CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Title: Wastewater treatment with Anaerobic Digester at Truong Thnih starch processing plant in Tay Ninh, Vietnam

Version no. and Date: Version 1, dated 3 April 2008

A.2. Description of the small-scale project activity:

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Purpose of the project activity

- By capturing the biogas with the installation of an anaerobic digester, the amount of CO_2 emissions derived from the emitted methane gases at existing open lagoons into the atmosphere will be significantly reduced.
- Captured biogas from the anaerobic digester will be used to generate heat energy for substituting coal and also used to generate electricity for displacing grid electricity. Therefore the amount of CO_2 emissions derived from combustion of coal as fossil fuels and consuming grid electricity will be significantly reduced.

Description of the project activity

- TRUONG THNIH CO., LTD. is capable of producing 120 tons per day of Tapioca starch. TRUONG THNIH CO., LTD. currently produces approximately 20,000 tons of Tapioca starch per year, and its production process emits approximately 2,500 m^3/day of wastewater from the plant.
- The project activity involves the installation of an anaerobic digester with biogas extraction capacity for the treatment of organic wastewater treatment of Tapioca starch-processing plant of TRUONG THNIH CO., LTD. located in Tay Ninh Province, Vietnam.
- In the project activity, biogas will be captured in the anaerobic digester of the methane fermentation facilities. The captured biogas will be utilised as the fuel of the energy generation facilities, which is composed of boiler, furnace and the electric power generator for tapioca starch-processing plant.
- At an existing plant, open lagoons store wastewater for a long time, and so organic substances contained in the wastewater decompose, generating large amounts of methane gases that are emitted into the atmosphere. Coal is used as the fuel in the existing coal furnace, and electricity consumed at the plant is supplied from grid.
- In the project activity, total amount of 24,294 tCO_2 /year is expected to reduce by avoiding methane gas emissions from the existing open lagoons, by substituting coal with captured biogas and by displacing grid electricity with the electricity generated from captured biogas.

Sustainable Development Benefit of the Project

The project activity will contribute to the sustainable development and meets the sustainability criteria of Vietnam as follows.

Contribution to Environmental Sustainability:

- ♦ The project activity will reduce the uncontrolled emissions of methane from the existing open lagoons, and replacing the use of fossil fuels by utilizing the captured biogas for heat generation, and displacing grid electricity with the electricity generated from captured biogas, thus reducing the GHG emission into the atmosphere and the impact on global warming.

- The project activity will contribute to reduce the organic substance load flowing into the lagoons, thus improving the quality of treated water and consequently, contributing to improve the water quality in nearby water areas.
- The project activity will contribute to reduce the generation of offensive odour from the lagoons.

Contribution to Economic Sustainability:

- The project activity will contribute to promote energy saving and will enhance the production efficiency of the plant, producing economic effects.

Contribution to Social Sustainability:

- The project activity will contribute to enable transfer of wastewater treatment technology that uses a digester, which is not generally used in the starch plants in Vietnam.
- The transfer of these technologies will promote wastewater treatment improvement in the future through training and fostering of human resources.

A.3. Project participants:

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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 participants (Yes/No)
Japan	TOSHIBA CORPORATION	No
Socialist Republic of Vietnam (host)	TRUONG THNIH CO., LTD	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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Socialist Republic of Vietnam

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

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Tay Ninh Province

Figure A-1: Location of Tay Ninh Province

A.4.1.3. City/Town/Community etc:

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Tan Chau District, Suoi Ngo Village

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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The project is located at the TRUONG THNIH CO., LTD in Tay Ninh Province (Figure A-2)

Precise coordinates of the project site are latitude 11° 35’ N, longitude 106 15’ E.

Figure A-2: Location of the Project activity

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type and categories of the project activity

The project activity consists of three components:

1. "Methane Recovery in Wastewater Treatment", (Scopes 13; "waste handling and disposal)
2. "Thermal Energy for the user with or without electricity", (Scope 1, "Energy industries (renewable -, non-renewable sources)")
3. "Grid connected renewable electricity generation", (Scope 1, "Energy industries (renewable -, non-renewable sources)")

Component 1: Methane Recovery in Wastewater Treatment

The project activity complies with type III, category H of the most recent version of Appendix B to the simplified modalities and procedures for small-scale CDM project activities, because:

- The project activity introduces methane recovery and combustion to an existing anaerobic wastewater treatment which consists of open lagoons.

Component 2: Thermal energy for the user with or without electricity

The project activity complies with type I, category C of the most recent version of Appendix B to the simplified modalities and procedures for small-scale CDM project activities, because:

- The project activity supplies heat from renewable biogas to the Process Plant

Component 3: Grid connected renewable electricity generation

The project activity complies with type I, category D of the most recent version of Appendix B to the simplified modalities and procedures for small-scale CDM project activities, because:

- ♦ The project activity comprises a renewable energy generation unit that supplies electricity to displace electricity from grid.

Hence, the project is carried out under AMS III H, AMS I C. and AMS I D.

Technology/measure of the project activity

- The scope of this project includes additional installation of methane fermentation facilities, desulfurizing facilities, and energy generation facilities in the existing wastewater treatment facilities. (Figure A-3)
- Wastewater emitted by the plant containing sludge will be pumped from the existing holding pool to methane fermentation facilities installed in this project.
- Wastewater will be fermented in the methane fermentation facilities using a digester, in which organic components contained in the wastewater are decomposed under an anaerobic condition, to produce biogases whose main component is methane. The methane fermentation process in the digester will decompose and remove about 85% of organic substances in the wastewater, and the fermented wastewater will flow into the existing lagoons.
- Biogases produced in the methane fermentation facilities will be fed to the desulfurizing facilities, which will remove impurities such as hydrogen sulfide contained in biogases. By removing impurities, the operational safety of the equipment when biogases are used as energy will be enhanced, enabling sound operation of the project facilities for a long time.
- Part of the biogases produced in the desulfurizing facilities will be fed to the boiler in the energy generation facilities and will be consumed as a heat source for heating the digester.
- The remaining biogases will be used as a fuel of the furnace in the energy generation facilities for supplying heat energy to the starch production process, substituting coal that has been used in the existing coal furnace.
- The furnace installed in the project will be co-fired system, which uses both the captured biogas and Fuel Oil as a fuel. The furnace will mainly use captured biogas and not FO oil, except when the biogas is short for continuous operation of the furnace.
- The remaining biogases will be also used as a fuel of the electric power generator for supplying electricity to the starch processing plant, displacing grid electricity that has been consumed at the plant.
- In principle, biogases that will be generated and recovered in the methane fermentation facilities will almost be used in the boiler, furnace and power generator. When these gas utilization facilities are not running and excessive biogases are generated, these gases will be burnt in the flaring system.

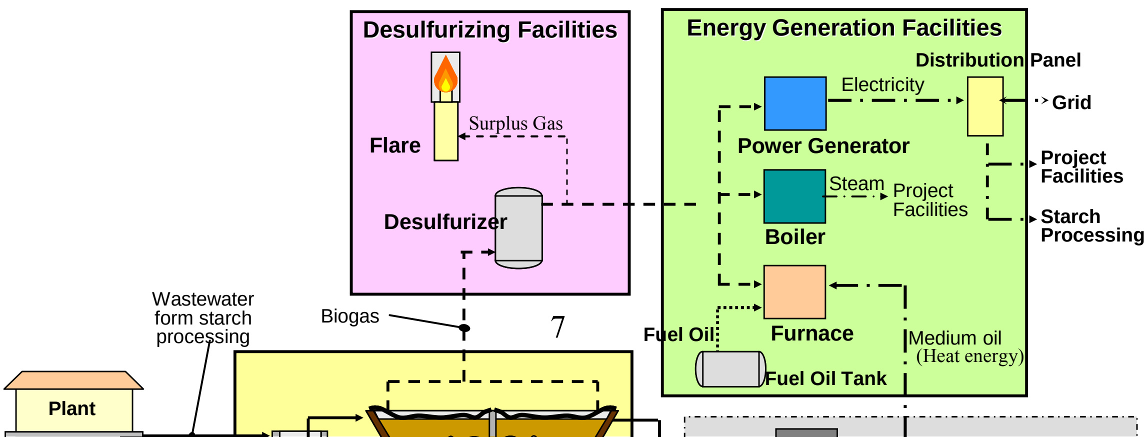

Figure A-3: Process diagram of the Project wastewater treatment system

- This project will use a digester that can receive, decompose, and remove wastewater that contains solid contents for the methane fermentation of wastewater.
- The digester to be employed in this project will have high operation stability, featuring ease of operation and management. Thus, local workers who do not have the technology for or knowledge of operation of methane fermentation facilities in the past will be able to continue stable operation.
- Estimating volume of captured methane at the digester will be 1315 tCH_4/yr in the project activity.
- The specifications of the digester are presented below.

Type of Digester	Fully Mixed, Mesophilic fermentation
Active Volume of Digester	45,000 m^3
Retention time	Approx. 15- 20days
Target Removal Efficiency for COD	85% COD removal
Target Removal Efficiency for SS	50% SS removal
Feed / Draw	Top Feed / Top Draw
Mixing equipment	Submersible Mixer

- The desulfurizing facilities will remove hydrogen sulfide using microorganisms. Unlike other systems that use desulfurizing catalysts or chemicals, the facilities will not require consumable parts or supplies that will need periodic supply and replacement, except for a small amount of the electric power consumed by the pump and other equipment. The running cost of the facilities will be low, and a contribution will be made to the sustainable development of rural regions of Viet Nam, which are faced with issues such as availability of chemicals and other materials, transportation problems, and economic problems.
- The boiler will be used to generate steam for heating digester by using captured biogas. Steam producing capacity of the boiler will be 1.5t/h, and the boiler will be consumed 343tCH_4/yr of captured methane in the project activity.
- The furnace will be used to generate heat energy for drying process of the plant. The capacity of energy output of the furnace will be 2900kW, as same as existing coal furnace. The furnace will be

consumed 337tCH_4/yr of captured methane in the project activity. The furnace will be consumed no Fuel Oil in the normal operation because captured methane will be more than the capacity of furnace.

- The power generator will generate electricity for starch processing plant. The capacity of power generator will be 500kW, and the power generator will be consumed 576tCH_4/yr of captured methane in the project activity.
- The flaring system will burn 59tCH_4/yr of methane as excessive biogases.
- Sludge (solid contents) that is emitted from the plant and mixed in the wastewater will be transported to the digester together with the wastewater. Part of the sludge will be dissolved and made soluble in the digester and will flow into the lagoons together with digester effluent.
- The wastewater treatment facilities of this project will not have a process to separate sludge from wastewater and to dewater it, thus producing no additional sludge in the wastewater treatment process.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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This project will reduce GHGs by 24,294tCO_2/year every year, and the total acquired CERs during the crediting period of 10 years will be 242,940tCO_2.

Years	Annual estimation of emission reductions in tonnes of tCO_2e
2009	6,122
2010	24,294
2011	24,294
2012	24,294
2013	24,294
2014	24,294
2015	24,294
2016	24,294
2017	24,294
2018	24,294
2019	18,172
Total estimated reductions (tCO_2e)	242,940
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tCO_2e)	24,294

A.4.4. Public funding of the small-scale project activity:

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Neither public funding nor official development assistance will be utilized to finance the Project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities specify de-

bundling in a small scale CDM project as follows:
A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants
- In the same project category and technology/measure
- Registered within the previous 2 years and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

Eventually, the project participants do not have any other ongoing or future activity related to this project in anyway. Hence the project is not a debundled activity of a larger project.

