.4.1.2. Region/State/Province etc.:

Lampung Province, Sumatra Island

A.4.1.3. City/Town/Community etc:

Desa Gunung Batin, Terusan Nunyai, Lampung Tengah

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Project activity will be located on the premises of BAJ Way Abung factories, located in the village of Desa Gunung Batin in the central part of Lampung Province in the southern part of Sumatra, Indonesia. Its physical address is as follows:
Divisi Tapioca JL. Raya Way Abung Km 105 Desa Gunung Bain Udik Kecamatan Terusan Nunyai Lampung Tengah

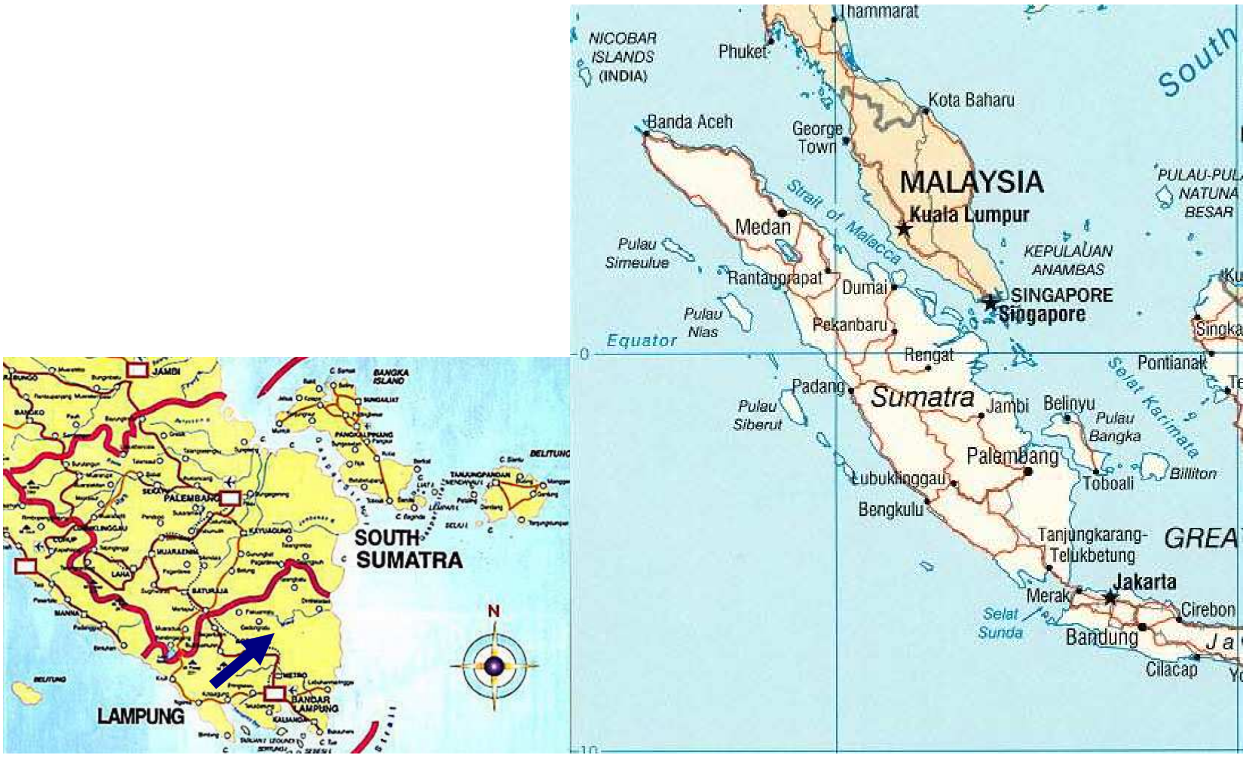

Figure 1: Location map of proposed project activity

A.4.2. Category(ies) of project activity:

Sectoral scope 13: Waste handling and disposal

A.4.3. Technology to be employed by the project activity:

The technology to be implemented by the Project activity is an Upflow Anaerobic Sludge Blanket (UASB) system. Developed in the late 1970's, it is an internationally recognized "high rate" anaerobic treatment technology known for its effectiveness in the treatment of high strength organic wastewater from such operations as food processing and distillery. The UASB system is supplied by a Thai engineering company, Papop Co., Ltd. Since it has started its business in 1997, it has accumulated know-how and experiences in construction of biogas production and utilization system.

In the UASB process, wastewater flows upward through a sludge blanket composed of microorganisms that naturally form granules or particles of 0.5 to 2 mm in diameter ("sludge granules"). When wastewater comes in contact with the granules, anaerobic decomposition of the organic material contained in the wastewater takes place, resulting in the generation of methane-rich biogas. The hydraulic turbulence caused by produced biogas bubbles provides mixing to the digester. The high sedimentation velocity of biological granules formed in the digester prevents washout of the sludge granules, leading to longer sludge retention time in the digester.

Through the utilization of this advanced technology, the Project will be able to achieve approximately 90% removal of COD, significantly reducing the COD load to the open lagoons, which subsequently receive effluent from the UASB digester.

Extracted biogas will be forwarded from a gasholder to biogas engine generators for electricity generation. A set of gas engines supplied by a Spanish company, GUASCOR is installed for biogas applications. On GUASCOR engines, load carburetion, speed and load are electrically self-controlled, so the engines can operate at constant and limited emissions in spite of variation. A computerised module provides readouts of the spark plugs condition or allows ignition advance to be adjusted through external signals.

To combust the excess biogas, a flare system is installed. The flare system is supplied by a Thai company, Patchara Automatic Control Ltd. It is an enclosed type flare system. Enclosure height and diameter are 15m and 2.9 m, respectively. Enclosure material is made of carbon steel with ceramic fiber and/or refractory insulation which are covered by expansion stainless steel sheers. The biogas flow rate of the flare system is 2,500 m^3/hr at 250 mBar, with minimum flow rate of 600m^3/hr. Operating pressure is 100 ~ 250 mBar. Flaring starts automatically when biogas reach high pressure setting and stop automatically when biogas pressure drops to low pressure setting.

Due to the Project activity, no additional sludge will be generated. Sludge generated during the wastewater treatment process will be treated by land application, same as before the implementation of the project activity.

The planned treatment system is illustrated in the flow chart shown in Figure 2 below.

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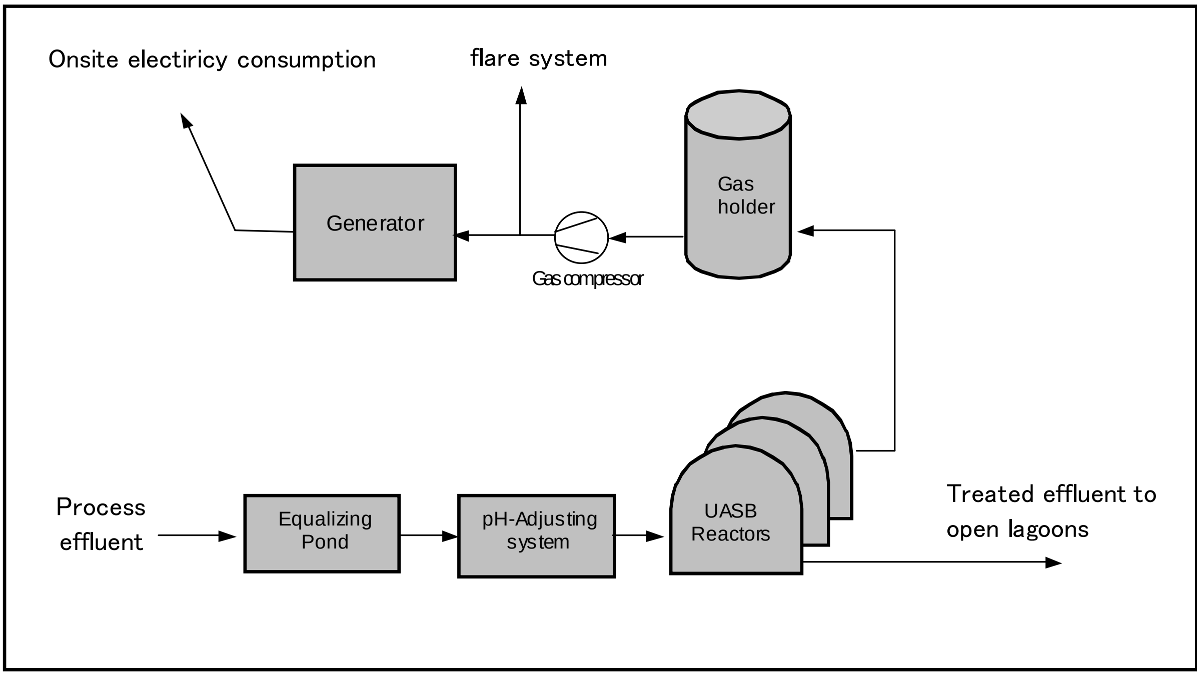

Figure 2: Process Flow Diagram

With the adoption of a UASB system, flow regime of the wastewater will be changed, as some of the existing lagoons will not be used after the Project is implemented. These changes will be reflected in the calculation of emission reductions. Details of the existing lagoon system and its changes are described in the Annex 3.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
Year 1 (Sept 2007 – Aug2008)	271,436
Year 2 (Sept 2008 – Aug 2009)	271, 436
Year 3 (Sept 2009 – Aug 2010)	271, 436
Year 4 (Sept 2010 – Aug 2011)	271, 436
Year 5 (Sept 2011 –Aug 2012)	271, 436
Year 6 (Sept 2012 – Aug 2013)	271, 436
Year 7 (Sept 2013 – Aug 2014)	271, 436
Total estimated reductions (tonnes of CO_2 e)	1,900,052
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	271, 436

A.4.5. Public funding of the project activity:

The Project will receive partial capital cost funding from New Energy and Industrial Technology Development Organization (NEDO), an administrative agency incorporated under Japan's Ministry of Economy, Trade and Industry. Funding from NEDO, though public, is not counted as part of Japan's official development assistance.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

The approved baseline and monitoring methodology applied to the Project activity is:

Avoided wastewater and on-site energy use emissions in the industrial sector – version04 (AM0022 version 04)

The tool used for the determination of project emissions from flaring gases is:

Methodological tool to determine project emissions from flaring gases containing methane

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

AM0022 version 04 has been chosen because the Project activity involves the installation of an anaerobic treatment system in an existing open lagoon-based wastewater treatment facility and meets all the applicability conditions stated in the baseline methodology as follows:

- Project is implemented in existing lagoon-based industrial wastewater treatment facilities for wastewater with high organic loading;

The Project is implemented in an existing lagoon-based industrial wastewater treatment facility in a tapioca starch manufacturing plant. The wastewater in the Project plant treats high organic loading materials (compounds).

- The organic wastewater contains simple organic compounds (mono-saccharides). If the methodology is used for wastewater containing materials not akin to simple sugars a CH_4 emissions factor different from 0.21 kgCH_4/kgCOD has to be estimated and applied;

The primary organic compound contained in the cassava processing wastewater is starch, which is a poly-saccharide, a more complex organic compound compared to mono-saccharide. As the baseline methodology stipulates, an alternative CH_4 emission factor is estimated and applied for the project activity. The maximum CH_4 producing capacity (B_0), 0.21 kg CH_4/kg COD, stated in approved baseline methodology AM0013 "Avoided methane emissions from organic waste-water treatment" is selected for the Project. As discussed in AM0013, this value is based on the default IPCC value for B_0, 0.25 kg CH_4/kg COD, taking account of the 50 – 100% uncertainty range, and it is applicable to all organic wastewater types. Considering the fact that this value has been established as the result of comprehensive discussions among the methodology panel as well as the CDM Executive Board, it is a conservative and transparent approach for the project participant to adopt this value for the methane emission factor. The choice of this value is also justified by the research[2] conducted for the tapioca starch wastewater. According to the results from the research, CH_4 emissions factor is estimated as a range of 0.22 ~ 0.24 kgCH_4/kgCOD. The selected value of 0.21 kgCH_4/kgCOD for CH_4 emission factor is lower than the lowest range of the results from the research.

- The methodology is applicable only to the improvement of existing wastewater treatment facilities. It is not applicable for new facilities to be built or new build to extend current site capacity;

The Project activity only aims to the improvement of the existing lagoon based wastewater treatment system. There is no need for BAJ to build new wastewater treatment system since the existing system can treat the wastewater to meet the discharge standard of Indonesia.

- It can be shown that the baseline is the continuation of a current lagoon system for managing wastewater. In particular, the current lagoon based system is in full compliance with existing rules and regulations;

As described in section B. 4 below, the baseline is the utilization of the current lagoon system for managing wastewater. Also, the current lagoon based system is in full compliance with existing rules and regulations of the Republic of Indonesia[3]. At present, BAJ is discharging its final effluent, which is from the existing lagoon based wastewater treatment system, to the adjacent river. The COD out from the lagoon system is lower than 250 mg/liter, which is the discharge standard for the tapioca industry.

- The depth of the anaerobic lagoons should be at least 1m;

The designed depth of the anaerobic lagoons varies from 3.4 m to 6 m. Actual depth of the wastewater in the lagoons varies from 2.4 m to 5.7 m.

- The temperature of the wastewater in the anaerobic lagoons is always at least 15℃;

Annual minimum temperature of the wastewater in the anaerobic lagoon is approximately 30 ℃.

- In the project, the biogas recovered from the anaerobic treatment system is flared and/or used on-site for heat and/or power generation, surplus biogas is flared;

The Project utilizes the biogas recovered from the UASB system for power generation and surplus biogas is flared.

- Heat and electricity needs per unit input of the water treatment facility remain largely unchanged before and after the project;

While there is no heat and electricity needs for wastewater treatment using the existing lagoon based treatment system, the new wastewater treatment system using anaerobic digesters needs to consume a

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[2] Ajit P. Annachhatre and Prasanna L. Amatya (2000), "UASB Treatment of Tapioca Starch Wastewater", Journal of Environmental Engineering, December 2000, 1149 ~ 1152

[3] Ministerial Decree No. KEP-51/MENLH/10/1995: Liquid Waste Quality Standards for Industrial Activities

small amount of electricity. It is expected to use 3,223 MWh of electricity annually to treat approximately 5,920,000 m^3 of wastewater, which means that approximately 0.56 kWh of electricity is needed to treat 1 m^3 of wastewater. Not only the required amount of electricity for wastewater treatment is relatively small, but also the electricity required will be produced by the Project activity. Therefore, it can be considered that the energy needs per unit input of the water treatment facility remain largely unchanged before and after the Project.

- Data requirements as laid out in the related Monitoring Methodology are fulfilled. In particular, organic materials flow into and out of the considered lagoon based treatment system and the contribution of different removal processes can be quantified (measured or estimated)

As described in section B.7 below, data requirements will be fulfilled. Organic materials flow into and out of the considered lagoon based treatment system and the contribution of different removal processes will be measured and quantified.

The baseline methodology will be used in conjunction with the approved monitoring methodology AM0022 version04.

B.3. Description of how the sources and gases included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	CH_4 emissions from the open lagoon	CO_2	Excluded	Originating from a biogenic source, considered carbon neutral
		CH_4	Included	Main GHG emission source
		N_2O	Excluded	Negligible
	On site CO_2 emissions from fossil fuel displaced by biogas	CO_2	Included	Main GHG emission source
		CH_4	Excluded	Negligible
		N_2O	Excluded	Negligible
	Grid CO_2 emissions from fossil fuel displaced by biogas	CO_2	Included	Main GHG emission source
		CH_4	Excluded	Negligible
		N_2O	Excluded	Negligible
Project Activity	CH_4 emissions from the open lagoon	CO_2	Excluded	Originating from a biogenic source, considered carbon neutral
		CH_4	Included	Main GHG emission source
		N_2O	Excluded	Negligible
	CH4 emissions from the new wastewater treatment facility	CO_2	Excluded	Originating from a biogenic source, considered carbon neutral
		CH_4	Included	Main GHG emission source
		N_2O	Excluded	Negligible
	CH4 emissions from inefficient combustion and leaks	CO_2	Excluded	Originating from a biogenic source, considered carbon neutral
		CH_4	Included	Main GHG emission source

		N_2O	Excluded	Negligible

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

As per the baseline methodology, the baseline determination follows a six-step process below.

Step 1: List a range of potential baseline options
Step 2: Select the barriers from the range of potential barriers
Step 3: Score the barriers
Step 4: Compare which is the most plausible baseline option
Step 5: Investment Analysis
Step 6: Conclusion

Step 1: List a range of potential baseline options

Following alternatives are considered as potential baseline scenarios.

Alternative 1: Continuation of the current situation
Alternative 2: The Project is undertaken without CDM assistance. (Anaerobic digestion system)
Alternative 3: Aerobic wastewater treatment system (activated sludge or filter bed treatment)
Alternative 4: Direct release of wastewater to a nearby water body

Step 2: Select the barriers from the range of potential barriers

The following barriers that may prevent the implementation of the considered alternatives are selected.

1. Legal barriers
2. Technical barriers
3. Financial barriers
4. Social barriers
5. Business culture barriers

Step 3: Score the barriers

Each barrier selected in Step 2 is scored by addressing a range of potential questions.

1. Legal barrier

- Does the practice violate any host country laws or regulations or is it not in compliance with them?

At present in Indonesia there are no regulatory or contractual requirements which enforce implementation of a specific wastewater treatment technology such as anaerobic digester or aerobic treatment system to cassava processing plants for effluent treatment. Current Indonesian law allows utilization of open lagoon systems for wastewater treatment in tapioca industry. BAJ currently meets the industrial effluent discharge standards for the tapioca industry by utilizing the existing open lagoon based wastewater treatment system. Therefore, alternative 1 does not face any legal barriers.

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Since alternative 2 and 3 improve the wastewater treatment system and do not violate any laws or regulations in Indonesia, they also do not face legal barriers.

Direct release of starch processing wastewater to water bodies without further treatment will result in violation of the effluent discharge standards set by the laws and regulations of Indonesia. Therefore, Alternative 4 cannot be considered the baseline and is excluded from further assessment.

2. Technical barrier

- Is this technology option currently difficult to purchase through local equipment suppliers?
- Are skills and labor to operationalize and maintain this technology in country insufficient?
- Is this technology outside common practice in similar industries in the country?
- Is performance certainty not guaranteed within tolerance limits?
- Is there real, or perceived, technology risk associated with the technology?

Alternative 1 has been a common way of handling wastewater from tapioca starch production in Indonesia. In Lampung province, most of the tapioca starch production facilities utilize open lagoon based systems for treating wastewater. The related technology, skills and labor are readily available in Indonesia and there are few risks associated with this technology. Therefore, Alternative 1 dose not face technical barriers.

At present in Lampung province, only a few tapioca starch processing facilities adopt anaerobic bioreactor technology for wastewater treatment. Since the related technology, such as UASB digesters, generators are not available domestically, BAJ decided to adopt foreign technology which has reliable track records. Even though BAJ is the largest tapioca starch produce in Indonesia, it only relies on the lagoon based wastewater treatment system at its 16 facilities in Indonesia. Most of other starch producers are also using lagoon treatment system for wastewater treatment. Due to such practice, not only in BAJ, but also in Indonesia, skills and labor to operationalize and maintain the new wastewater treatment system properly is not sufficient. These facts can entail significant performance and technology risks in effluent treatment. Therefore, Alternative 2 faces strong technical barriers.

Similar technical barriers are also applied to an aerobic wastewater treatment system. As mentioned above, most of the starch producers are using lagoon based wastewater treatment system in Indonesia. Aerobic treatment system is not common practice in starch produce industry in Indonesia and starch producers including BAJ can have difficulties in operating and maintaining the system properly due to the lack of experiences and knowledge. Also considering the high organic load of the starch wastewater, there could be strong performance uncertainty in applying this technology in starch industry. Therefore, Alternative 3 also faces strong technical barriers.

3. Financial barrier

- Is the technology intervention financially less attractive in comparison to other technologies (taking into account potential subsidies, soft loans or tax windows available)?
- Is equity participation difficult to find locally?
- Is equity participation difficult to find internationally?
- Are site owners/ project beneficiaries carrying any risk?
- Is technology currency (country) denomination a risk?

- Is the proposed project exposed to commercial risk?

At present, BAJ is utilizing open lagoon based system. Therefore, Alternative 1 does not face any financial barriers.

Compared with the current practice, both anaerobic digesters and aerobic treatment systems entail high initial and O&M costs. BAJ does not plan to install anaerobic digesters or an aerobic treatment system at its own capital because the existing wastewater treatment system fulfills all regulatory requirements for industrial wastewater discharge in Indonesia. The feasibility study conducted before the implementation of the Project activity investigated the financial attractiveness of the Project activity. In the feasibility study, two scenarios for anaerobic treatment system were considered[4]. However, without the additional benefit from CDM, it is concluded that the continuation of the current practice is the best option for BAJ considering the capital needs for the expansion of its main business. Due to this reason, it is difficult for BAJ to find local/ international equity investor.

The interest shown by Sumitomo Corporation (Japan) and partial capital cost funding from NEDO are contingent on the Project being implemented as a CDM activity. The Project site owner and the Project beneficiaries will face the risk of introducing a completely new technology. Based on the above arguments, it is concluded that Alternatives 2 and 3 face a significant financial barrier.

4. Social barrier

- Is the understanding of the technology low in the host country/ industry considered?

Since Alternative 1 is currently used at the Project site and is common practice in Indonesia, no social barriers are identified.

Alternative 2 and 3 face certain social barriers associated with the low understanding of the technology. However, it is expected that these barriers can be overcome through the public meetings and public awareness promotion campaigns.

5. Business Culture barrier

- Is there reluctance to change to alternative management practices in the absence of regulations?