SECTION B. Application of a baseline and monitoring methodology

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

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Component 1: AMS-III.H Methane Recovery in Waste Water Treatment
(Version 09, Scope 13, published at EB38)

Component 2: AMS- I.C. Thermal energy for the user with or without electricity
(Version 13, Scope 01, published at EB38)

Component 3: AMS- I.D. Grid connected renewable electricity generation
(Version 13, Scope 01, published at EB36)

B.2 Justification of the choice of the project category:

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Since the emission reductions are less than or equal to 60ktCO_2 equivalent, it is justified that the project is eligible for Type III project activities of small scale CDM project.
The emission reduction of Component 1 will be 21,928tCO_2/yr and thus below the limit 60ktCO_2/yr for type III project activity.

And the recovered methane is used for heat generation that component of the project activity can use a corresponding category under type I.C.
The total of maximum output capacity of the boiler, the furnace and the power generator will be 4.6$MW_{thermal}$ and thus below the limit 45$MW_{thermal}$ for type I.C. projects.

And the recovered methane is also used for electricity generation that component of the project activity can use a corresponding category under type I.D.
Maximum output capacity of the renewable energy generation unit is 0.5MW_e and thus below the limit 15 MW for type I.D. projects.

The project activity qualifies as a small-scale project activity and that it will remain under the limits of small-scale project activity types during every year of the crediting period.

- **Component 1:** AMS- III.H. Methane Recovery in Wastewater Treatment

The applicability criteria for the methodology "*AMS- III.H.*" is as follows.

The applicability criteria for *AMS- III.H.*	Baseline wastewater treatment is anaerobic lagoon
1. This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options:	-
(i) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with methane recovery and combustion.	Not applicable; The baseline wastewater treatment scenario comprises anaerobic lagoons.
(ii) Introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant without sludge treatment.	Not applicable; The project does not introduce a sludge treatment process.
(iii) Introduction of methane recovery and combustion to an existing sludge treatment system.	Not applicable; There is no existing sludge treatment system.
(iv) Introduction of methane recovery and combustion to an existing anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant.	**Applicable;** The baseline wastewater treatment scenario comprises anaerobic lagoons.
(v) Introduction of anaerobic wastewater treatment with methane recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream.	Not applicable; In the baseline scenario there is no untreated wastewater stream.
(vi) Introduction of a sequential stage of wastewater treatment with methane recovery and combustion, with or without sludge treatment, to an existing wastewater treatment system without methane recovery (e.g. introduction of treatment in an anaerobic reactor with methane recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	Not applicable; The project does not involve the introduction of a sequential stage of wastewater treatment.
2. The recovered methane from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly; or (b) Thermal or electrical energy generation after bottling of upgraded biogas; or (c) Thermal or electrical energy generation after upgrading and distribution: (i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; or (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (d) Hydrogen production.	**Applicable;** The recovered methane is used for thermal and electrical energy generation directly.
3. If the recovered methane is used for project activities covered	**Applicable**

under paragraph 2 (a), that component of the project activity can use a corresponding category under type I.	Type I.C. : The recovered methane is used for heat generation by the project, therefore Type I.C. will be applied. And/or Type I.D. : The recovered methane is used for electricity generation by the project, therefore Type I.D. will be applied.
4. If the recovered methane is utilized for production of hydrogen (project activities covered under paragraph 2 (d)), that component of project activity shall use corresponding category AMS III.O.	Not applicable; No hydrogen production will be applied in the project activity.
5. In case of project activities covered under paragraph 2 (b) if bottles with upgraded biogas are sold outside the project boundary the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If however the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO_2 emissions avoided by the displacement of the fuels is eligible under a corresponding type I methodology, e.g. AMS I.C.	Not applicable; No biogas bottling will be applied in the project activity.
6. In case of project activities covered under paragraph 2 (c i) emission reductions from the displacement of the use of natural gas is eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	Not applicable; No biogas upgrading will be applied in the project activity.
7. In case of project activities covered under paragraph 2 (c ii) emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding type I methodology, e.g. AMS I.C.	Not applicable; No biogas upgrading will be applied in the project activity.
8. In case of project activities covered under paragraph 2 (b) and (c), methodology is only applicable if upgrade is done by way of absorption with water (with or without recovery of methane emissions from discharge) such that the methane content of the upgraded biogas shall be in accordance with national regulations (where these exist) or a minimum of 96% (by volume). These conditions are necessary to ensure that the recovered biogas is completely destroyed through combustion in an end use.	Not applicable; No biogas bottling and no biogas upgrading will be applied in the project activity.
9. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all type III components of the project activity.	**Applicable;** The annual emission reductions are less than 60kt CO_2 equivalent

As can be seen, scenario (iv) “Introduction of methane recovery and combustion to existing anaerobic wastewater or sludge treatment systems” is applicable for the calculations of the emission reductions achieved by the project activity.

• **<u>Component 2:</u>** AMS- I.C. Thermal energy for the user with or without electricity
The applicability criteria for the methodology "*AMS- I.C.*" is as follows.

The applicability criteria (Technology/measure) for *AMS- I.C.*	Baseline is coal combustion in the furnace
1. This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel. Biomass-based co-generating systems that produce heat and electricity are included in this category.	Applicable for: ♦ Supply users with thermal energy that displaces fossil fuels ♦ Heat is generated by captured methane from Component 1
2. Where thermal generation capacity is specified by the manufacturer, it shall be less than 45MW.	Applicable; The thermal energy generation capacity shall not exceed 45MW.
3. For co-fired[1] systems the aggregate installed capacity (specified for fossil fuel use) of all systems affected by the project activity shall not exceed 45 MW_{th}. Cogeneration projects that displace/ avoid fossil fuel consumption in the production of thermal energy (e.g. steam or process heat) and/or electricity shall use this methodology. The capacity of the project in this case shall be the thermal energy production capacity i.e. 45 MW_{th}.	Applicable; Co-fired furnace will be used. Total of thermal energy generation capacity shall not exceed 45MW.
4. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should be lower than 45 MW_{th} and should be physically distinct[2] from the existing units.	Not Applicable; There is no existing renewable energy facility.

The total installed capacity of the boiler, furnace and power generator included in the project activity is 4.6$MW_{thermal}$ this is below the threshold of 45$MW_{thermal}$. The breakdown of the installed capacity can be found in the table below.

Table; Breakdown installed capacity of boiler and furnace

Facility	Installed capacity ($MW_{thermal}$)
Boiler	1.2
Furnace	2.9
Power Generator	0.5
Total	**4.6**

Thus, it is justified that the project is eligible for approved small scale baseline methodology AMS-I.C.

• **<u>Component 3:</u>** AMS- I.D. Grid connected renewable electricity generation
The applicability criteria for the methodology "*AMS- I.D.*" is as follows.

The applicability criteria (Technology/measure) for *AMS- I.D.*	Baseline is using grid electricity

1. This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	Applicable for: ♦ Electricity is generated by captured methane from Component 1. ♦ Generated electricity displaces electricity from grid.
2. If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel1, the capacity of the entire unit shall not exceed the limit of 15MW.	Not Applicable; No non-renewable components are used.
3. Combined heat and power (co-generation) systems are not eligible under this category.	Not Applicable ; Renewable power generation unit in the project generates only electricity.
4. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct2 from the existing units.	Not Applicable; No existing renewable power generation facility has been used.
5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	Not Applicable; No existing renewable power generation facility has been used.

The installed capacity of the renewable power generation unit included in the project activity is $0.5MW_e$ this is below the threshold of $15MW_e$.
Thus, it is justified that the project is eligible for approved small scale baseline methodology AMS-I.D.

B.3. Description of the project boundary:

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- In accordance with the project boundary for type III.H (AMS-III.H) projects, the project boundary is the physical, geographical site where the wastewater and sludge treatment takes place.
- In accordance with the project boundary for type I.C (AMS-I.C) projects, the physical, geographical site of the renewable generation delineates the project boundary.
- In accordance with the project boundary for type I.D (AMS-I.D) projects, the project boundary encompasses the physical, geographical site of the renewable generation source.

These all definitions have been included in the determination of the project boundary. A representation of the project boundary can be seen in the Figure B-1 below.

*** Imperfect combustion methane emission:**

Electricity and heat generating equipments and a flare stack installation are included in the boundary.

*** Emission leaked from anaerobic digester and pipelines:**
Biogas production in digester and emission during biogas supply of pipelines are included.

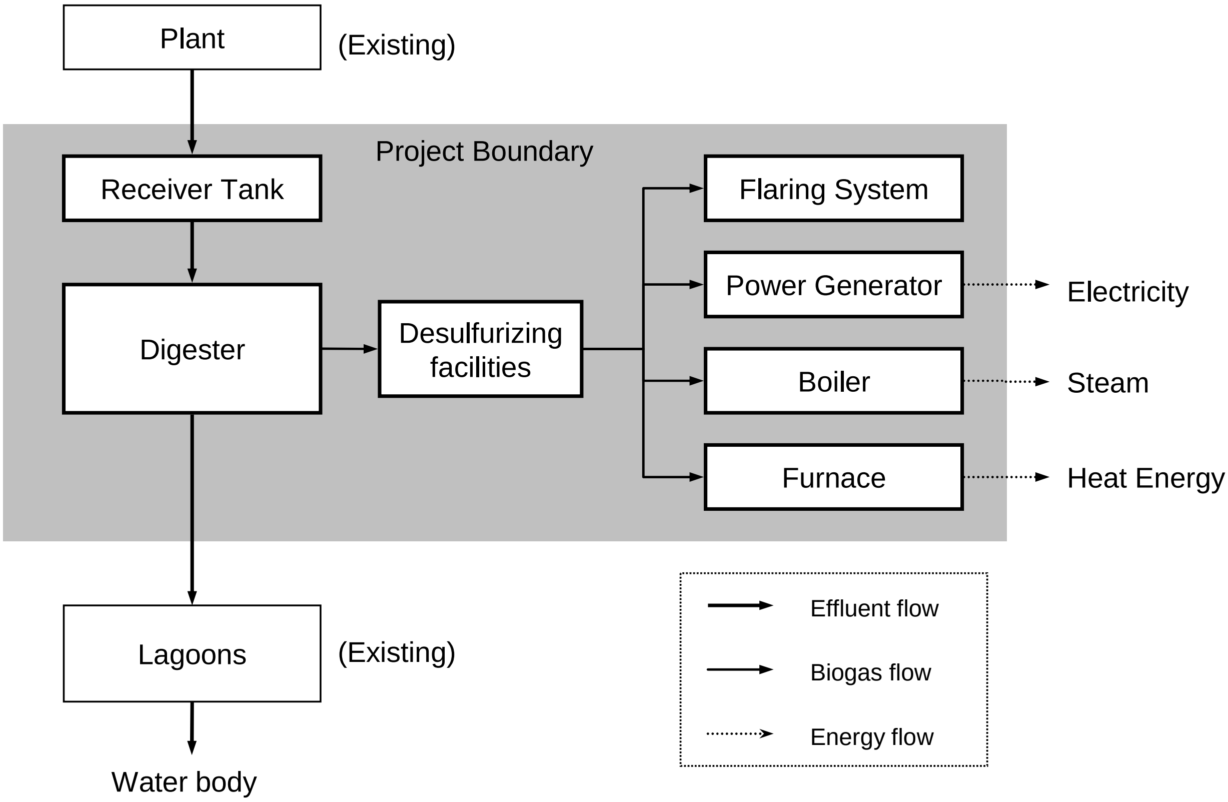

Figure B-1: Project Boundary

B.4. Description of baseline and its development:

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- **Component 1:** AMS- III.H. Methane Recovery in Wastewater Treatment

In this case, the baseline scenario is continuation of the present open lagoon based treatment of organic wastewater and release of methane into the atmosphere.
At an existing plant, open lagoons store wastewater for a long time, and organic substances contained in the wastewater decompose, generating large amounts of methane gases that are emitted into the atmosphere.
In accordance with the methodology AMS- III.H., the above stated conditions fit well with No.6 scenario (iv) of AMS-III.H.
Applicable situation is shown in the following table.

The baseline scenario of AMS- III.H.	Applicability
(i) The existing aerobic wastewater or sludge treatment system, in the case of substitution of one or both of these systems for anaerobic ones with methane recovery and combustion.	Not applicable; The existing wastewater treatment system is anaerobic lagoon.

(ii) The existing sludge disposal system, in the case of introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant.	Not applicable; There is no existing sludge disposal system.
(iii) The existing sludge treatment system without methane recovery and combustion.	Not applicable; There is no existing sludge treatment system.
(iv) The existing anaerobic wastewater treatment system without methane recovery and combustion.	**Applicable;** The existing anaerobic lagoon does not have methane recovery and combustion.
(v) The untreated wastewater being discharged into sea, river, lake, stagnant sewer or flowing sewer, in the case of introducing the anaerobic treatment to an untreated wastewater stream.	Not applicable; Effluent of the plant has been treated by existing lagoons.
(vi) The existing anaerobic wastewater treatment system without methane recovery for the case of introduction of a sequential anaerobic wastewater treatment system with methane recovery.	Not applicable; In the project activity, aerator system will be installed to existing lagoon for keeping aerobic condition.

Following are the data used to determine the baseline emissions.

Parameters	Variables	Value	Unit	Source
Annual starch production rate		20,484	t/year	Annex 3
Wastewater flow per production		21.4	m^3/t-starch	Annex 3
COD of the wastewater to be treated in the digester		16.807	kg/m^3	Measured plant data
COD removal rate of digester		0.85	-	Supplied by manufacturer
Methane correction factor for the wastewater treatment system	$MCF_{ww,treatment}$	0.8	-	IPCC default value
Global Warming Potential of Methane	GWP_CH_4	21	-	IPCC
Methane producing capacity of the wastewater	$B_{0,ww}$	0.21	-	IPCC
Mass conversion factor		44/12	t CO_2/t C	IPCC

The baseline emission of Component 1 is calculated to be 21,928tCO_2/year for this project.

• **Component 2:** AMS- I.C. Thermal energy for the user with or without electricity
In this case, the baseline scenario is continuation of using coal to generate heat energy for the starch drying process.
At an existing plant, coal is used as the fuel in the drying facilities and large amount of carbon dioxide is emitted into the atmosphere with exhaust gas from drying facilities by coal combustion.
The baseline emission of Component 2 is calculated to be 1,377tCO_2/year for this project.

• **Component 3:** AMS- I.D. Grid connected renewable electricity generation
In this case, the baseline scenario is continuation of using grid electricity for the starch processing.
In the case of project activities, recovered methane under Component 1 is used for electricity generating unit that supply electricity to displace electricity from grid.
The baseline emission of Component 3 is calculated to be 989tCO_2/year for this project.

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 small-scale CDM project activity:

Following explanation on the barriers can demonstrate that the proposed project activity is additional as per options provided under attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

The project activity would not have occurred anyway due to at least one of the following barriers:

Investment barriers
The investments needed for throughput and upgrading (project implementation) to be used in calculations of IRR for the tapioca starch-processing plant in this project are shown in the following table. The benchmarks of IRR can be derived as 6.875% from Vietnam government bonds. The IRR to be cleared in business is 6.875% (10-year Viet Nam government bonds, coupons (yield)) .

Parameter	Value
Capital cost inclusive of: Engineering, procurement & construction	2.57 million USD
Operation & maintenance cost inclusive of: Labour, administration, repair, fuel and power cost	399,800 USD/year
Revenue from sales of biogas for coal alternative	66,190 USD/year
Revenue from sales of electricity	131,340 USD/year
CER price	0, 10, 15, 20 US$/t$CO_2$

Based on the foregoing data, IRR with and without CER was calculated. In the calculations, the CER trading price was set at USD15/tCER to US20/tCER, and evaluation was made taking fluctuations of the trading price into consideration.

With/without CER	Without	With CER trading price 10US$			Benchmark
		10US$	15US$	20US$	
IRR(%)	-	2	9	16	6.875

* IRR is a value in Year 10 of the project.

As shown in the above table, the CDM project activity has the lower IRR than the benchmark, and then the CDM project activity cannot be considered as financially attractive. Thus, the additionally of the CDM project can be demonstrated.

The calculations confirmed that IRR would be small without CER, that the project would be without BAU, and that the investment would accrue an advantage through CER.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The project follows the AMS III .H. small-scale methodology for Methane Recovery in Wastewater Treatment, Version 09, Sectoral Scope 13 published at EB38.

In addition, the project follows the AMS I .C. small-scale methodology for thermal energy for the user with or without electricity, Version 13, Sectoral Scope 01 published at EB38 and the AMS I .D. small-scale methodology for grid connected renewable electricity generation, Version 13, published as EB36.

- **<u>Component 1:</u>** AMS- III.H. Methane Recovery in Wastewater Treatment

Estimating the Project activity emissions:

Project activity emissions consist of:

(i) CO_2 emissions on account of power used by the project activity facilities. Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category AMS I.D.;
(ii) Methane emissions on account of inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater;
(iii) Methane emissions from the decay of the final sludge generated by the treatment systems;
(iv) Methane fugitive emissions on account of inefficiencies in capture and flare systems;
(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.
(vi) Where relevant, emissions related to the upgrading and compression of biogas (cases covered under paragraph 2 (b) and 2 (c)).
(vii) Where relevant, emissions due to physical leakage from the dedicated piped network for transport of upgraded biogas to the end users (cases covered under paragraph 2 (c ii)).

$$PE_y = PE_{y,power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,upgrading} + PE_{y,leakage,pipeline}$$

Where:

PE_y	Project activity emissions in the year “y” (tCO_2e)
$PE_{y,power}$	Emissions from electricity or diesel consumption in the year “y”
$PE_{y,ww,treated}$	Emissions from degradable organic carbon in treated wastewater in year “y”
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in the year “y”. If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term can be neglected, and the final disposal of the sludge shall be monitored during the crediting period.
$PE_{y,fugitive}$	Emissions from methane release in capture and utilization/combustion/flare systems in year “y”.
$PE_{y,dissolved}$	Emissions from dissolved methane in treated wastewater in year “y”. Project emissions from this source are only considered for project activities involving measures described in cases (i), (v) and (vi) of paragraph 1
$PE_{y,upgrading}$	Emissions related to the upgrading and compression of biogas in year “y”
$PE_{y,leakage,pipeline}$	Emissions due to physical leakage from the dedicated piped network in year “y”

(i) Project activity emissions from electricity consumption are determined as per the procedures described in AMS I.D. The energy consumption of all equipment/devices installed by the project activity, *inter alia* facilities for upgrade and compression, filling of bottles, distribution and the final end use of biogas shall be included. For project activity emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO_2/tonne). Local values are to be used, if local values are difficult to obtain, IPCC default values may be used. If recovered methane is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.

$$PE_{y,\ power} = PC_y * CEF_{grid}$$

Where:

PC_y	is the amount of electricity in the year y that is consumed at the project site for the project activity (MWh)
CEF_{grid}	is the CO_2 emissions factor for electricity consumed at the project site during the project activity (tCO_2/MWh), estimated under the simplified methodology AMS-I.D.

(ii) Project activity emissions from degradable organic carbon in treated wastewater are determined as follows:

$$PE_{y,ww,treated} = Q_{y,ww} * GWP\_CH_4 * B_{o,ww} * COD_{y,ww,treated} * MCF_{ww,final}$$

Where:

$Q_{y,ww}$	Volume of wastewater treated in the year "y" (m^3)
$COD_{y,ww,treated}$	Chemical oxygen demand of the final treated wastewater discharged into sea, river or lake in the year "y" (tonnes/m^3)
$B_{o,ww}$	methane producing capacity of the wastewater (IPCC default value for domestic wastewater of 0.21 kgCH4/kgCOD)
$MCF_{ww,final}$	**M**ethane correction factor based on type of treatment and discharge pathway of the wastewater (fraction) (MCF Higher Value in table III.H.1 for sea, river and lake discharge i.e. 0.2).
GWP_CH_4	Global Warming Potential for methane (value of 21 is used)

Table III.H.1. IPCC default values[1)] for Methane Correction Factor (MCF)

Type of wastewater treatment and discharge pathway or system	**MCF lower values**	**MCF higher values**
Discharge of wastewater to sea, river or lake	0.0	0.2
Aerobic treatment, well managed	0.0	0.1
Aerobic treatment, poorly managed or overloaded	0.2	0.4
Anaerobic digester for sludge without methane recovery	0.8	1.0
Anaerobic reactor without methane recovery	0.8	1.0
Anaerobic shallow lagoon (depth less than 2 metres)	0.0	0.3
Anaerobic deep lagoon (depth more than 2 metres)	0.8	1.0
Septic system	0.5	0.5
1) Default values from chapter 6 of volume 5.Waste in *2006 IPCC Guidelines for National Greenhouse Gas Inventories*		

(iii) Project activity emissions from anaerobic decay of the final sludge produced are determined as follows:

$$PE_{y,s,final} = S_{y,final} * DOC_{y,s,final} * MCF_{s,final} * DOC_F * F * 16/12 * GWP\_CH_4$$

Where:

$PE_{y,s,final}$	Methane emissions from the anaerobic decay of the final sludge generated in the wastewater system in the year "y" (tCO_2e)
$S_{y,final}$	Amount of final sludge generated by the wastewater treatment in the year y (tonnes)
$DOC_{y,s,final}$	Degradable organic content of the final sludge generated by the wastewater treatment in the year y (fraction). IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10 percent) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent) may be used. Optionally other values determined through ex post measurement of the sludge produced on a sampling basis may be used during the crediting period
$MCF_{s,final}$	Methane correction factor of the landfill that receives the final sludge, estimated as described in category AMS III.G.
DOC_F	Fraction of DOC dissimilated to biogas (IPCC default value of 0.5)
F	Fraction of CH_4 in landfill gas (IPCC default of 0.5).