As mentioned above, Alternative 1 is currently used for wastewater treatment and meets all regulatory requirements of Indonesia. Therefore there is no barrier caused by the change of the management practice.

As for Alternatives 2 and 3, in the absence of regulations that require installation of anaerobic digesters or aerobic treatment systems, BAJ would not have any incentive to change the effluent treatment system due to the technology and financial barriers mentioned above. Furthermore, BAJ has no experience in managing anaerobic digestion or aerobic treatment system. Therefore there are significant business culture barriers associated with the change of the management practices.

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[4] IRRs of each option are 1.44% and 6.61%, respectively. Financial analysis for aerobic treatment system is not conducted. However, without any revenue from aerobic treatment system, it is obvious the IRR of aerobic treatment system is much lower than the other options. The IRR calculation is provided in the separate document.

Summary of Barrier Analysis

The table bellow summarizes the results of the barrier analysis conducted above.

Table 1: Summary of Barrier Analysis

Barrier Tested / **Plausible Baseline Alternative**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Legal	**N**	**N**	**N**	**Y**
• Does the practice violate any host country laws or regulations or is it not in compliance with them?	N	N	N	Y
Technical	**N**	**Y**	**Y**	**-**
• Is this technology option currently difficult to purchase through local equipment suppliers?	N	Y	Y	-
• Are skills and labour to operationalize and maintain this technology in country insufficient?	N	Y	Y	-
• It this technology outside common practice in similar industries in the country?	N	Y	Y	-
• Is performance certainty not guaranteed within tolerance limits?	N	Y	Y	-
• Is there real, or perceived, technology risk associated with the technology?	N	Y	Y	-
Financial	**N**	**Y**	**Y**	**-**
• It the technology intervention financially less attractive in comparison to other technologies (taking into account potential subsidies, soft loans or tax window available)?	N	Y	Y	-
• It equity participation difficult to find locally?	N	Y	Y	-
• Is equity participation difficult to find internationally?	N	Y	Y	-
• Are site owners/ project beneficiaries carrying any risk?	N	Y	Y	-
• Is technology currency (country) denomination risk?	N	N	N	-
• Is the proposed project exposed to commercial risk?	N	N	N	-
Social	**N**	**N**	**N**	**-**
• Is the understanding of the technology low in the host country/ industry considered?	N	N	N	-
Business Culture	**N**	**Y**	**Y**	**-**
• Is there a reluctance to change to alternative management practices in the absence of regulation?	N	Y	Y	-

<u>Step 4: Compare which is the most plausible baseline option</u>

As discussed above, Alternative 1, continuation of the current situation, does not have any significant barriers while Alternative 2, anaerobic digestion system, and Alternative 3, aerobic treatment system, face insurmountable technical, financial and business culture barriers, which prevent the implementation of these alternatives. Therefore, Alternative 1, continuation of the current situation, is considered to be the most plausible baseline scenario.

Step 5: Investment analysis

Since there is only one baseline option, this step is not required by the baseline methodology.

Step 6: Conclusion

Based on the above arguments, continuation of the current open lagoon based wastewater treatment system is the baseline scenario in the absence of the CDM project activity.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

As per AM0022, the Project is additional because the baseline scenario is different from the proposed Project activity. In the absence of the project activity, effluent from the plant will continue to be treated by the existing open lagoon system, emitting a large amount of methane into the atmosphere.

As per the "Specific guideline for completing the Project Design Document (CDM-PDD)", it is required to provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the Project activity since the starting data of the Project activity is before the date of validation.

Before the implementation of the Project activity, feasibility study was conducted by project participants to investigate the eligibility of the Project activity as a CDM project activity in 2005. The feasibility study shows that the Project activity is difficult to be implemented without additional benefits from CDM. Based on the results of the feasibility study, Sumitomo Corporation and BAJ have contracted "Joint Implementation Agreement" to proceed the Project activity as a CDM project activity on 16th February, 2006. The feasibility study and Joint Implement Agreement will be submitted to DOE for validation.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

In order to quantify emission reductions achieved by the project activity, procedures to calculate project emissions, baseline emissions, leakage and emission reductions set out in the methodology are applied as follows.

Project emissions

Total estimated project emissions are the sum of fugitive methane emissions from the existing lagoon based wastewater treatment system, possible methane emissions from the new anaerobic wastewater treatment facility, from incomplete biogas combustion and biogas leaks.

As per the procedures set out in AM0022 version 04, total project emissions are estimated using the following equations.

$$E_{project} = E_{CH4\_lagoons} + E_{CH4\_NAWTF} + E_{CH4\_IC+Leaks} \qquad (1)$$

where:

$E_{project}$ is the Total Project Emissions (tCO_2e)

$E_{CH4\_lagoons}$ is the fugitive methane emissions from lagoons (tCO_2e)

E_{CH4_NAWTF} is the fugitive methane emissions from the new anaerobic wastewater treatment facility (tCO_2e)

$E_{CH4\_IC+Leaks}$ is the methane emissions from inefficient combustion and leaks (tCO_2e)

The calculations for each component of equation (1) are provided below.

1) Fugitive Methane Emissions from Lagoons ($E_{CH4\_lagoons}$)

The digester effluent is discharged into lagoons where it is further treated prior to its release into the adjacent river system. While the removal of residual COD in lagoons is expected to occur under aerobic conditions, Fugitive Methane Emissions from Lagoons are calculated as follows:

$$E_{CH4\_lagoons} = M_{lagoon\_anaerobic} \cdot EF_{CH4} \cdot GWP_{CH4} / 1000 \qquad (2)$$

where:

$M_{lagoon\_anaerobic}$ is the amount of organic material removed by anaerobic processes in the lagoon system (kgCOD)

EF_{CH4} is the methane emission factor ($kgCH_4/kgCOD$). 0.21kg $CH_4/kgCOD$ of COD to Methane conversion factor is used.

GWP_{CH4} is the Global Warming Potential of methane (GWP_{CH4}= 21)

Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic}$)

$$M_{lagoon\_anaerobic} = M_{lagoon\_tatal} - M_{lagoon\_aerobic} - M_{lagoon\_chemical\_ox} - M_{lagoon\_deposition} \qquad (3)$$

where:

M_{lagoon_total} is the total amount of organic material removed in the lagoon system from equation (5) (kg COD)

$M_{lagoon\_aerobic}$ is the amount of organic material degraded aerobically in the lagoon system (kg COD). Surface aerobic losses of organic material in pond-based systems equal to 254kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processes.

$M_{lagoon\_chemical\_ox}$ is the amount of organic material lost through chemical oxidation in the lagoon system (kg COD).

$M_{lagoon\_deposition}$ is the amount of organic material lost through deposition in the lagoon system from equation (6) (kg COD)

Amount of organic material removed in the lagoon system (M_{lagoon_total})

$$M_{lagoon\_total} = M_{lagoon\_input} \cdot R_{lagoon} \quad (5)$$

with $M_{lagoon\_input} = M_{input\_total} \cdot (1 - R_{NAWTF})$ (4)

where:

M_{lagoon_input} is the input of organic material from the new project anaerobic wastewater treatment facility into the lagoon system (kg COD)

R_{lagoon} is the total organic material removal ratio of the lagoon. It is a project specific factor, and is equal to the proportion of organic material removed (through all route) within the boundaries of the lagoon system under consideration.

M_{input_total} is the total amount of organic material fed into the new project wastewater treatment facility (kg COD)

R_{NAWTF} is the total organic material removal efficiency of the new project wastewater treatment facility. Manufacturer’s estimate of 90% is used as a project specific value.

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic}$)

The amount of organic material degraded aerobically in the lagoon system is calculated as the product of default value of surface aerobic losses of organic material in pond (254 kg COD/ha/day), total surface area of the lagoons (23.32 ha) and number of days in a year (365 days).

As per the methodology, sensitivity analysis was conducted in order to determine the effect of change in the surface aerobic loss of COD to the emission reductions. The results of the sensitivity analysis is described in the Annex 3.

Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox}$)

Throughout the feasibility study, it is found that there exists small amount of SO_4^{2-} in the wastewater. The amount of SO_4^{2-} in the wastewater is approximately 71mg/l. The losses of chemical oxidation demand through chemical oxidation will be accounted in the emission reductions calculation.

Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition}$)

$$M_{lagoon\_depositionl} = M_{lagoon\_input} \cdot R_{deposition} \quad (6)$$

where:

$R_{deposition}$ is the organic material deposition ratio of the lagoon.

A series of experiment shows that approximately 2.27% of chemical oxygen demand is lost through sedimentation. The details of the experiment are described in the Annex 3.

2) Methane emissions from new anaerobic wastewater treatment facility (E_{CH4_NAWTF})

Methane emissions from the specific anaerobic wastewater treatment facilities that are installed by the Project, are assessed and estimated based on monitoring measurements, technology supplier data and expert estimates. They may be disregarded if documented evidence for their insignificance is given.

The technology provider, PAPOP CO., LTD., has estimated based on their experience that the physical leakage from UASB system is less than 1% for systems with size similar to the project activity. To ensure conservativeness, physical leakage factor of 1% of total biogas production is used for the Project activity.

3) Methane emissions from inefficient combustion emissions ($E_{CH4\_IC+Leaks}$)

The Project activity only involves on site electricity generation and excess biogas flaring. Therefore, methane emissions from inefficient combustion emissions are calculation as follows:

$$E_{CH4\_IC+Leaks} = V_{el} \cdot C_{CH4\_el} \cdot (1 - f_{el}) \cdot GWP_{CH4} + PE_{flare} \quad (7)$$

where:

$E_{CH4\_IC+Leaks}$ is the methane emissions from inefficient combustion (t CO_2e)
V_{el} is the biogas combustion process volume in electricity generation (Nm^3)
C_{CH4_el} is the methane concentration in biogas to be measured on wet basis (tCH_4/Nm^3)[5].
f_{el} is the proportion of biogas destroyed by electricity generation set

[5] Though not specified in the baseline methodology, it is calculated using CH_4 density of 0.7168 kg CH_4/Nm^3 CH_4 at standard temperature and pressure (0 degree Celsius and 1,013 bar) as per ACM0001ver.05 and biogas methane concentration monitored during the project activity.

PE_{flare} is the project emissions from flaring of the residual gas stream (tCO_2e) calculated following the procedures described in the "Tool to determine project emissions from flaring gases containing Methane" (flaring tool).

Among the options for flaring systems, enclosed flare system is chosen by the project participants. For the determination of the flare efficiency, default value will be used for the calculation of project emissions from flaring gases. Following steps and equations from the flaring tool are used to determine the project emissions from flaring of the residual gas stream.

Step 1: Determination of the mass flow rate of the residual gas that is flared

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h}$$

where:

$FM_{RG,h}$	Mass flow rate of the residual gas in hour h (kg/h)
$\rho_{RG,n,h}$	Density of the residual gas at normal conditions in hour h (kg/m^3)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h (m^3/h)

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$$

where:

$\rho_{RG,n,h}$	Density of the residual gas at normal conditions in hour h (kg/m^3)
P_n	Atmospheric pressure at normal condition (101325 Pa)
R_u	Universal ideal gas constant (8314 $Pa.m^3/kmol.K$)
$MM_{RG,h}$	Molecular mass of the residual gas in hour h (kg/kmol)
T_n	Temperature at normal condition (273.15 K)

$$MM_{RG,h} = \sum_i (fv_{i,h} \times MM_i)$$

where:

$MM_{RG,h}$	Molecular mass of the residual gas in hour h (kg/kmol)
$fv_{i,h}$	Volumetric fraction of component i in the residual gas in the hour h
MM_i	Molecular mass of residual gas component i
i	The components CH_4, CO, CO_2, O_2, H_2, N_2

Step 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}}$$

where:

$fm_{j,h}$	Mass fraction of element j in the residual gas in hour h

$fv_{i,h}$	Volumetric fraction of component i in the residual gas in the hour h
AM_j	Atomic mass of element j (kg/kmol)
$NA_{j,i}$	Number of atoms of element j in component i
$MM_{RG,h}$	Molecular mass of the residual gas in hour h (kg/kmol)
j	The elements carbon, hydrogen, oxygen and nitrogen
i	The components CH_4, CO, CO_2, O_2, H_2, N_2

Step 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is skipped since default value will be used for the determination of the methane combustion efficiency of flare.

Step 4: Determination of methane mass flow rate in the exhaust gas on a dry basis

This step is skipped since default value will be used for the determination of the methane combustion efficiency of flare.

Step 5: Determination of methane mass flow rate in the residual gas on a dry basis

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

where:

$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h (kg/h)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h)
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour h
$\rho_{CH4,n}$	Density of methane at normal condition (0.716 kg/m^3)

Step 6: Determination of the hourly flare efficiency

Since the enclosed flare system will be installed and default value for the flare efficiency will be used, the flare efficiency in the hour h ($\eta_{flare,h}$) is as follows;

- 0 %, if the temperature in the exhaust gas of the flare (T_{flare}) is below 500℃ for more than 20 minutes during the hour h.
- 50 %, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500℃ for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500℃ for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.

The Manufacturer's specifications on proper operation of the flare are described in the section B.7.

Step 7: Calculation of annual project emissions from flaring

$$PE_{flare,y} = \sum_{h-1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$

where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y (tCO_2e)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h (kg/h)
$\eta_{flare,h}$	Flare efficiency in hour h
GWP_{CH4}	Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

4) Methane emissions from leaks in biogas system

Leaks in the biogas system include leaks from any anaerobic digester and leaks from the biogas pipeline delivery system.
Leaks in the biogas system (i.e. pipeline leakage) are anticipated to be negligible compared to the baseline emissions due to the short distance covered by the pipeline from UASB reactors to gas holders and then to the generator. The total distance of the pipelines is approximately 200 m and stainless pipes will be utilized in construction. The pipeline will undergo regular maintenance and monitoring to ensure the leakage remains negligible.

Baseline Emissions

Total estimated baseline emissions are the sum of fugitive methane emissions from the existing lagoon based wastewater treatment system and CO_2 emissions from the generation of power on site or off site.

$$E_{BL} = E_{CH4\_lagoon\_BL} + E_{CO2\_power\_BL} \quad (8)$$

where:

E_{BL}	is the total baseline emissions (tCO_2e)
$E_{CH4\_lagoon\_BL}$	is the fugitive methane emissions from lagoons in the baseline case (tCO_2e). It is calculated with baseline data based on equation (2) in the section on project emissions.
$E_{CO2\_power\_BL}$	is the CO2 emissions from on site or off site fossil power generation in the baseline case (tCO_2) that is displaced by generation based on biogas collected in the anaerobic treatment facility.

1) Fugitive methane emissions from lagoons ($E_{CH4\_lagoon\_BL}$)

Methane emissions from lagoons are calculated using equations (2), (3), (5) and (6). In the baseline case, without the new anaerobic treatment facility, no wastewater material degrades before entering the lagoon system and all the organic material to be treated enters the lagoons system. Therefore, equation (4) has to be changed for the baseline calculations as shown below:

$$M_{lagoon\_input\_BL} = M_{input\_total} \quad (11)$$

where:

$M_{lagoon\_input\_BL}$ is the input of organic material from the new project anaerobic wastewater treatment facility into the lagoon system (kg COD)

M_{input_total} is the total amount of organic material fed into the baseline wastewater treatment facility (kg COD) It is the same amount as fed into the project wastewater treatment facility.

All emission factors for surface aerobic losses of organic material, aerobic degradation, deposition or removal as well as chemical oxidation are determined in the same way as described for project emissions calculations.

<u>2) On site and off site grid power generation emissions displaced by generation based on biogas collected in the anaerobic treatment facility</u> *($E_{CO2\_power\_BL}$)*

Displaced electricity CO_2 emissions are:

$$E_{CO2\_power} = EL \cdot CEF \qquad (10)$$

where:

EL is the amount of electricity displaced by the electricity generation from the biogas collected from the anaerobic treatment facility. This is estimated as product of: (1) average specific electricity consumption for the output of the facility, estimated using 3 years historical data: and (2) the annual production.

CEF is the carbon emission factor for the electricity displaced by the electricity generated from the biogas. (tCO_2e/MWh).

For the purpose of ex-ante calculation, EL was determined from the expected electricity generation from the gen set installed as the part of the Project activity because the EL determined by the procedure provided in the baseline methodology appear to be beyond the maximum generation capacity of the Project activity. For the ex-post calculations, the appropriateness of the *EL* value will be evaluated by comparing the actual power generation and the value of *EL* estimated as per the methodology.

For the project activity, two sources of electricity (grid and captive generation) are used in the baseline situation. As specifically directed in the methodology, the lowest among following two values is applied for the calculations;

(i) CEF of the grid which is calculated based on ACM0002 (tCO2e/MWh)
(ii) CEF of the on site electricity generation equipment displaced (tCO2e/MWh)

CEF of the grid (0.82 tCO_2e/MWh) is utilized in the Project calculations because it was smaller than the CEF of the on site electricity (0.91 tCO_2e/MWh). Details of the CEF calculations are included in Annex 3.

Leakage

As per the methodology, leakage is considered to be negligible.

Emission Reductions

Emission reductions, ER (tCO_2e) are calculated as the difference between the total baseline emissions (equation (8)) and the total project emissions (equation (1)). Leakage is considered to be negligible.

$$ER = E_{BL} - E_{project} \qquad (12)$$

It has to be verified that the emissions of CH_4 from the lagoons in the baseline scenario are not higher than the total emissions of biogas from the digester and the lagoons in the project scenario. Therefore calculate:

$$E_{CH4\_lagoon\_BL} - \left(E_{CH4\_lagoon} + E_{CH4\_NAWTF} + E_{CH4\_coll}\right) \qquad (13)$$

where:

E_{CH4_coll} is the amount of methane expressed in (tCO_2e) contained in the biogas collected from the anaerobic treatment facility (i.e. the sum of the biogas sent to generation sets and biogas sent to the flare)

If the result of the equation (13) is positive, it will be deducted from the result obtained through the equation (12) in order to obtain the final estimation of the emission reductions.

For the purpose of ex-ante calculation, it is assumed that the emissions of CH_4 from the lagoons in the baseline scenario are equal to the total emissions of biogas from the digester and the lagoons in the Project. Therefore, equation (13) sums up to zero and is disregarded in the emission calculations.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**EF_{CH4}**
Data unit:	kg CH_4/ kg COD
Description:	Methane emission factor
Source of data used:	Estimated by project developer as a part of feasibility study
Value applied:	0.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	The primary organic compound contained in the cassava processing wastewater is starch, which is a poly-saccharide, a more complex organic compound compared to mono-saccharides. As the baseline methodology stipulates, an alternative CH_4 emission factor is estimated and applied for the project activity. The maximum CH_4 producing capacity (B_0), 0.21 kg CH_4/kg COD, stated in approved baseline methodology AM0013 "Avoided methane emissions from organic waste-water treatment" is selected for the Project. As discussed in AM0013, this value is based on the default IPCC value for B_0, 0.25 kg CH_4/kg COD, taking account of the 50 – 100% uncertainty range, and it is applicable to all organic wastewater types. Considering the fact that this value has been

	established as the result of comprehensive discussions among the methodology panel as well as the CDM Executive Board, it is a conservative and transparent approach for the project participant to adopt this value for the methane emission factor. The choice of this value is also justified by the research conducted for the tapioca starch wastewater. According to the results from the research, CH_4 emissions factor is estimated as a range of 0.22 ~ 0.24 $kgCH_4/kgCOD$. The selected value of 0.21 $kgCH_4/kgCOD$ for CH_4 emission factor is lower than the lowest range of the results from the research.
Any comment:	

Data / Parameter:	$\mathbf{R_{lagoon}}$
Data unit:	%
Description:	Organic material removal ratio
Source of data used:	Estimated by project developer as a part of feasibility study
Value applied:	98.76
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated by project developer using historical COD data of wastewater entering open lagoon treatment system and of wastewater leaving open lagoon treatment system. Data in more detail is described in the Annex 3.
Any comment:	Data provided in Annex 3

Data / Parameter:	$\mathbf{R_{deposition}}$
Data unit:	%
Description:	Organic material deposition ratio
Source of data used:	Estimated by project developer as a part of feasibility study
Value applied:	2.27 (Project scenario), 2.27 (Baseline scenario)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated by project developer throughout the experiments
Any comment:	Details are described in the Annex 3.

Data / Parameter:	**Proportion of methane emitted from UASB digesters**
Data unit:	%
Description:	Proportion of methane emitted from UASB digesters
Source of data used:	IPCC default value
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures	The technology provider, PAPOP CO., LTD., has estimated the physical leakage based on their experiments conducted for the other project that have similar size to the Project activity. The results show that the physical leakage from UASB system is less than 1%. To ensure conservativeness, physical leakage factor of 1% of total biogas production is used for the Project activity.

actually applied :	
Any comment:	

Data / Parameter:	**Lagoon Surface area**
Data unit:	ha
Description:	Total Lagoon area
Source of data used:	Project developer
Value applied:	23.32 (project scenario) / 29.83 (baseline scenario)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Some of the lagoon used for wastewater treatment will not be used after the implementation of the Project activity.
Any comment:	Details are described in the Annex 3.

Data / Parameter:	**CEF**
Data unit:	tCO_2/MWh
Description:	Carbon emission factor for the electricity displaced by the electricity generated from the biogas
Source of data used:	
Value applied:	0.82
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity involves displacement of both grid electricity and captive generated electricity. As per the methodology, the smaller of the following two values was chosen as the CEF; (i) CEF of the grid which is calculated based on ACM0002 (tCO2e/MWh) (ii) CEF of the on site electricity generation equipment displaced (tCO2e/MWh) CEF of the grid is chosen for the project calculations because it was smaller than the CEF of the on site electricity.
Any comment:	Data provided in Annex 3.