(iv) Project activity emissions from methane release in capture and utilization/combustion/ flare systems are determined as follows:

$$PE_{y,fugitive} = PE_{y,fugitive,ww} + PE_{y,fugitive,s}$$

Where:

$PE_{y,fugitive,ww}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic wastewater treatment in the year "y" (tCO_2e)
$PE_{y,fugitive,s}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic sludge treatment in the year "y" (tCO_2e)

$$PE_{y,fugitive,ww} = (1 - CFE_{ww}) * MEP_{y,ww,treatment} * GWP\_CH_4$$

Where:

CFE_{ww}	Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the wastewater treatment (a default value of 0.9 shall be used, given no other appropriate value)
$MEP_{y,ww,treatment}$	**M**ethane emission potential of wastewater treatment plant in the year "y" (tonnes)

$$MEP_{y,ww,treatment} = Q_{y,ww} * B_{o,ww} * \sum_j COD_{y,removed,j} * MCF_{ww,j}$$

Where:

$COD_{y,removed,j}$	**The c**hemical oxygen demand removed by the treatment system "j" of the project activity equipped with methane recovery in the year "y" ($tonnes/m^3$)

$MCF_{ww, treatment}$ Methane correction factor for the wastewater treatment system "j" equipped with methane recovery and combustion/flare/utilization equipment (MCF higher values in table III.H.1).

$$PE_{y,fugitive,s} = (1 - CFE_s) * MEP_{y,s,treatment} * GWP\_CH_4$$

Where:

CFE_s Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the sludge treatment (a default value of 0.9 shall be used, given no other appropriate value)

$MEP_{y,s,treatment}$ Methane emission potential of the sludge treatment system in the year "y" (tonnes)

$$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12 * MCF_{s,treatment}$$

Where:

$S_{y,untreated}$ Amount of untreated sludge generated in the year "y" (tonnes)

$DOC_{y,s,untreated}$ Degradable organic content of the untreated sludge generated in the year y (fraction). It shall be measured by sampling and analysis of the sludge produced, and estimated ex-ante using the IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10 percent) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent)

$MCF_{s,treatment}$ Methane correction factor for the sludge treatment system that will be equipped with methane recovery and combustion /utilization/flare equipment (MCF Higher value of 1.0 as per table III.H.1).

(v) Project activity emissions from dissolved methane in treated wastewater are determined as follows:

$$PE_{y,dissolved} = Q_{y,ww} * [CH_4]_{y,ww,treated} * GWP\_CH_4$$

Where:

$[CH_4]_{y,ww,treated}$ Dissolved methane content in the treated wastewater (tonnes/m^3). In aerobic wastewater treatment default value is zero, in anaerobic treatment it can be measured, or a default value of $10e^{-4}$ tonnes/m^3 can be used.

(vi) In case of project activities covered under paragraph 2 (b) and 2 (c) the following project emissions related to the upgrading and compression of the biogas ($PE_{y,upgrading}$) shall be included:

(1) Methane emissions from the discharge of the water wash upgrading equipment (tCO_2e);
(2) Fugitive methane emissions from leaks in compression equipment (tCO_2e);
(3) Emissions on account of vent gases from the water wash upgrade equipment (tCO_2e);

$$PE_{y,upgrading} = PE_{y,ww,upgrading} + PE_{y,CH4,equip} + PE_{y,ventgas}$$

Where:

$PE_{y,ww,upgrading}$ Emissions from methane contained in waste water discharge of water wash upgrading installation in year "y" (tCO_2e)

$\mathbf{PE_{y,CH4,equip}}$	Emissions from compressor leaks in year "y" (tCO_2e)
$\mathbf{PE_{y,ventgas}}$	Emissions from venting gases retained in water wash upgrading equipment in year "y"(tCO_2e)

Project activity emissions from methane contained in waste water discharge of water wash upgrading installation are determined as follows:

$$PE_{y,ww,upgrading} = Q_{y,ww,upgrade} * [CH_4]_{y,ww,upgrade} * GWP\_CH_4$$

Where:

$\mathbf{Q_{y,ww,upgrade}}$	Volume of wastewater discharge from water wash upgrading installation in year "y"
$\mathbf{[CH_4]_{y,ww,upgrade}}$	Dissolved methane contained in the wastewater discharge in year "y"

Project activity emissions from compressor leaks are determined as follows:

$$PE_{y,CH4,equip} = GWP\_CH_4 * (1/1000) * \sum_{equipment} w_{CH4stream,y} * EF_{equipment} + T_{yequipment,y}$$

Where:

$\mathbf{w_{CH4stream,y}}$	Average methane weight fraction of the gas (kg-CH_4/kg) in year "y"
$\mathbf{T_{yequipment,y}}$	Operation time of the equipment in hours in year "y" (in absence of detailed information, it can be assumed that the equipment is used continuously, as a conservative approach)
$\mathbf{EF_{equipment}}$	Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer in kg/hour/compressor. If no default value from the technology provider is available, the approach below shall be used.

Fugitive methane emissions occurring during the recovery and processing of gas may in some projects be small, but should be estimated as a conservative approach. Emission factors may be taken from the 1995 Protocol for Equipment Leak Emission Estimates, published by EPA[5].

Emissions should be determined for all relevant activities and all equipment used for the upgrading of biogas (such as valves, pump seals, connectors, flanges, open-ended lines, etc.).

The following data needs to be obtained:

1. The number of each type of component in a unit (valve, connector, etc.);
2. The methane concentration of the stream;
3. The time period each component is in service.

The EPA approach is based on average emission factors for Total Organic Compounds (TOC) in a stream and has been revised to estimate methane emissions. Methane emissions are calculated for each single piece of equipment by multiplying the methane concentration with the appropriate emission factor from table III.H.2 below.

Table III.H.2. Methane emission factors for equipment[6]

Equipment type	**Emission Factor (kg/hour/ source) for methane**
Valves	4.5E-0.3
Pump seals	2.4E-0.3

Others[7]	8.8E-0.3
Connectors	2.0E-0.4
Flangs	3.9E-0.4
Open ended lines	2.0E-0.3

Project activity emissions from venting gases retained in water wash upgrading equipment do not have to be considered if vent gases ($PE_{y,ventgas}$) are channeled to storage bags. In case vent gases are flared, emissions due to the incomplete or inefficient combustion of the gases will be calculated using the *"Tool to determine project emissions from flaring gases containing methane"*, as follows:

$$\mathbf{PE_{y,ventgas}} = \sum_{h=1}^{8760} \mathbf{TM_{RG,h} * (1- \eta_{flare,h}) * (GWP\_CH_4 / 1000)}$$

Where:

$\mathbf{TM_{RG,h}}$	Mass flow rate of the residual gas in hour "*h*" (kg/h)
$\eta_{\mathbf{flare,h}}$	Flare efficiency in hour "*h*"

In case vent gases are not flared the *"Tool to determine project emissions from flaring gases containing methane" will be used*, without considering measurements and calculations for the flare efficiency, which will be assumed to be zero. In this case, emissions due to the vent gases will be:

$$\mathbf{PE_{y,ventgas}} = \sum_{h=1}^{8760} \mathbf{TM_{RG,h} * (GWP\_CH_4 / 1000)}$$

Alternatively, in case vent gases are directly vented to the atmosphere, it may also be calculated by conservatively calculating the mass of the gases vented based on the volume, pressure and temperature of gas retained in water wash upgrading equipment. This mass should be multiplied with the frequency with which it is vented and assuming that the vented gas is pure methane.

In order to account for emissions that occur when the water wash upgrade facility is shut down due to maintenance, repair work or emergencies one of the alternatives proposed above should be used to calculate and include emissions from flaring or venting.

(vii) In case of project activities covered under paragraph 2 (c ii) emissions due to physical leakage of upgraded biogas from the dedicated piped network ($PE_{y,leakage,pipeline}$) shall be determined as follows:

$$\mathbf{PE_{y,leakage,pipeline} = Q_{y,methane,pipeline} * LR_{pipeline} * GWP_{CH4}}$$

Where:

$\mathbf{PE_{y,leakage,pipeline}}$	Emissions due to physical leakage from the dedicated piped network in year "y" (tCO_2e)
$\mathbf{Q_{y,methane,pipeline}}$	Total quantity of methane transported in the dedicated piped network in year "y" (m^3)
$\mathbf{LR_{pipeline}}$	Physical leakage rate from the dedicated piped network (if no project-specific values can be identified a conservative default value of 0.0125 Gg per 10^6 m^3 of utility sales shall be applied[8].)

Estimating the Baseline emissions:

The baseline scenario of the project is the situation 23. (iv) of simplified baseline methodology AMS III.H.
For the cases 23 (iii) and 23 (iv) the baseline emissions are calculated as per the formulas provided for calculating the project emissions, with the exception that MCF lower values in Table III.H.1 are used:

$$BE_y = MEP_{y,ww,bl} * GWP\_CH_4 + MEP_{y,s,treatment} * GWP\_CH_4$$

Where:

BE_y	Baseline emissions in the year “y” (tCO_2 e)
$MEP_{y,ww,bl}$	Methane emission potential of the anaerobic wastewater treatment plant(s) in the baseline situation in year “y” (tonnes) determined as follows:
GWP_CH_4	Global Warming Potential for methane (value of 21 is used)
$MEP_{y,s,treatment}$	methane emission potential of the sludge treatment system in the year “y” (tonnes)

$$MEP_{y,ww,treatment} = Q_{y,ww} * \sum_i (COD_{y,removed,i} * B_{o,ww} * MCF_{ww,treatment,i})$$

Where:

$Q_{y,ww}$	Volume of wastewater treated in the year “y” (m^3)
$COD_{y,removed,i}$	Chemical oxygen demand removed by the anaerobic wastewater treatment system “i” in the baseline situation in the year “y” ($tonnes/m^3$)
$B_{o,ww}$	methane producing capacity of the wastewater (IPCC default value for domestic wastewater of 0.21 $kgCH_4/kgCOD$)1
$MCF_{ww, treatment}$	Methane correction factor for the anaerobic wastewater treatment system “i” (MCF lower values in table III.H.1).

$$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12 * MCF_{s,treatment}$$

Where:

$S_{y,untreated}$	Amount of untreated sludge generated in the year “y” (tonnes)
$DOC_{y,s,untreated}$	Degradable organic content of the untreated sludge generated in the year y (fraction). It shall be measured by sampling and analysis of the sludge produced, and estimated ex-ante using the IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10 percent) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent)
$MCF_{s,treatment}$	methane correction factor for the sludge treatment system that will be equipped with methane recovery and combustion (MCF lower values in table III.H.1).

Estimating the Leakage:

If the used technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered.

• **Component 2:** AMS- I.C. Thermal energy for the user with or without electricity

Estimating the Baseline emissions:

The baseline scenario of the project is the No. 10 of simplified baseline methodology AMS I.C.
For steam/heat produced using fossil fuels the baseline emissions are calculated as follows:

$$BEy = HGy * EF\ CO_2 / \eta_{th}$$

Where;

BEy	the baseline emissions from steam/heat displaced by the project activity during the year y in tCO_2e.
HGy	the net quantity of steam/heat supplied by the project activity during the year y in TJ.
EF CO_2	the CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO_2 / TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used.
η_{th}	the efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.

Estimating the Leakage:

If the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

• **Component 3:** AMS- I.D. Grid connected renewable electricity generation

Estimating the Baseline emissions:

The baseline scenario of the project is the No. 9 of simplified baseline methodology AMS I.D.
In this case, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'

OR

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available) 3 and made publicly available.