Data / Parameter:	**Density of CH_4**
Data unit:	Kg CH_4/Nm^3 CH_4
Description:	Density of methane at standard condition (0 degree Celsius, 1,013 bar)
Source of data used:	ACM0001ver.04
Value applied:	0.7168
Justification of the choice of data or description of measurement methods and procedures actually applied :	As provided by the approved methodology ACM0001. Being a physical property of methane (CH_4), the value is constant at standard condition (0 degree Celsius, 1,013 bar).
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Project emissions

$$E_{project} = E_{CH4\_lagoons} + E_{CH4\_NAWTF} + E_{CH4\_IC+Leaks}$$
$$= 17{,}718\,(tCO_2e/yr) + 2{,}535\,(tCO_2e/yr) + 11{,}020\,(tCO_2e/yr)$$
$$= 31{,}263\ (tCO_2e/yr)$$

1) Fugitive methane emissions from lagoons ($E_{CH4\_lagoons}$)

$$E_{CH4\_lagoons} = M_{lagoon\_anaerobic} \cdot EF_{CH4} \cdot GWP_{CH4} / 1000$$
$$= 4{,}017{,}696\,(kg\,COD) \times 0.21\,(kg\,CH_4 / kg\,COD) \times 21\,(tCO_2e/tCH_4)\ /\ 1000\,(kg/t)$$
$$= 17{,}709\,(tCO_2e)$$

Total amount of organic material removed by anaerobic processes in the lagoons system ($M_{lagoon\_anaerobic}$)

$$M_{lagoon\_anaerobic} = M_{lagoon\_tatal} - M_{lagoon\_aerobic} - M_{lagoon\_chemical\_ox} - M_{lagoon\_deposition}$$
$$= 6{,}603{,}039\,(kg\,COD) - 2{,}161{,}997\,(kg\,COD) - 273{,}575\,(kg\,COD) - 151{,}771\,(kg\,COD)$$
$$= 4{,}015{,}696\,(kg\,COD)$$

Total amount of organic material removed in the lagoon system (M_{lagoon_total})

$$M_{lagoon\_total} = M_{lagoon\_input} \cdot R_{lagoon}$$
$$= 6{,}685{,}945\,(kg\,COD) \times 0.9876$$
$$= 6{,}603{,}039\,(kg\,COD)$$

Input of organic material from the new project anaerobic wastewater treatment facility (M_{lagoon_input})

$$M_{lagoon\_input} = M_{input\_total} \cdot (1 - R_{NAWTF})$$
$$= 66{,}859{,}450\,(kg\,COD) \times (1 - 0.9)$$
$$= 6{,}685{,}945\,(kg\,COD)$$

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic}$)

$$M_{lagoon\_aerobic} = 254\,(kg\,COD/ha/day) \times 23.32\,(ha) \times 365\,(day) = 2{,}161{,}997\,(kg\,COD)$$

Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox}$)

$$M_{lagoon\_chemical\_ox} = 651 \times 0.071 \times 5{,}918{,}850 \div 1{,}000 = 273{,}575\,kg\,COD$$

Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition}$)

$$M_{lagoon\_deposition} = M_{lagoon\_input} \cdot R_{deposition}$$
$$= 6,685,945\,(kg\ COD) \times 0.0227$$
$$= 151,771\,(kg\ COD)$$

<u>2)Methane missions from new anaerobic wastewater treatment facility (E_{CH4_NAWTF})</u>

$$E_{CH4\_NAWTF} = (E_{CH4\_lagoon\_BL} - E_{CH4\_laggon}) \times 0.01$$
$$= [271,098\,(tCO_2e) - 17,709(tCO_2e)] \times 0.01$$
$$= 2,534\,(tCO_2e)$$

<u>3)Methane emissions from inefficient combustion emissions and leaks in biogas system ($E_{CH4\_IC+Leak}$)</u>

$$E_{CH4\_IC+Leaks} = (\sum_r V_r \cdot C_{CH4\_r} \cdot (1 - f_r) \cdot GWP_{CH4}) + PE_{flare}$$
$$= 16,401,061\,(Nm^3 biogas) \times 0.000466\,(tCH_4 / Nm^3 biogas) \times (1 - 0.99) \times 21\,(tCO_{2e} / tCH_4) + 9,415\,(tCO_{2e})$$
$$= 11,020\ (tCO_2e)$$

$$PE_{flare,y} = \sum_{h-1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$
$$= \sum_{h-1}^{8760} 511.80 \times (1 - 0.9) \times \frac{21}{1000} = 9,415\,(tCO_2e)$$

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$
$$= 1099.7 \times 0.65 \times 0.716 = 511.80$$

Baseline emissions

Total estimated baseline emissions are the sum of fugitive methane emissions from the existing lagoon based wastewater treatment system and CO_2 emission from the generation of power on site and off site

$$E_{BL} = E_{CH4\_lagoons\_BL} + E_{CO2\_power\_BL}$$
$$= 271,098\,(tCO_2e / yr) + 31,600\,(tCO_2e / yr)$$
$$= 302,699\ (tCO_2e / yr)$$

<u>1) Fugitive methane emissions from lagoons(($E_{CH4\_lagoon\_BL}$))</u>

$$E_{CH4\_lagoons\_BL} = M_{lagoon\_anaerobic\_BL} \cdot EF_{CH4} \cdot GWP_{CH4} / 1000$$
$$= 61,473,569\,(kg\ COD) \times 0.21\,(tCH_4 / kg\ COD) \times 21 / 1000\,(kg / t)$$
$$= 271,098\ (tCO_2e)$$

Total amount of organic material removed by anaerobic processes in the lagoons system ($M_{lagoon\_anaerobic\_BL}$)

$$
\begin{aligned}
M_{lagoon\_anaerobic\_BL} &= M_{lagoon\_tatal\_BL} - M_{lagoon\_aerobic\_BL} - M_{lagoon\_chemical\_ox\_BL} - M_{lagoon\_deposition\_BL} \\
&= 66{,}030{,}393 - 2{,}765{,}539 - 273{,}575 - 1{,}517{,}710 \\
&= 61{,}473{,}569 \left(kg\ COD\right)
\end{aligned}
$$

Total amount of organic material removed in the lagoon system ($M_{lagoon\_total\_BL}$)

$$
\begin{aligned}
M_{lagoon\_total\_BL} &= M_{lagoon\_input\_BL} \times R_{lagoon} \\
&= M_{input\_total} \times R_{lagoon} \\
&= 66{,}859{,}450 \left(kg\ COD\right) \times 0.9876 \\
&= 66{,}030{,}393 \left(kg\ COD\right)
\end{aligned}
$$

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic\_BL}$)

$$M_{lagoon\_aerobic\_BL} = 254 \left(kg\ COD / ha / day\right) \times 29.83 \left(ha\right) \times 365 \left(day\right) = 2{,}765{,}539 \left(kg\ COD\right)$$

Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox\_BL}$)

$$M_{lagoon\_chemical\_ox\_BL} = 651 \times 0.071 \times 5{,}918{,}850 \div 1{,}000 = 273{,}575 \left(kg\ COD\right)$$

Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition\_BL}$)

$$
\begin{aligned}
M_{lagoon\_depositionl\_BL} &= M_{lagoon\_input\_BL} \cdot R_{deposition} \\
&= 66{,}859{,}450 \,(kg\ COD) \times 0.0227 \\
&= 1{,}517{,}710 \,(kg\ COD)
\end{aligned}
$$

2) On site and off site grid power generation emissions displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_power\_BL}$)[6]

$$
\begin{aligned}
E_{CO2\_power\_BL} &= EL \cdot CEF \\
&= 38{,}537 \left(MWh\right) \times 0.82 \left(tCO_2 / MWh\right) \\
&= 31{,}600 \left(tCO_2\right)
\end{aligned}
$$

Leakage

[6] The above calculations are performed for the case of 5 MW total generation capacity. However, if developer decides to increase total generation capacity up to 8 MW, baseline emissions reduction from power generation will increase accordingly.

As per the methodology, leakage is considered to be negligible.

$$Leakgae = 0\ (tCO_2e)$$

Emission Reductions

$$\begin{aligned} ER &= E_{BL} - E_{project} \\ &= 302{,}699\,(tCO_2e/yr) - 31{,}263(tCO_2e/yr) \\ &= 271{,}436\,(tCO_2e/yr) \end{aligned}$$

$$E_{CH4\_lagoon\_BL} - \left(E_{CH4\_lagoon} + E_{CH4\_NAWTF} + E_{CH4\_coll}\right) = 0\,(tCO_2e/yr)$$

$$ER = 271{,}050\,(tCO_2e/yr)$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO2e)	Estimation of baseline emissions (tonnes of CO2e)	Estimation of leakage (tonnes of CO2e)	Estimation of overall emission reductions (tonnes of CO2e)
Year 1 (Sept 2007 – Aug 2008)	31,263	302,699	0	271,436
Year 2 (Sept 2008 – Aug 2009)	31,263	302, 699	0	271, 436
Year 3 (Sept 2009 – Aug 2010)	31,263	302, 699	0	271, 436
Year 4 (Sept 2010 – Aug 2011)	31,263	302, 699	0	271, 436
Year 5 (Sept 2011 – Aug 2012)	31,263	302, 699	0	271, 436
Year 6 (Sept 2012 – Aug 2013)	31,263	302, 699	0	271, 436
Year 7 (Sept 2013 – Aug 2014)	31,263	302, 699	0	271, 436
Total (tonnes of CO_2e)	**218,841**	**2,118,892**	**0**	**1.900,052**

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**Wastewater flows entering the project treatment facility**

Data unit:	m^3 / year
Description:	The volume of wastewater flows entering into the new anaerobic digestion system
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,918,850
Description of measurement methods and procedures to be applied:	Measured continuously by flow meters.
QA/QC procedures to be applied:	Flow meters will undergo maintenance / calibration subject to appropriate industry standards.
Any comment:	Used for project emissions and baseline emissions calculation. The value applied for the purpose of ex-ante estimation was calculated using the daily flow rate of wastewater (16,911 m^3/ day) measured on-site as a part of feasibility study and annual operating days of the plant (350days).

Data / Parameter:	**Wastewater flows leaving project treatment facility**
Data unit:	m^3 / year
Description:	The volume of wastewater flows leaving the new anaerobic digestion system
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,918,850
Description of measurement methods and procedures to be applied:	Measured continuously by flow meters.
QA/QC procedures to be applied:	Flow meters will undergo maintenance / calibration subject to appropriate industry standards.
Any comment:	Used for project emissions calculation. The value applied for the purpose of ex-ante estimation was calculated using the daily flow rate of wastewater (16,911 m^3/ day) measured on-site as a part of feasibility study and annual operating days of the plant (350days).