Estimating the Leakage:

If the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

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

Data / Parameter:	**$Q_{y,ww}$**
Data unit:	m^3/y
Description:	Volume of wastewater treated in the year "y"
Source of data used:	Feasibility study and Annex 3 BASELINE INFORMATION
Value applied:	438,358 m^3/y
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate the organic load to the wastewater treatment plant. This is based on the average value of annual tapioca starch production volume multiplied by the wastewater flow rate per production.
Any comment:	

Data / Parameter:	**$COD_{y,removed,i}$**
Data unit:	$tonnes/m^3$
Description:	Chemical oxygen demand removed by the anaerobic wastewater treatment system "i" in the baseline situation in the year "y"
Source of data used:	Laboratory analysis
Value applied:	0.016777 t/m^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is a key data for estimation of ex-ante baseline emissions and project activity emissions. This is based on the value subtracting **$COD_{y,ww,treated}$** from the average of the result of water content analysis according to APHA 5220 C.
Any comment:	

Data / Parameter:	**$B_{0,ww}$**
Data unit:	$kgCH_4/kgCOD$
Description:	Methane producing capacity of the wastewater
Source of data used:	IPCC default value for domestic wastewater
Value applied:	0.21 $kgCH_4/kgCOD$
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is required to estimate ex-ante baseline emissions and project activity emissions. The default IPCC value for B_0, the maximum amount of CH_4 that can be produced from given quantity of wastewater, is 0.25 $kgCH_4/kgCOD$. Taking into account the uncertainty of this estimate, a value of 0.21 $kgCH_4/kgCOD$ is used as a conservative assumption for B_0.
Any comment:	

Data / Parameter:	**$CEF_{grid\ BL}$**
Data unit:	tCO_2e/MWh
Description:	CO_2 emissions factor for electricity consumed at the project site during the project activity

Source of data used:	estimated under the simplified methodology AMS-I.D.
Value applied:	0.496
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante and ex-post estimation of baseline emissions.
Any comment:	

Data / Parameter:	**$CEF_{grid\ PJ}$**
Data unit:	tCO_2e/MWh
Description:	CO_2 emissions factor for electricity supplied at the project site during the project activity
Source of data used:	estimated under the simplified methodology AMS-I.D.
Value applied:	0.412
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante and ex-post estimation of project activity emissions.
Any comment:	

Data / Parameter:	**PC_y**
Data unit:	MWh/y
Description:	The amount of electricity in the year y that is consumed at the project site for the project activity
Source of data used:	
Value applied:	578 MWh/y
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of project activity emissions. This value is based on the estimation by the manufacturer of project facilities.
Any comment:	

Data / Parameter:	**$COD_{y,ww,treated}$**
Data unit:	$tonnes/m^3$
Description:	Chemical oxygen demand of the treated wastewater in the year “y”
Source of data used:	Calculated value
Value applied:	$0.00003\ t/m^3$
Justification of the choice of data or description of measurement methods and procedures actually	This data is required to calculate ex-ante estimation of project activity emissions. This is based on the Vietnam environmental standard (TCVN 5945 -2005). Maximum COD of discharging from the plant is 30mg/L in type A category.

applied :	
Any comment:	

Data / Parameter:	**$MCF_{ww,final}$**
Data unit:	Fraction
Description:	Methane correction factor based on type of treatment and discharge pathway of the wastewater
Source of data used:	IPCC default value for anaerobic decay of the untreated wastewater
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of project activity emissions. MCF higher value of Anaerobic deep lagoon (depth more than 2 meters)" in table III.H.1 is used.
Any comment:	

Data / Parameter:	**$COD_{y,removed,j}$**
Data unit:	tonnes/m^3
Description:	Chemical oxygen demand removed by the anaerobic wastewater treatment system "i" in the baseline situation in the year "y"
Source of data used:	Laboratory analysis
Value applied:	0.014286 t/m^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is a key data for estimation of ex-ante project activity emissions and project activity emissions. This is based on the average value of the result of water content analysis according to APHA 5220 C. multiplied by the COD removal rate of digester employed in the project activity. 0.85 of COD removal rate is used.
Any comment:	

Data / Parameter:	**$MCF_{ww,treatment\_bl}$**
Data unit:	Fraction
Description:	Methane correction factor for the wastewater treatment system that will be equipped with methane recovery and combustion
Source of data used:	IPCC default value for anaerobic decay of the untreated wastewater
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of baseline emissions. MCF lower value of "Anaerobic deep lagoon" in table III.H.1 is used. Depth of existing lagoon is more than 3.5m.
Any comment:	

Data / Parameter:	**$MCF_{ww,treatment\_pr}$**
Data unit:	Fraction

Description:	Methane correction factor for the wastewater treatment system that will be equipped with methane recovery and combustion
Source of data used:	IPCC default value for anaerobic decay of the untreated wastewater
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of project activity emissions. MCF higher value of “Anaerobic reactor without methane recovery” in table III.H.1 is used. The digester to be employed in this project will be operated with well-managed conditions for methane fermentation.
Any comment:	

Data / Parameter:	**CFE_{ww}**
Data unit:	Fraction
Description:	Capture and flare efficiency of the methane recovery and combustion equipment in the wastewater treatment
Source of data used:	Default value from UNFCCC methodological tool to determine project emissions from flaring gases containing methane
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of project activity emissions. Default value of the small scale CDM methodology AMS III.H. is used
Any comment:	Flame is detected on minute basis and flow rate of biogas is monitored continuously to use this default value. Enclosed flare is used.

Data / Parameter:	**$[CH_4]_{y,ww,treated}$**
Data unit:	tCH_4/m^3
Description:	Dissolved methane content in the treated wastewater (tonnes/m^3)
Source of data used:	IPCC default value and AMS III.H.
Value applied:	0.0001
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of project activity emissions. Default value of the small scale CDM methodology AMS III.H. is used
Any comment:	

Data / Parameter:	**HGy**
Data unit:	TJ/y
Description:	The net quantity of steam/heat supplied by the project activity during the year y in TJ.
Source of data used:	
Value applied:	14.56 TJ/y

Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante and ex-post estimation of baseline emissions. In the ex-ante estimation, This value is equal to the heat output of the furnace to be employed in this project.
Any comment:	

Data / Parameter:	**EF CO_2**
Data unit:	tCO_2/TJ
Description:	The CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO_2 / TJ)
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2
Value applied:	94.60 tCO_2/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante and ex-post estimation of baseline emissions.
Any comment:	

Data / Parameter:	η_{th}
Data unit:	Fraction
Description:	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.
Source of data used:	IPCC default value and AMS I.C.
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante and ex-post estimation of baseline emissions. In accordance with No. 14 (c) of methodology AMS-I.C., maximum efficiency of 100% is used as a conservative assumption for η_{th}.
Any comment:	

Data / Parameter:	**EG_y**
Data unit:	MWh/yr
Description:	The kWh produced by the renewable generating unit
Source of data used:	Plan of the project perticipants
Value applied:	2400 MWh/yr
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to calculate ex-ante estimation of baseline emissions.

Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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The description of the ex-post emission reductions can be found under B.7.1

The ex-ante approach described in this section is used for an estimation of the emission reductions.

• **Component 1:** AMS- III.H. Methane Recovery in Wastewater Treatment

Ex-ante estimation of the baseline emissions:

$MEP_{y,ww,bl} = Q_{y,ww} * COD_{y,removed,i} * B_{o,ww} * MCF_{ww,treatment,bl}$

$= 438358\ (m^3/y) * 0.016777\ (t/m^3) * 0.21\ (kgCH_4/kgCOD) * 0.8$

$\mathbf{= 1236\ (tCH_4/y)}$

$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12 * MCF_{s,treatment}$

$\mathbf{= 0\ (tCH_4/y)}$

In this project, sludge flows into lagoons together with wastewater directly from existing starch processing plant, and there is no process to separate sludge from wastewater.

$BE_y = MEP_{y,ww,treatment} * GWP\_CH_4 + MEP_{y,s,treatment} * GWP\_CH_4$

$= 1236\ (tCH_4/y) * 21\ (tCO_2/tCH_4) + 0\ (tCH_4/y) * 21\ (tCO_2/tCH_4)$

$\mathbf{= 25956\ (tCO_2e/y)}$

Ex-ante estimation of the project activity emissions:

(i) CO_2 emissions on account of power used by the project activity facilities. Emission factors for grid electricity or diesel fuel use as the case shall be calculated as described in category AMS I.D;

$PE_{y,\ power} = PC_y * CEF_{grid\ BL}$

$= 578\ (MWh/y) * 0.496\ (tCO2e/MWh)$

$\mathbf{= 287\ (tCO_2e/y)}$

(ii) Methane emissions on account of inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater;

$PE_{y,ww,treated} = Q_{y,ww} * GWP\_CH_4 * B_{o,ww} * COD_{y,ww,treated} * MCF_{ww,final}$

$= 438358\ (m^3/y) * 21\ (tCO_2/tCH_4) * 0.21\ (kgCH_4/kgCOD) * 0.00003\ (tones/m^3) * 1.0$

$\mathbf{= 58\ (tCO_2e/y)}$

(iii) Methane emissions from the decay of the final sludge generated by the treatment systems;

$PE_{y,s,final} = S_{y,final} * DOC_{y,s,final} * MCF_{s,final} * DOC_F * F * 16/12 * GWP\_CH_4$

$\mathbf{= 0\ (tCO_2e/y)}$

In this project, sludge will flow into lagoons together with wastewater through the methane fermentation facilities, and there will be no process to separate sludge from wastewater.

(iv) Methane fugitive emissions on account of inefficiencies in capture and flare systems;

$MEP_{y,ww,treatment} = Q_{y,ww} * B_{o,ww} * COD_{y,removed,j} * MCF_{ww,treatment,pr}$
$= 438358 (m^3/y) * 0.21 (kgCH_4/kgCOD) * 0.014286 (t/m^3) * 1.0$
$= 1315 (tCH_4/y)$

$PE_{y,fugitive,ww} = (1 – CFE_{ww}) * MEP_{y,ww,treatment} * GWP\_CH_4$
$= (1- 0.9) * 1315 (tCH_4/y) * 21 (tCO_2/tCH_4)$
$= 2762 (tCO_2e/y)$

$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12 * MCF_{s,treatment}$
$= 0 (tCH_4/y)$

In this project, sludge will flow into lagoons together with wastewater through the methane fermentation facilities, and there will be no process to separate sludge from wastewater.

$PE_{y,fugitive,s} = (1 – CFE_s) * MEP_{y,s,treatment} * GWP\_CH_4$
$= 0 (tCO_2e/y)$

$PE_{y,fugitive} = PE_{y,fugitive,ww} + PE_{y,fugitive,s}$
$= 2762 (tCO_2e/y) + 0 (tCO_2e/y)$
$= 2762 (tCO_2e/y)$

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.

$PE_{y,dissolved} = Q_{y,ww} * [CH_4]_{y,ww,treated} * GWP\_CH_4$
$= 438358 (m^3/y) * 0.0001 (tCH_4/m^3) * 21 (tCO_2/tCH_4)$
= **$921 (tCO_2e/y)$**

(vi) Emissions related to the upgrading and compression of biogas

In this project, no biogas upgrading system will be applied.

$PE_{y,upgrading} = 0$ **(tCO_2e/y)**

(vii) Emissions due to physical leakage from the dedicated piped network

In this project, upgrading and transportation of biogas via a dedicated piped network will not be applied.

$PE_{y,leakage, pipeline} = 0$ **(tCO_2e/y)**

(vi) Amount of project activity emissions

$PE_y = PE_{y, power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,upgrading} + PE_{y,leakage, pipeline}$
$= 287\ (tCO_2e/y) + 58\ (tCO_2e/y) + 0\ (tCO_2e/y) + 2762\ (tCO_2e/y) + 921\ (tCO_2e/y)$
$+ 0\ (tCO_2e/y) + 0\ (tCO_2e/y)$
$= 4028\ (tCO_2e/y)$

Ex-ante estimation of the Leakage:

No technological equipment will be transferred from another activity and no existing equipment will be transferred to another activity.

Ex-ante estimation of the emission reductions:

$ERy = BE_y - PE_y - Leakage$
$= 25956\ (tCO_2e/y) - 4028\ (tCO_2e/y) - 0\ (tCO_2e/y)$
$= 21928\ (tCO_2e/y)$

- **Component 2:** AMS- I.C. Thermal energy for the user with or without electricity

Ex-ante estimation of the Baseline emissions:

$BEy = HGy * EF\ CO_2 / \eta_{th}$
$= 14.56\ (TJ) * 94.6\ (tCO_2/TJ) / 1.0$
$= 1377\ (tCO_2e/y)$

The furnace applied in the project activity will be co-fired system which use both captured biogas and Fuel Oil, and the furnace will be used instead of existing coal furnace. Therefore existing coal consumption will be displaced to captured biogas and Fuel Oil.
Note that only the heat displaced using captured biogas is considered as a baseline emission. The heat displaced using Fuel Oil is not included for a baseline emission as a conservative assumption.

Ex-ante estimation of the Leakage:

No energy generating equipment will be transferred from another activity and no existing equipment will be transferred to another activity.

Ex-ante estimation of the emission reductions:

$ERy = BE_y - Leakage$
$= 1377\ (tCO_2e/y) - 0\ (tCO_2e/y)$
$= 1377\ (tCO_2e/y)$

• **Component 3:** AMS- I.D. Grid connected renewable electricity generation

Ex-ante estimation of the Baseline emissions:

$BRy = EG_y * CEF_{grid\ PJ}$
$= 2400$ (MWh/yr) * 0.412 (tCO2e/MWh)
= **989 (tCO_2e/y)**

Determination of $CEF_{grid\ BL}$:
All the electricity to be consumed at the site of this project will be supplied by AC power through the grid. $CEF_{grid\ BL}$ was calculated by applying the calculation formula for combined margins based on Category I.D. Renewable electricity generation for a grid, which is a methodology for small-scale CDMs, to the electricity generation unit requirement in Viet Nam. **Tables B-3-1** and **B-3-2**, respectively, show the operating margins and build margins.
Based on these margins, the electricity generation unit requirement of a baseline grid can be calculated as follows:

$$CEF_{grid\ BL} = (0.650+0.342)/2=0.496\ (kg\text{-}CO_2/kWh)$$

Table B-3-1 : The average emission coefficient of operating margin from 2004 to 2006

Type of plants	Applied technology	EG (MWh)	η Average net energy conversion efficiency of power unit in year (%)	EF CO_2 Emission Factor (kg-CO_2/TJ)	CEF CO_2 Emissions Factor (kg-CO_2/kWh)	OMsimple Average Operating Margin CO_2 Emissions Factor (kg-CO_2/kWh)
Hydoro (Excluding)						
Coal-thermal (Other Bit.)	Subcritical (after 2000)	7,982,667	39.0	94,600	0.87	
Fuel Oil-thermal	Steam turbine (after 2000)	626,667	39.0	77,400	0.71	
Diesel oil thermal	Steam turbine (after 2000)	46,333	39.0	74,100	0.68	
Natural Gas	Steam turbine (after 2000)	16,331,333	37.5	56,100	0.54	
Total ΣP=		24,987,000				0.650
Data Source	Select the most conservative condiition from EB35 Report Annex I In the case of EG increase	ELECTRICYTY OF VIETNAM 2004-2005 EVN Anuual Report 2005-2006 EVN Corporate Profile 2006-2007	Default value EB35 Report Annex12 "Tool to calculate the emission factor an electricity system" Annex I	Default value 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Table1.4 Table2.2	Calculation CEF=EF*3.6/ η /10,000	Calculation

Table B-3-2: The average emission coefficient of build margin

Year of operation	Names of plants	Type of plants	Applied technology	EG (MWh)	η Average net energy conversion efficiency of power unit in year (%)	EF CO_2 Emission Factor (kg-CO_2/TJ)	CEF CO_2 Emissions Factor (kg-CO_2/kWh)	BM Build Margin CO_2 emissions factor (kg-CO_2/kWh)
2006	Cao Ngan	Coal(Other Bit.)	CFBS	445,000	40.0	94,600	0.85	
2006	Se San 3	Hydro		1,190,000			0.00	
2006	Se San 3A	Hydro		345,000			0.00	
2004	Na Duong,	Coal(Other Bit.)	CFBS	744,000	40.0	94,600	0.85	
2004	Phu my 4	Gas	Combined-cycle	3,142,000	60.0	56,100	0.34	
2004	Phu my 2.2	Gas	Combined-cycle	5,004,000	60.0	56,100	0.34	
2003	Phu my 2.1	Gas	Combined-cycle	5,843,000	60.0	56,100	0.34	
Total				16,713,000				0.342
Data Source	Report from National Load Dispatching Center of EVN				Default value EB35 Report Annex12 "Tool to calculate the emission factor an electricity system" Annex I	Default value 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Table1.4 Table2.2	Calculation CEF =EF*3.6/ η /10,000	Calculation
Note	Total EG is over 20% of total generation (MWh) in 2006 CFBS:Atmospheric Circulating Fluidised Bed Combustion							

Determination of $CEF_{grid\ PJ}$:

All the electricity to be consumed at the site of this project will be supplied by AC power through the grid. $CEF_{grid\ PJ}$ was calculated by applying the calculation formula for combined margins based on Category I.D. Renewable electricity generation for a grid, which is a methodology for small-scale CDMs, to the electricity generation unit requirement in Viet Nam. **Tables B-4-1** and **B-4-2**, respectively, show the operating margins and build margins.

Based on these margins, the electricity generation unit requirement of a project case grid can be calculated as follows:

$$CEF_{grid\ PJ} = (0.481+0.342)/2=0.412\ (kg\text{-}CO_2/kWh)$$

Table B-4-1 : The average emission coefficient of operating margin from 2004 to 2006

Type of plants	Applied technology	EG EG(MWh)	η Average net energy conversion efficiency of power unit in year (%)	EF CO_2 Emission Factor (kg-CO_2/TJ)	CEF CO_2 Emissions Factor (kg-CO_2/kWh)	OMsimple Average Operating Margin CO_2 Emissions Factor (kg-CO_2/kWh)
Hydoro (Excluding)						
Coal-thermal (Other Bit.)	Supercritical (after 2000)	7,982,667	45.0	94,600	0.76	
Fuel Oil-thermal	Open cycle (after 2000)	626,667	39.5	77,400	0.71	
Diesel oil thermal	Open cycle (after 2000)	46,333	39.5	74,100	0.68	
Natural Gas	Combined cycle (after 2000)	16,331,333	60.0	56,100	0.34	
Total ΣP=		24,987,000				0.481
Data Source	Select the most conservative condiition from EB35 Report Annex I In the case of EG decrease	ELECTRICYTY OF VIETNAM 2004-2005 EVN Anuual Report 2005-2006 EVN Corporate Profile 2006-2007	Default value EB35 Report Annex12 "Tool to calculate the emission factor an electricity system" Annex I	Default value 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Table1.4 Table2.2	Calculation CEF=EF*3.6/ η /10,000	Calculation

Table B-4-2: The average emission coefficient of build margin

Year of operation	Names of plants	Type of plants	Applied technology	EG (MWh)	η Average net energy conversion efficiency of power unit in year (%)	EF CO_2 Emission Factor (kg-CO_2/TJ)	CEF CO_2 Emissions Factor (kg-CO_2/kWh)	BM Build Margin CO_2 emissions factor (kg-CO_2/kWh)
2006	Cao Ngan	Coal(Other Bit.)	CFBS	445,000	40.0	94,600	0.85	
2006	Se San 3	Hydro		1,190,000			0.00	
2006	Se San 3A	Hydro		345,000			0.00	
2004	Na Duong,	Coal(Other Bit.)	CFBS	744,000	40.0	94,600	0.85	
2004	Phu my 4	Gas	Combined-cycle	3,142,000	60.0	56,100	0.34	
2004	Phu my 2.2	Gas	Combined-cycle	5,004,000	60.0	56,100	0.34	
2003	Phu my 2.1	Gas	Combined-cycle	5,843,000	60.0	56,100	0.34	
Total				16,713,000				0.342
Data Source	Report from National Load Dispatching Center of EVN				Default value EB35 Report Annex12 "Tool to calculate the emission factor an electricity system" Annex I	Default value 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Table1.4 Table2.2	Calculation CEF =EF*3.6/ η /10,000	Calculation
Note	Total EG is over 20% of total generation (MWh) in 2006 CFBS:Atmospheric Circulating Fluidised Bed Combustion							

Ex-ante estimation of the Leakage:

No energy generating equipment will be transferred from another activity and no existing equipment will be transferred to another activity.

Ex-ante estimation of the Leakage:

No energy generating equipment will be transferred from another activity and no existing equipment will be transferred to another activity.

Ex-ante estimation of the emission reductions:

ERy = BE_y - Leakage
= 989 (tCO_2e/y) - 0 (tCO_2e/y)
= 989(tCO_2e/y)

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

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Summarize the results of the ex-ante estimation of emission reductions for all years of the crediting period, using the table below.
The project activity involves three components, **Component 1:** AMS-III.H., **Component 2:** AMS-I.C. and **Component 3:** AMS-I.D.
Three separate tables for each Components of the approved project category are applied as show in Table B.6-1, B.6-2., B.6-3. and B.6-4.
Table B.6-4 shows the aggregate emission reductions of the project activity for 10 years crediting period.