Data / Parameter:	**Wastewater organic material concentration entering the project treatment facility**
Data unit:	kg COD/ m^3
Description:	COD concentration of the wastewater entering the new anaerobic digestion system
Source of data to be	Measured by project developer

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	11.296
Description of measurement methods and procedures to be applied:	Daily sampling of the untreated process effluent will be conducted. COD concentration will be analyzed daily at the Project site. To ensure accuracy, tests will be carried out under the supervision of an accredited laboratory each week.
QA/QC procedures to be applied:	Sampling and analysis will be carried out adhering to internationally recognized procedures
Any comment:	Used for project emissions and baseline emissions calculation

Data / Parameter:	**Wastewater organic material concentration leaving the treatment facility**
Data unit:	kg COD/ m^3
Description:	COD concentration of the wastewater leaving the new anaerobic digestion system
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.1296
Description of measurement methods and procedures to be applied:	Daily sampling of the UASB reactor effluent will be conducted. COD concentration will be analyzed daily at the Project site. To ensure accuracy, tests will be carried out under the supervision of an accredited laboratory each week.
QA/QC procedures to be applied:	Sampling and analysis will be carried out adhering to internationally recognized procedures
Any comment:	Used for project emissions calculation. The value used in section B.5 is calculated using COD concentration entering the project treatment facility (11.296 kg COD/ m3) and the assumed total organic material removal efficiency of the new project wastewater facility (0.9).

Data / Parameter:	R_{NAWTF}
Data unit:	Fraction
Description:	Total organic material removal efficiency of the new project wastewater facility.
Source of data to be used:	Calculated using COD concentration entering the project treatment facility and COD concentration leaving the treatment facility.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.9
Description of measurement methods	Calculated using COD concentration entering the project treatment facility and COD concentration leaving the treatment facility.

and procedures to be applied:	
QA/QC procedures to be applied:	Sampling and analysis will be carried out adhering to internationally recognized procedures
Any comment:	

Data / Parameter:	**Electricity generated**
Data unit:	MWh
Description:	Electricity generated from the biogas collected in the anaerobic treatment facility and consumed on site or sent the grid
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	41,760 (electricity generated) 38,537 (electricity that displaces the on-site generated electricity or grid electricity)
Description of measurement methods and procedures to be applied:	Measured continuously using electricity meters For the purpose of ex-ante calculation, electricity generated by the project activity was assumed as follows: 5MW ×24hours/year×348 days/year. As explained in Section A.2, the project developer plans to increase the generation capacity to 8.0 MW depending on the amount of biogas generated by the UASB reactors. This will influence in no way other aspects of the project. In this case expected annual power generation will increase up to 66,816 MWh (= 8 MW × 24 hours/year×348 days/year). For the calculation of emission reductions, the electricity used for the operation of a UASB system will be deducted.
QA/QC procedures to be applied:	Electricity meters will undergo maintenance / calibration subject to appropriate industry standards.
Any comment:	

Data / Parameter:	**Biogas sent to flares (V_{res})**
Data unit:	Nm^3 biogas
Description:	Surplus biogas sent to flare system
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	9,237,443
Description of measurement methods and procedures to be applied:	Measured continuously by flow meters
QA/QC procedures to be applied:	Flow meters will undergo maintenance / calibration subject to appropriate industry standards
Any comment:	Used for project emissions and emissions reduction calculation

Data / Parameter:	**Biogas sent to generation sets (V_{el})**
Data unit:	Nm^3 biogas
Description:	Biogas sent to generation facility and used for electricity generation
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	16,401,061
Description of measurement methods and procedures to be applied:	Measured continuously by flow meters
QA/QC procedures to be applied:	Flow meters will undergo maintenance / calibration subject to appropriate industry standards
Any comment:	Used for project emissions and emissions reduction calculation

Data / Parameter:	**Biogas methane concentration**
Data unit:	%
Description:	Percentage of methane in the biogas
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	65
Description of measurement methods and procedures to be applied:	Measured continuously by near infrared spectrometry
QA/QC procedures to be applied:	Near infrared spectrometry will undergo maintenance / calibration subject to appropriate industry standards
Any comment:	Used for project emissions and emissions reduction calculation

Data / Parameter:	C_{CH4}
Data unit:	t CH_4 / Nm^3 biogas
Description:	Methane concentration in biogas
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.000466
Description of	Calculated using biogas methane concentration (65%, volume/volume) and

measurement methods and procedures to be applied:	methane density at standard condition (0.7168 $kgCH_4/Nm^3$)
QA/QC procedures to be applied:	Near infrared spectrometry will undergo maintenance / calibration subject to appropriate industry standards.
Any comment:	

Data / Parameter:	**Project emissions from flaring of the residual gas stream (PE_{flare})**
Data unit:	t CO_{2e}
Description:	**Project emissions from flaring of the residual gas stream**
Source of data to be used:	Measured/Calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	9,415
Description of measurement methods and procedures to be applied:	Calculated as per the guideline of "Tool to determine project emission from flaring gases containing Methane".
QA/QC procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y (PE_{flare}) should use the QA/QC procedures as per the "Tool to determine project emissions from flaring gases containing Methane".
Any comment:	The parameters used for determining the project emissions from flaring of the residual gas stream (PE_{flare}) should be monitored as per the "Tool to determine project emissions from flaring gases containing Methane".

Data / Parameter:	**$fv_{i,h}$**
Data unit:	-
Description:	Volumetric fraction of component i in the residual gas in the hour h where i = CH_4, CO, CO_2, O_2, H_2, N_2
Source of data to be used:	Measurements by project developer using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	CH_4: 65% CO: 0% CO_2: 0% O_2: 0% H_2: 0% N_2 : 35%
Description of measurement methods and procedures to be applied:	This parameter will be monitored continuously and values will be averaged hourly. The same basis (dry or wet) will be considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60℃.

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QA/QC procedures to be applied:	Analysers will be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N_2.

Data / Parameter:	**$FV_{RG,h}$**
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements by project developer using a flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1099.7
Description of measurement methods and procedures to be applied:	This parameter will be monitored continuously and values will be averaged hourly. The same basis (dry or wet) will be considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60℃.
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	**T_{flare}**
Data unit:	℃
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurement by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	600℃
Description of measurement methods and procedures to be applied:	This parameter will be monitored continuously. Temperature of the exhaust gas stream in the flare will be measured by a Type N thermocouple. A temperature above 500℃ indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year.
Any comment:	An excessively high temperature at the sampling point (above 700℃) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter:	**Minimum flow rate**
Data unit:	m^3/hr

Description:	Minimum flow rate for the operation of flare system
Source of data to be used:	Measurement by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1099.7
Description of measurement methods and procedures to be applied:	This is a manufacture's specification for the proper operation of flare system. To ensure that the flare system is operating adequately, minimum flow rate of 600 m^3/hr should be met. This parameter will be monitored continuously by a flow meter.
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	**Operating pressure**
Data unit:	mBar
Description:	Operating pressure of flare system
Source of data to be used:	Measurement by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	200 mBar
Description of measurement methods and procedures to be applied:	This is a manufacture's specification for the proper operation of flare system. To ensure that the flare system is operating adequately, operating pressure of 100 ~ 250 mBar should be met. This parameter will be monitored continuously by a pressure gauge.
QA/QC procedures to be applied:	Pressure gauges are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	**Gen set combustion efficiency (f_{el})**
Data unit:	%
Description:	Proportion of biogas combusted by generation facility
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	99
Description of measurement methods and procedures to be applied:	Generation set combustion efficiency will be determined annually during regular O&M down time and as part of the regular O&M schedule.

QA/QC procedures to be applied:	Generation set combustion efficiency will be calibrated annually.
Any comment:	Used for project emissions calculation

Data / Parameter:	**Amount of chemical oxidising agents entering system boundary**
Data unit:	tonnes/m^3
Description:	Amount of chemical oxidising agents entering system boundary
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SO_4^{2-} : 71mg/liter of wastewater
Description of measurement methods and procedures to be applied:	Continuously monitored whether oxidative chemical species are utilized in the process.
QA/QC procedures to be applied:	Regular samples will test for concentration of oxidising agents where they are identified as being likely to be present in wastewater when they are part of the process
Any comment:	Used for project emissions and baseline emissions calculation

Data / Parameter:	**Flow of wastewater directly to the current wastewater treatment system**
Data unit:	m^3
Description:	Volume of flow of wastewater directly to the current wastewater treatment system and bypassing the new wastewater treatment facility
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Bypass flow is measured by an electromagnetic flow meter.
QA/QC procedures to be applied:	Monitoring equipment will undergo maintenance / calibration subject to appropriate industry standards
Any comment:	Used for project emissions calculation

Data / Parameter:	**Loss of biogas from pipeline**
Data unit:	%
Description:	Loss of biogas from pipeline
Source of data to be used:	Measured by project developer
Value of data applied	0

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Integrity of biogas pipeline for losses of biogas methane will be tested annually through pressurizing the system and establishing pressure drops through leakage.
QA/QC procedures to be applied:	Annual checks to be carried out to international standards
Any comment:	Used for project emissions calculation

Data / Parameter:	**Organic material removed from wastewater facility**
Data unit:	t COD
Description:	Organic material removed from wastewater facility
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	60,173
Description of measurement methods and procedures to be applied:	Removal of COD after monitoring and prior to entry to the lagoon system should be recorded to ensure CH4 emissions are not overestimated. This may be material screened out after the wastewater concentration is recorded
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**Biogas calorific value**
Data unit:	J/Nm^3
Description:	Calorific value of biogas
Source of data to be used:	Measured by project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	24,128
Description of measurement methods and procedures to be applied:	Measured annually by accredited laboratory
QA/QC procedures to be applied:	Measured annually by accredited laboratory
Any comment:	

B.7.2 Description of the monitoring plan:

All monitoring equipment will be installed by experts and regularly calibrated to the highest standards by BAJ. BAJ will form a team to maintain and operate the Project activity and monitor the parameters required by the methodology. The team will compose of a plant manager, a Production/Biogas plant supervisor, a Genset plant supervisor and operational staff. Figure 3 outlines the structure of operational and management of the Project activity.

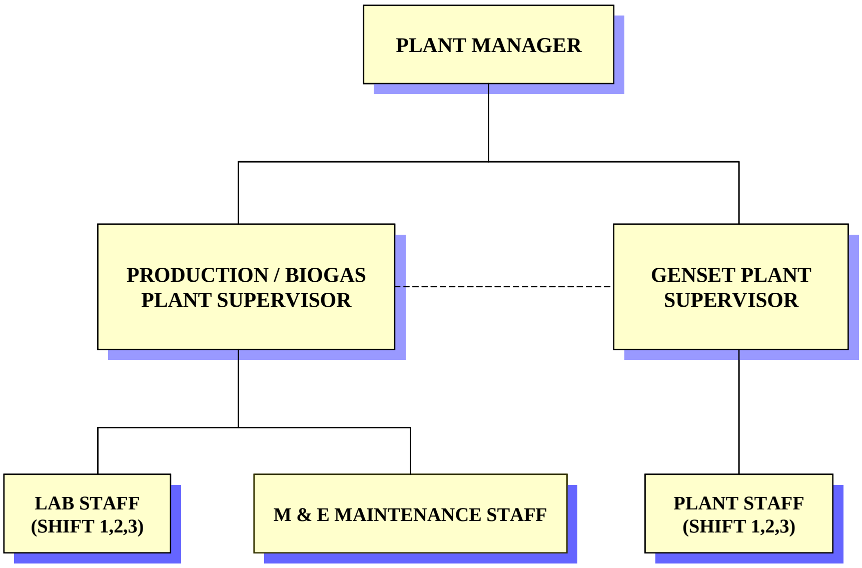

Figure 3. Operational and management structure of the Project activity

The team will be the authority that is responsible for the management and operation of the Project activity which includes the monitoring of the parameters required for the emission reduction calculation.