Table B.6-1 **Component 1 :** AMS-III.H Methane Recovery in Waste Water Treatment

Year	Estimation of project activity emissions (Tonnes of CO_2e)	Estimation of baseline Methane emissions (Tonnes of CO_2e)	Estimation of Leakage (Tonnes of CO_2e)	Estimation of emission reductions by Methane Recovery (Tonnes of CO_2e)
2009	1,015	6,541	0	5,526
2010	4,028	25,956	0	21,928
2011	4,028	25,956	0	21,928
2012	4,028	25,956	0	21,928
2013	4,028	25,956	0	21,928
2014	4,028	25,956	0	21,928
2015	4,028	25,956	0	21,928
2016	4,028	25,956	0	21,928
2017	4,028	25,956	0	21,928
2018	4,028	25,956	0	21,928
2019	3,013	19,415	0	16,402
Total (tCO_2e)	40,280	259,560	0	219,280

Table B.6-2 **Component 2 :** AMS-I.C. Thermal energy for the user with or without electricity

Year	Estimation of project activity emissions (Tonnes of CO_2e)	Estimation of baseline emissions by coal combustion (Tonnes of CO_2e)	Estimation of Leakage (Tonnes of CO_2e)	Estimation of emission reductions for thermal Energy (Tonnes of CO_2e)
2009	0	347	0	347
2010	0	1,377	0	1,377
2011	0	1,377	0	1,377
2012	0	1,377	0	1,377
2013	0	1,377	0	1,377
2014	0	1,377	0	1,377
2015	0	1,377	0	1,377
2016	0	1,377	0	1,377
2017	0	1,377	0	1,377
2018	0	1,377	0	1,377
2019	0	1,030	0	1,030

Total (tCO_2e)	0	13,770	0	13,770

Table B.6-3 **Component 3 :** AMS-I.D. Grid connected renewable electricity generation

Year	Estimation of project activity emissions (Tonnes of CO_2e)	Estimation of baseline emissions by displacing grid electricity (Tonnes of CO_2e)	Estimation of Leakage (Tonnes of CO_2e)	Estimation of emission reductions for thermal Energy (Tonnes of CO_2e)
2009	0	249	0	249
2010	0	989	0	989
2011	0	989	0	989
2012	0	989	0	989
2013	0	989	0	989
2014	0	989	0	989
2015	0	989	0	989
2016	0	989	0	989
2017	0	989	0	989
2018	0	989	0	989
2019	0	740	0	740
Total (tCO_2e)	0	9,890	0	9,890

Table B.6-4 Summary of estimation of overall emission reductions

Year	Estimation of project activity emissions (Tonnes of CO_2e)	Estimation of baseline emissions (Tonnes of CO_2e)	Estimation of Leakage (Tonnes of CO_2e)	Estimation of overall emission reductions (Tonnes of CO_2e)
2009	1,015	7,137	0	6,122
2010	4,028	28,322	0	24,294
2011	4,028	28,322	0	24,294
2012	4,028	28,322	0	24,294
2013	4,028	28,322	0	24,294
2014	4,028	28,322	0	24,294
2015	4,028	28,322	0	24,294
2016	4,028	28,322	0	24,294
2017	4,028	28,322	0	24,294
2018	4,028	28,322	0	24,294
2019	3,013	21,185	0	18,172
Total (tCO_2e)	40,280	283,220	0	242,940

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

B.7.1 Data and parameters monitored:

- **Component 1:** Methane Recovery in Wastewater Treatment

Data / Parameter:	**EC_y (ID_1)**
Data unit:	GWh/yr
Description:	Amount of electricity in the year y that is consumed at the project site for the project activity
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate project emissions
Description of measurement methods and procedures to be applied:	Measurement by a watt-hour meter
QA/QC procedures to be applied:	Electricity meters will undergo maintenance/calibration subject to appropriate industry standards. The accuracy of the meter readings will be verified by receipts issued by the purchasing power company. Uncertainty of the meters to be obtained from the manufacturers. This uncertainty to be included in a conservative manner while calculating CERs.
Any comment:	Data should be kept two years after last issuance of CERs

Data / Parameter:	**$W_{CH4,y}$ (ID_2)**
Data unit:	m^3_{CH4}/m^3_{biogas}
Description:	Percentage of methane
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	Calculated based on analytical data obtained in sampling
QA/QC procedures to be applied:	Sampling will be carried out adhering to internationally recognized procedures.
Any comment:	Data should be kept two years after last issuance of CERs

Data / Parameter:	**$BG_{flare,y}$ (ID_3)**
Data unit:	Nm^3/yr
Description:	The amount of biogas flowed into the flaring system in year y
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be	Measurement by flow meter

applied:	
QA/QC procedures to be applied:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The frequency of calibration and control procedures would be different for each application e.g. wastewater flow rate, gas flow rate, etc.
Any comment:	Data should be kept two years after last issuance of CERs Parameter monitored continuously but aggregated monthly for calculations

Data / Parameter:	**$BG_{boiler,y}$ (ID_4)**
Data unit:	Nm^3/yr
Description:	The amount of biogas consumed in the air-dryer in year y
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	Measurement by flow meter
QA/QC procedures to be applied:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The frequency of calibration and control procedures would be different for each application e.g. wastewater flow rate, gas flow rate, etc.
Any comment:	Data should be kept two years after last issuance of CERs Parameter monitored continuously but aggregated monthly for calculations

Data / Parameter:	**$BG_{furnace,y}$ (ID_5)**
Data unit:	Nm^3/yr
Description:	The amount of biogas consumed in the air-dryer in year y
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	Measurement by flow meter
QA/QC procedures to be applied:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The frequency of calibration and control procedures would be different for each application e.g. wastewater flow rate, gas flow rate, etc.
Any comment:	Data should be kept two years after last issuance of CERs Parameter monitored continuously but aggregated monthly for calculations

Data / Parameter:	**$BG_{generator,y}$ (ID_6)**
Data unit:	Nm^3/yr
Description:	The amount of biogas consumed in the power generator in year y
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods	Measurement by flow meter

and procedures to be applied:	
QA/QC procedures to be applied:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The frequency of calibration and control procedures would be different for each application e.g. wastewater flow rate, gas flow rate, etc.
Any comment:	Data should be kept two years after last issuance of CERs Parameter monitored continuously but aggregated monthly for calculations

Data / Parameter:	**T_{flare} (ID_7)**
Data unit:	deg C
Description:	Temperature of exhaust gas of flare
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to estimate project emissions due to emissions of flare inefficiency
Description of measurement methods and procedures to be applied:	Measurements by temperature meter
QA/QC procedures to be applied:	-
Any comment:	Data should be kept two years after last issuance of CERs Daily average is monitored but monthly average is used in the calculations

Data / Parameter:	**Other flare operation parameters (ID_8)**
Data unit:	-
Description:	This should include all data and parameters that are required to monitor whether the flare operates within the range of operating conditions according to the manufacturer’s specifications.
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to estimate project emissions due to emissions of flare inefficiency
Description of measurement methods and procedures to be applied:	Continuously
QA/QC procedures to be applied:	-
Any comment:	Only applicable in case of use of default value

• **Component 2:** Thermal energy for the user with or without electricity

Data / Parameter:	**$F_{furnace}$ (ID_9)**
Data unit:	m^3
Description:	Daily amount of flow volume of medium oil
Source of data to be	Measurements by project participants

used:	
Value of data	Value of data would be used to estimate project emissions due to emissions of flare inefficiency
Description of measurement methods and procedures to be applied:	Measurements by flow meter
QA/QC procedures to be applied:	-
Any comment:	Data should be kept two years after last issuance of CERs Daily average is monitored but monthly average is used in the calculations

Data / Parameter:	**$T_{furnace,in}$ (ID_10)**
Data unit:	deg C
Description:	Daily average of intlet temperature of medium oil fed into the furnace under operation
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to estimate project emissions due to emissions of flare inefficiency
Description of measurement methods and procedures to be applied:	Measurements by temperature meter
QA/QC procedures to be applied:	-
Any comment:	Data should be kept two years after last issuance of CERs Daily average is monitored but monthly average is used in the calculations

Data / Parameter:	**$T_{furnace,out}$ (ID_11)**
Data unit:	deg C
Description:	Daily average of outlet temperature of medium oil from the furnace under operation
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to estimate project emissions due to emissions of flare inefficiency
Description of measurement methods and procedures to be applied:	Measurements by temperature meter
QA/QC procedures to be applied:	-
Any comment:	Data should be kept two years after last issuance of CERs Daily average is monitored but monthly average is used in the calculations

- **Component 3:** Grid connected renewable electricity generation

Data / Parameter:	**EG_y (ID_12)**
Data unit:	MWh/yr
Description:	Electricity output of the power generator in year y
Source of data to be used:	Measurements by project participants
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	Measurement by Watt-hour meter
QA/QC procedures to be applied:	-
Any comment:	Data should be kept two years after last issuance of CERs Daily average is monitored but monthly average is used in the calculations

<u>Ex-post calculations of emission reductions:</u>

The ex-post emission reductions are calculated according to sum of the calculation results of each component.

$ER_y = ER_{1,y} + ER_{2,y} + ER_{3,y}$

Where:

$ER_{1,y}$ = Emission reductions by the methane captured and destroyed by the project activity in the year "y" in tones CO_2-eq in Component 1.

$ER_{2,y}$ = Emission reduction from steam/heat displaced by the project activity during the year y in tones CO_2e in Component 2.

$ER_{y,3}$ = Emission reduction from grid electricity displaced by the project activity during the year y in tones CO_2e in Component 3.

• **<u>Component 1</u>:** Methane Recovery in Wastewater Treatment

The ex-post emission reductions are determined by measuring the methane captured and destroyed by the project activity during a year.

The monitored volume of biogas (BGi) is automatically corrected to standard conditions by the measuring equipment, therefore no temperature and pressure measurement are required. The standard value for the density is derived from the standard conditions used for correction of the volume.

The project emissions are resulting from incomplete combustion of the biogas. Since the boilers have a combustion efficiency of 100% the only project emissions occur at the flare.
The project emissions are determined as in the Methodological "Tool to determine project emissions from flaring gases containing methane" (EB 28- annex 13). The project uses an enclosed flare, and use of the default value.

By monitoring the above parameters the amount of methane captured and destroyed can be calculated according to:

$ER_{1,y} = (MD_y * GWP\_CH_4) – (EC_y * CEF_{grid})$

Where:

MD_y = Amount of methane fuelled and flared in year "y" in tonnes
EC_y = Electricity consumption from the biogas capture equipment in the year "y" GWh/year
Note: in the baseline situation there is no electricity usage.
CEF_{grid} = Emission factor of grid in tCO_2-eq/GWh. Determined under ex-ante estimation and fixed throughout the crediting period.
GWP_CH_4 = Global warming potential for CH_4 (value of 21 is used)

The amount of methane destroyed is determined by adding the methane fed into the boiler, the furnace, the power generator and the flare:

$MD_y = MD_{boiler,y} + MD_{furnace,y} + MD_{generator,y} + MD_{flare,y}$

Where:

$MD_{boiler,y}$ = Amount of methane destroyed in year "y" by boiler in tonnes
$MD_{furnace,y}$ = Amount of methane destroyed in year "y" by furnace in tonnes
$MD_{generator,y}$ = Amount of methane destroyed in year "y" by power generator in tonnes
$MD_{flare,y}$ = Amount of methane destroyed in year "y" by flare in tonnes

The amount of methane destroyed in the boiler, furnace and power generator is calculated according to;

$MD_{boiler,y} = BG_{boiler,y} * W_{CH4,y} * D_{CH4}$
$MD_{airdryer,y} = BG_{furnace,y} * W_{CH4,y} * D_{CH4}$
$MD_{generator,y} = BG_{generator,y} * W_{CH4,y} * D_{CH4}$

Where:

$BG_{boiler,y}$ = The quantity of biogas fed into boiler in year "y" by boiler in Nm^3
$BG_{furnace,y}$ = The quantity of biogas fed into furnace in year "y" by furnace in Nm^3
$BG_{generator,y}$ = The quantity of biogas fed into generator in year "y" by power generator in Nm^3
$W_{CH4,y}$ = The average methane fraction of the biogas as measured during the year "y" and expressed as a fraction (in m^3CH_4/m^3Biogas)
D_{CH4} = The methane density expressed in tones of methane per cubic meter of methane (tCH_4/m^3CH_4)

The amount of methane destroyed in the flare is calculated according to;

$$MD_{flare,y} = BG_{flare,y} * W_{CH4,y} * D_{CH4} * \eta_{flare,h}$$
$$= \sum_{n=1}^{8760} BG_{flare,h} * W_{CH4,y} * D_{CH4} * \eta_{flare,h}$$

Where:

$BG_{flare,y}$ = The quantity of biogas fed into flare in year "y" by boiler in Nm^3
$\eta_{flare,h}$ = Flare efficiency in the hour *h*

The flare efficiency in the hour *h* ($\eta_{flare,h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C 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 °C 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 °C 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*.