Plant manager will be responsible for the management of the team. Plant manager’s responsibilities include:

- To review and approve the monthly monitoring report
- To review and approve the calibration schedule
- To review and approve the regular training plan
- To review the results of the calibration and the regular training
- To review and approve an Emergency Management Plan
- To ensure the corrective actions for erroneous measurements and uncertainty

Production/Biogas plant supervisor and Genset plant supervisor will be responsible for the supervision of the staff and the review of the monitored parameters. Supervisors’ responsibilities include:

- To review the daily recorded parameters and report aggregated data to the Plant manager on a monthly basis
- To prepare the calibration schedule as per the recommendation of the manufacturer
- To prepare/conduct the regular training plan
- To prepare an Emergency Management Plan

- To initiate the corrective actions for any erroneous measurement and uncertainty found

Each staff will monitor the assigned parameters and conduct lab experiment on a timely basis. Operators are also responsible for reporting erroneous measurement, uncertainty of the parameters for which he/she is responsible.

Monitored parameters and experiment results will be recorded in SCADA system. To ensure the proper operation and maintenance of the Project activity, training will be provided to the supervisors by the technology providers.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

The current version of the PDD is completed on 27 April 2007 by:

Clean Energy Finance Committee
Mitsubishi UFJ Securities Co., Ltd.
Tokyo, Japan

Phone: +81 3 6213 6860
Fax: +81 3 6213 6175
E-mail: hatano-junji@sc.mufg.jp

Mitsubishi UFJ Securities Co., Ltd. is the CDM advisor to the Project (not a project participant).

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

03/04/2006

C.1.2. Expected operational lifetime of the project activity:

21 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

25/09/2007 or date of registration whichever is later

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Under the current Indonesian Law, an Environmental Impact Assessment (EIA) is not required for the implementation of the Project activity. According to the Ministry of Environment, when the project participant applies for an Indonesian DNA approval, it is only required to submit the documents about EIA conducted prior to the construction/expansion of Way Abung Factory.

However, the expected environmental impact of the Project activity was considered as a part of the feasibility study. According to the results of the feasibility study, it is expected that the Project activity will improve the water quality as well as air quality.

At present, final effluent is discharged to the river after the wastewater is treated in the existing lagoon based wastewater treatment system. By adopting the anaerobic wastewater treatment system which is more advanced technology than the existing system, it is expected that the Project activity will improve the water quality.

At the same time, the anaerobic wastewater treatment system will be equipped by the biogas collection/ utilization system. By collecting and utilizing biogas, which is directly attributable to strong odour in the vicinity of the project site, the Project activity will improve the local air quality.

There will be no additional sludge generation by the Project activity. Sludge generated during the wastewater treatment process will be treated by land application, same as before the implementation of the project activity.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As described above, no significant environmental impacts are expected to result from the Project activity.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

PT Budi Acid Jaya (BAJ) conducted a stakeholders' consultation meeting for the Project on November 10th, 2006. The meeting took place at BAJ's Way Abung facility in Gunung Batin in Terusan Nunyai, Lampung Tengah. The purpose of the stakeholders' meeting was to present to the community surrounding the project location an overview of the Project, its development as well as the benefits of the Project implementation.

Letters of invitation were sent out to government officials and local community leaders. The officials and the community leaders then further distributed the invitation to the surrounding communities.

Nineteen people including members of the local community, government officials, and non-governmental organization attended the meeting.

The meeting was facilitated by BAJ and preceded according to the agenda attached below.

Program Agenda

1. Registration
2. Opening
3. Introduction of participants
4. Opening speech by PT BAJ Way Abung
5. Speech by an official from Mining and Energy Agency representing Middle Lampung Region
6. Introducing the company profile of BAJ
7. Introduction of Biogas project
8. Presentation on the Project with CDM scheme
9. Discussion
10. Signing of minute of meeting
11. Closing

The minutes of the meeting are available upon request.

E.2. Summary of the comments received:

The representatives of the local community acknowledged the direct and indirect benefits resulting from the Project and showed support to the implementation of the project by BAJ and Sumitomo Corporation.

The participants raised the following environmental concerns:

- Waste generated by the project and its handling.
- Handling of potential methane gas leakage.
- Impact of the introduction of additional microorganisms in the waste water treatment process.

E.3. Report on how due account was taken of any comments received:

Due account was taken of all comments and BAJ provided detailed explanation of all issues raised during the stakeholders' meeting.

- Waste generated by the project and its handling.

  →The effluent from the project will be utilized mainly for irrigation and washing purposes. The UASB process installed as part of the project activity provides an advanced treatment prior to the lagoon system, so it is anticipated that the effluent from the lagoon in the project case will contain a much lower organic load compared to the current situation (i.e. anaerobic lagoon system alone). There will be no direct disposal of the treated effluent into the community waterworks. The solid waste will be collected and managed for composting and/or fertilizer purpose.

- Handling of potential methane gas leakage.

→ The company is obliged to design an Environment Management Procedure (UKL) and Environment Monitoring Procedure (UPL). The periodic measurement and monitoring scheduled by the UKL and UPL will control for the occurrence of leakage.

- Impact of the introduction of additional microorganisms in the waste water treatment process and its handling.

→ No additional microorganisms from other sources will be introduced. Because all microorganisms required for anaerobic digestion are formed in UASB reactors, there will be no additional negative environmental impact.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Project will receive partial capital cost funding from New Energy and Industrial Technology Development Organization (NEDO), an administrative agency incorporated under Japan's Ministry of Economy, Trade and Industry. Funding from NEDO, though public, is not counted as part of Japan's official development assistance.

Annex 3

BASELINE INFORMATION

Table 3: Description of lagoon system

Lagoon number	Length (m)	Width (m)	Designed Depth (m)
1a	165	27	6 (5.3)
2a	250	50	6 (5.3)
3a	164	40	6 (5.3)
4a	84	55	6 (4.4)
5a	84	20	6 (5.0)
6a	115	44	6 (4.5)
7a	117	51	6 (5.0)
8a	115	29	6 (4.0)
9a	75	53	6 (4.5)
10a	62	53	6 (5.7)
11a	96	46	6 (4.5)
12a	84	54	6 (4.5)
1b	89	53	6 (5.4)
2b	103	79.4	6 (5.8)
3b	139.7	90	6 (5.1)
4b	100.3	121	6 (5.0)
5b	225.4	85	6 (5.5)
6b	160	89	6 (3.6)
7b	88	85	6 (5.5)
8b	162	85	6 (5.4)
9b	174	67.5	6 (5.3)
10b	75.2	110	6 (4.3)
11b	94.5	110	6 (4.8)
13	150	90	6 (5.4)
14	78	76	6 (4.9)
15	125	76	6 (4.5)
16	174	78	6 (4.5)
17	250	83	5.6 (4.6)
18	258	58	6 (4.4)
19	174	49	5.6 (4.0)
20	171	68	3.7 (2.5)
21	227	62	3.8 (2.8)
22	50	19	3.6 (2.4)
23	50	19	3.6 (2.4)
24	50	19	3.6 (2.4)

Data source: BAJ

Note

1. Figures in the blank in the designed depth are the actual depth of wastewater in each lagoon measured as of 10 February 2007.
2. Lagoons 1a ~ 12a are used for the wastewater treatment from acetic acid production process.
3. Lagoon 1b is used for the wastewater treatment from tapioca starch production process.
4. Lagoons 2b ~ 11b are used for the wastewater treatment from tapioca starch and glucose production processes.
5. Lagoons 13 ~ 24 are used for the wastewater treatment from all the production processes.
6. Lagoons 1a ~ 12a and 1b will not be used after the implementation of the Project activity. After the implementation of the Project activity, lagoons 2b ~ 11b and 13 ~ 24 will be used for the wastewater treatment from the newly built anaerobic wastewater treatment system.

7. Minimum lagoon temperature and minimum ambient temperature in 2005 are 30℃ and 32℃, respectively. Surface area of lagoon system before and after the implementation of the Project activity are 29.83ha and 23.32ha, respectively.

Table 4：A sensitivity analysis for the surface aerobic losses of organic material

Surface aerobic losses kgCOD/ha/day	Error factor applied %	Project emissions from lagoons (tCO_2e)	Sensitivity %	Baseline emissions from lagoons (tCO_2e)	Sensitivity %	Emission reductions (tCO_2e)	Sensitivity %
254	-	17,709	-	271,098	-	271,050	-
280	10%	16,773	5.3%	269,850	0.5%	270,809	0%
330	30%	14,856	16.1%	267,449	1.3%	270,344	0%
381	50%	12,942	26.9%	265,000	2.2%	269,870	0%
508	100%	8,175	53.8%	258,902	4.5%	268,690	1%
635	150%	3,408	80.8%	252,804	6.7%	267,510	1%
762	200%	0	100.0%	246,706	9.0%	264,969	2%

The analysis clearly shows that the emissions reductions calculated are independent of the surface oxidative removal of COD in this project, and thus the 254 kgCOD/ha/day is appropriate for this project.

Table 5：COD lost by deposition

	Sample no.	COD before deposition (mg/l)	COD after deposition (mg/l)	COD lost by deposition (mg/l)
Wastewater from Tapioca production	1	12,704	11,498	1,206
	2	14,870	14,820	50
	3	9,350	9,285	65
	4	14,600	14,497	103
	5	16,650	15,995	655
	6	14,810	14,250	560
	7	10,710	10,250	460
	8	14,050	13,988	62
	9	15,900	15,887	13
	10	16,000	15,992	8
Wastewater from Glucose production	1	7,650	7,125	525
	2	3,050	2,058	992
	3	160	160	0
	4	9,000	6,665	2,335
	5	361	361	0
	6	5,370	5,370	0
	7	5,930	5,930	0
	8	53	53	0
	9	3,480	3,480	0
	10	4,050	2,860	1,190
Wastewater from Citric Acid production	1	27,160	27,098	62
	2	32,168	31,859	309
	3	35,150	34,985	165
	4	35,773	35,612	161
	5	31,706	31,651	55
	6	30,010	29,891	119
	7	30,298	30,241	57

Data source: BAJ

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1. The procedure for the measurement of COD lost by deposition is as follows:
   (1) Samples are randomly selected from each production process.
   (2) COD is measured for each sample taken before any deposition occurs.
   (3) The wastewater is put in a funnel-shaped flask and left until the level of sediment does not change.
   (4) After removing the sediment, COD is measured.
   (5) The difference between COD before the sedimentation and after the sedimentation is considered as the COD lost by deposition.
2. The weighted average based on the amount of wastewater from each production process is used for the total COD loss by deposition.

Table 6 : Wastewater characteristics

COD removal Efficiency of UASB system	0.9	
COD (before UASB system)	11,296	mg/liter
COD (after UASB system)	1,130	mg/liter
Effluent flow	16,911	m^3/day
Annual COD load to lagoons before UASB system implementation	66,859,357	kg COD/yr
Annual COD load to lagoons after UASB system implementation	6,685,936	kg COD/yr
Plant operation	350	days/ yr

Data source: BAJ

Table 7: Organic material removal ratio for lagoons based on the historical Lagoon COD data

Average COD in to the lagoon	11,296	mg/l
Average COD out from the lagoon	140.1	mg/l
Average COD removal ratio	98.76	%

Data source: BAJ

Table 8 : Historical Specific Electricity consumption

	Tapioca (MWh/ton)	Glucose (MWh/ton)	Citric Acid (MWh/ton)
2003	0.1907	0.1164	1.7554
2004	0.2003	0.1325	1.4885
2005	0.2081	0.1464	1.5240
Average	0.1997	0.1318	1.5893

Data source: BAJ

Table 9: Expected production and electricity consumption

	Expected production (Tonnes/year)	Electricity usage (MWh/year)
Tapioca	157,500	31,456
Glucose	21,000	2,767
Citric Acid	10,500	16,688
Total		50,911

Data source: BAJ

(i) CEF of the grid which is calculated based on ACM0002 (tCO2e/MWh)

Table 10: Fuel specification

	(A)	(B)	(C)	(D)	(E)
Fuel Type	Density [kg/kl]	Net Calorific value [TJ/Nm^3]	Net Calorific value [TJ/kt]	Carbon Emission Factor [tC/TJ]	Oxidation Factor
Data Source	PERTAMINA	PERTAMINA	IPCC	IPCC	IPCC
Coal	-	-	25.8	25.80	1.000
Natural gas	-	4.278E-05	-	15.30	1.000
HSD	850	-	43.0	20.20	1.000
IDO	880	-	43.0	20.20	1.000
MFO	990	-	40.4	21.10	1.000

HSD: High speed diesel
IDO: Industrial diesel oil
MFO: Marine fuel oil

Operating margin calculation

Table 11: SSWSR grid generation by source [MWh]

Fuel type	2001	2002	2003	2004	2005
Hydro	1,679,483	1,683,932	2,405,772	2,226,603	2,271,983
Coal	2,741,448	2,713,276	2,378,787	2,618,576	2,932,329
Natural gas	198,959	285,440	432,820	952,256	872,254
HSD	902,223	1,092,790	859,118	994,728	454,909
IDO	86,266	121,928	91,549	115,943	66,887
MFO	97,452	106,988	160,686	993	33,603
Total	5,705,831	6,004,354	6,328,732	6,909,099	6,631,965

Source: PLN publication, PLN hearing

Table 12: Proportion of electricity generated from low-cost/must run resources in SSWSR grid

Year	Total generation [MWh]	Low-cost/must run resources [MWh]	Proportion of low-cost/must run resources
2001	5,705,831	1,679,483	29%
2002	6,004,354	1,683,932	28%
2003	6,328,732	2,405,772	38%
2004	6,909,099	2,226,603	32%
2005	6,631,965	2,271,983	34%
5-year average	6,315,996	2,053,555	32%

Table 13: 2003 Operating margin for the SSWSR grid

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Fuel type	Electricity generated [MWh]	Fuel consumption [kt]	Fuel consumption [Nm3]	Calorific value per mass [TJ/kt]	Calorific value per volume [TJ/Nm3]	Calorific value [TJ] (B)×(D) or (C)×(E)	Carbon emission factor [tC/TJ]	Oxidation factor	CO_2 emission [tCO_2] (F)×(G)×(H)×44/12	CO_2 emission factor [tCO_2/MWh] (I) / (A)
Data Source	PLN	PLN	PLN	IPCC	PERTAMINA		IPCC	IPCC		
Coal	2,378,787	1,383	-	25.8	-	35,674	25.80	1	3,374,789	1.42
Natural gas	432,820	-	253,382,687	-	4.278E-05	10,839	15.30	1	608,078	1.40
HSD	859,118	286	-	43.0	-	12,308	20.20	1	911,635	1.06
IDO	91,549	19.2	-	43.0	-	828	20.20	1	61,297	0.67
MFO	160,686	12.4	-	40.4	-	502	21.10	1	38,834	0.24
Total	3,922,960								4,994,634	1.27

Table 14: 2004 Operating margin for the SSWSR grid

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Fuel type	Electricity generated [MWh]	Fuel consumption [kt]	Fuel consumption [Nm3]	Calorific value per mass [TJ/kt]	Calorific value per volume [TJ/Nm3]	Calorific value [TJ] (B)×(D) or (C)×(E)	Carbon emission factor [tC/TJ]	Oxidation factor	CO_2 emission [tCO_2] (F)×(G)×(H)×44/12	CO_2 emission factor [tCO_2/MWh] (I) / (A)
Data Source	PLN	PLN	PLN	IPCC	PERTAMINA		IPCC	IPCC		
Coal	2,618,576	1,469	-	25.8	-	37,912	25.80	1	3,586,457	1.37
Natural gas	952,256	-	384,624,620	-	4.278E-05	16,453	15.30	1	923,037	0.97
HSD	994,728	386	-	43.0	-	16,601	20.20	1	1,229,573	1.24
IDO	115,943	24.1	-	43.0	-	1,035	20.20	1	76,651	0.66
MFO	993	0.41	-	40.4	-	16	21.10	1	1,275	1.28
Total	4,682,496								5,816,993	1.24

Table 15: 2005 Operating margin for the SSWSR grid

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Fuel type	Electricity generated [MWh]	Fuel consumption [kt]	Fuel consumption [Nm3]	Calorific value per mass [TJ/kt]	Calorific value per volume [TJ/Nm3]	Calorific value [TJ] (B)×(D) or (C)×(E)	Carbon emission factor [tC/TJ]	Oxidation factor	CO_2 emission [tCO_2] (F)×(G)×(H)×44/12	CO_2 emission factor [tCO_2/MWh] (I) / (A)
Data Source	PLN	PLN	PLN	IPCC	PERTAMINA		IPCC	IPCC		
Coal	2,932,329	1,595	-	25.8	-	41,143	25.80	1	3,892,109	1.33
Natural gas	872,254	-	354,849,211	-	4.278E-05	15,180	15.30	1	851,581	0.98
HSD	454,909	134	-	43.0	-	5,749	20.20	1	425,807	0.94
IDO	66,887	13.8	-	43.0	-	593	20.20	1	43,897	0.66
MFO	33,603	3.26	-	40.4	-	132	21.10	1	10,204	0.30
Total	4,359,982								5,223,598	1.20

Table 16: Operating margin emission factor

	(A)	(B)	(C)	(D)
Year	CO_2 emission [tCO_2]	Total electricity generated [MWh]	Low-cost/must run resources [MWh]	OM emission factor [tCO_2/MWh] (A)/((B)-(C))
2003	4,994,634	6,328,732	2,405,772	1.27
2004	5,816,993	6,909,099	2,226,603	1.24
2005	5,223,598	6,631,965	2,271,983	1.20
3-year average				1.24

Build margin calculation

Table 17: Build margin emission factor

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Power Plant name	Commissioning year	Net electricity generated [MWh]	Fuel consumption [Nm^3]	Fuel Type	Calorific value [kJ/Nm^3]	Calrific value (C)×(E) [TJ]	Carbon Emission Factor [tC/TJ]	Oxidation Factor	CO2 Emission (F)×(G)×(H)×44/12 [tCO2]	CO2 Emission Factor (I) / (B) [tCO2/MWh]
Data Source	PLN	PLN	PLN		PERTAMINA		IPCC	IPCC		
PLTG Truck Mounted 1	Dec-04	109,551	34,262,838	Gas	42,778	1,466	15.30	1.000	82,225	0.751
PLTG Truck Mounted 2	Dec-04	121,387	38,509,084	Gas	42,778	1,647	15.30	1.000	92,416	0.761
PLTG Inderalaya II	Aug-04	235,375	83,301,359	Gas	42,778	3,563	15.30	1.000	199,910	0.849
PLTG Rental Tl. Duku #1	Jan-04	79,684	41,551,860	Gas	42,778	1,778	15.30	1.000	99,718	1.251
PLTG Apung	2004	81,776	25,020,604	Gas	42,778	1,070	15.30	1.000	60,045	0.734
PLTA BATUTEGI #1	2002	75,241	-	Hydro	-	-	-	-	-	-
PLTA BATUTEGI #2	2002	69,896	-	Hydro	-	-	-	-	-	-
PLTA BESAI #1	2001	154,075	-	Hydro	-	-	-	-	-	-
PLTA BESAI #2	2001	209,659	-	Hydro	-	-	-	-	-	-
PLTA SKRK #2 [VOEST ALPN]	1998	190,102	-	Hydro	-	-	-	-	-	-
Total		1,326,745				9,524			534,314	0.40

Combined margin calculation

$$
\begin{aligned}
EF_y &= w_{OM,y} \cdot EF_{OM,y} + w_{BM,y} \cdot EF_{BM,y} \\
&= (0.5) \cdot (1.24) + (0.5) \cdot (0.40) \\
&= 0.82
\end{aligned}
$$

(ii) CEF of the on site electricity generation equipment displaced (tCO2e/MWh)

Table 18: CEF of the on site electricity generation equipment displaced

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	Electricity generated* [MWh]	Fuel type	Fuel density [kg/kl]	Fuel consumtion [kl]	Fuel consumtion [kt] (C)×(D)×10^{-6}	Net calorific value per mass [TJ/kt]	Calorific value [TJ] (E)×(F)	Carbon emission factor [tC/TJ]	Oxidation factor	CO_2 emission [tCO_2] (G)×(H)×(I)×44/12	CO_2 emission factor [tCO_2/MWh] (J) / (A)
Data Source	BAJ	BAJ	PERTAMINA	BAJ		IPCC		IPCC	IPCC		
2003	7,765	IDO	880	2,523	2.22	43.0	95.47	20.2	1	7,071	0.91
2004	7,960	IDO	880	2,587	2.28	43.0	97.89	20.2	1	7,251	0.91
2005	6,891	IDO	880	2,240	1.97	43.0	84.76	20.2	1	6,278	0.91
3-year average											0.91

* Electricity generated was calculated using annual fuel consumption data shown in Table 19 below and a unit fuel consumption (0.325 litter Diesel oil/kWh), which is presented by the diesel generator supplier at the time of installation.

Table 19: Historical Diesel oil consumption for on-site electricity generation

Year	Annual Diesel oil consumption for on-site electricity generation (litters/year)
2003	2,523,000
2004	2,587,000
2005	2,240,000

Source: BAJ

Annex 4

MONITORING INFORMATION

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