- **Component 2:** Thermal energy for the user with or without electricity

The ex-post emission reductions are determined by measuring the heat output of the furnace installed in the project activity. The ex-post emission reductions are calculated according to the formula as same as ex-ante calculation.

$ER_{2,y} = HG_y * EF\ CO_2 / \eta_{th,existing}$

Where;
HG_y = The net quantity of steam/heat supplied by the project activity during the year y in TJ.
$EF\ CO_2$ = The CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO_2 / TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used.
$\eta_{th,existing}$ = The efficiency of the existing plant using fossil fuel that would have been used in the absence of the project activity. (In accordance with No. 14 (c) of methodology AMS-I.C., maximum efficiency of 100% is used as a conservative assumption)

The heat output of the furnace can be calculated according to:

$$HG_y = \sum_{n=1}^{365} HG_d / 1000$$

$$HG_d = F_{oil} * (T_{out,oil} - T_{in,oil}) * SH_{oil} * D_{oil}$$

Where;
HG_d = The net quantity of steam/heat supplied by the project activity during the day in GJ.
$F_{furnace}$ = Daily amount of flow volume of medium oil in m^3
$T_{furnace,out}$ = Daily average of outlet temperature of medium oil from the furnace under operation in deg C
$T_{furnace,in}$ = Daily average of inlet temperature of medium oil fed into the furnace under operation in deg C
SH_{oil} = Specific heat of medium oil in GJ/t
D_{oil} = Density of medium oil in t/ m^3

• **<u>Component 3</u>:** Grid connected renewable electricity generation

The ex-post emission reductions are determined by measuring the electricity generated by the renewable power generating unit installed in the project activity. The ex-post emission reductions are calculated according to the formula as same as the ex-ante calculation.

$ER_{3,y} = EG_y * CEF_{grid}$

Where;

EG_y = The generated electricity in year "y" by the renewable generating unit in kWh

CEF_{grid} = Emission factor of grid in tCO_2-eq/GWh. Determined under ex-ante estimation and fixed throughout the crediting period.

B.7.2 Description of the monitoring plan:

>>

The monitoring items are shown in Figure B-2. The Numbers in the diagram indicate ID Numbers.

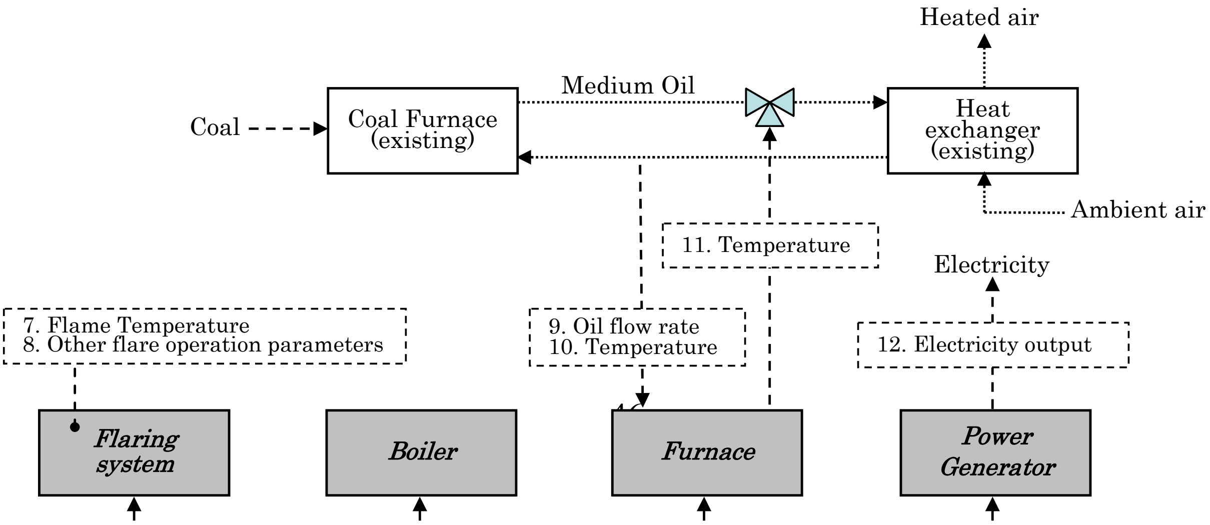

Figure B-2: Monitoring items

The organization that takes responsibility to conduct the management and monitoring of the project is shown in annex 4.

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

>>

Date of completion: 3 March 2008

Persons responsible:
Mr. Seiichiro Sano
Environmental Systems Engineering Department
TOSHIBA CORPORATION
1-1, Shibaura 1-Chome, Minato-ku, Tokyo 105-8001
Japan
Tel No: +81-3-3457-4181 Email: seiichiro1.sano@toshiba.co.jp

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:

>>
01/10/2008

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

>>
11 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:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/10/2009

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

The conclusion of Environmental Impact Assessment Report of CDM project is that environmental impacts such air pollution, water contamination may occur along with construction and operation, however, the project's overall impact on environment will not only be small but also be reduced to minimum by implementation of project.

Negative impacts on environment during construction include air pollution, water pollution and noise to some extent, as material transportation, increase of number of worker, installing of digester and pipelines. These negative impacts shall be reduced by taking the following mitigation measure: use truck with closed body for transportation of material, minimize the transport activities in the peak hours, spray water at site in the very hot and windy days etc.

Negative impacts on environment during operation include water and groundwater pollution, air pollution due to discharge of treated water to Tan Hiep channel and methane gas from flare and air-heating furnace may occur in case of incident happen with digester and flare. These negative impacts shall be reduced by taking the following mitigation measure: the stacks of flare and air-heating furnace will be made 3 meters higher than the roof of Truong Thnih plant for good dispersion of flue gas. The bottom of lagoons will be reinforced for prevention of groundwater pollution. The characteristics of inlet and outlet wastewater from treatment system will be strictly controlled. The solid waste (wet cassava residue) will be collected and transported to the sun dried site immediately etc.

The positive environmental impacts of the project activity are as follows:

-The project activity will reduce methane emission from existing lagoons to the atmosphere. This will improve working condition of employees of the factory and also improve living environmental conditions of the residents in surrounding area of the plant.

-The project will minimize the surface and ground water pollution by improving the treated wastewater quality before entering the lagoons.

- The project activity will reduce CO_2 emissions from coal combustion at the furnace by displacing coal to biogas, which is captured from installed anaerobic digester. Other emission from coal burning such as SO_X is also reduced

- In the project activity, total amount of 24,294 tCO_2 /year is expected to reduce by avoiding methane gas emissions from the existing open lagoons and by substituting coal with captured biogas.

Conclusion: Construction and operation period of the project will not bring out any negative impacts to the environment but will improve current environmental conditions as said above.

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

The Environmental Impact Assessment Report of CDM project has been conducted by the project participants. The contents of Environmental Impact Assessment Report which is required for approval process of CDM project in Vietnam is corresponding with the requirements of new Environmental Protection Law of 2006

The Environmental Impact Assessment Report was submitted to People's Committee and Department of Natural Resource and Environment of Tay Ninh in March 2007. People's Committee of Tay Ninh

formed a Committee for review EIA Report. It took about 30 days from submitting EIA report to Tay Ninh people's committee to receiving approval.
During preparation of EIA report, project participants have received the comments from people's Committee of Tan Hiep Village and Fatherland Front of Tan Hiep Village. This is formal procedure required by Environmental Protection Law of 2006.

The certificate of approval of EIA was given by Chairman of Tay Ninh people's committee on beginning of April 2007.

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:

>>
Not applicable

SECTION E. Stakeholders' comments

>>

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

>>
The conceptual plan of the CDM project activity was explained to Tay Ninh People's Committee (Local Authority) and relevant organizations of Tay Ninh such as Department of environment and Natural Resource, Department of Planning and Investment. They support the implementing of the project.
The conceptual plan of the CDM project activity was also explained to also Ministry of Agriculture and Rural Development (MARD) and Ministry of Environment and Natural Resources for getting the support in the approval procedures because they are Central government Authorities on CDM and tapioca starch development control.

The project design document of wastewater treatment with Anaerobic Digester at Truong Thnih starch-processing plant has been submitted to Tay Ninh People's Committee under the signature of Truong Thnih, a project partner. Tay Ninh People's Committee informed relevant parties of the project in writing and gathered their comments. Tay Ninh People's Committee sent the comments to Truong Thnih.
The project design document also has been submitted to MARD for stakeholder comments.

E.2. Summary of the comments received:

>>
All Parties welcome the participations of Truong Thnih and TOSHIBA Corporation in the project and support the implementation of project at Truong Thnih plant.

1. Ministry of Agriculture and Rural Development (MARD): This is a project for wastewater treatment with Anaerobic Digester at a starch processing plant and recovering the biogas that will be displacing coal for air-heating furnace. The project will improve the environment of Tay Ninh Province and promote the use of renewable energy in Vietnam. The treatment Technology may be transferred and used for other tapioca starch plants in Tay Ninh and other provinces.
2. Tay Ninh People's Committee and other relevant parties: Support this project because this is the first tapioca starch plant in Tay Ninh that is to be implemented under CDM policy. The project will not affect on the environment and also contribute to the economic development of Tay Ninh.

3. TRUONG THNIH CO., LTD supports the implementation of project and wishes the project would be build as soon as possible.

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

>>

At present project has not received any claims from local stakeholders to obstruct project implementation. All the local stakeholders including people's Committee of Tan Hiep Village and Fatherland Front of Tan Hiep Village support the project implementation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	TOSHIBA CORPORATION
Street/P.O.Box:	1-1, Shibaura 1-Chome
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City:	Minato-ku
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FAX:	
E-Mail:	
URL:	http://www.toshiba.co.jp/index_j3.htm
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Sano
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Direct tel:	+81-3-3457-4181
Personal E-Mail:	seiichiro1.sano@toshiba.co.jp

Organization:	TRUONG THNIH CO., LTD
Street/P.O.Box:	Tan Chau District, Suoi Ngo Village
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City:	
State/Region:	Tay Ninh Province
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FAX:	+84-66-732192
E-Mail:	
URL:	
Represented by:	
Title:	President
Salutation:	Mr.
Last Name:	VU
Middle Name:	HOANG
First Name:	LONG
Department:	
Mobile:	

Direct FAX:	
Direct tel:	
Personal E-Mail:	

<u>Annex 2</u>

INFORMATION REGARDING PUBLIC FUNDING

No public funding will be utilized to finance the project activity.

Annex 3

BASELINE INFORMATION

The following tables “Table Annex 3.1 –3” summarises the data used in the *ex-ante* calculations of baseline emissions.

Table Annex 3.1 Operation data of TRUONG THNIH factory (2006 -2007)

Item		Value	Remarks
Annual starch production volume	2006	25,343 t/year	According to the data provided by plant owner
	2007	15,625 t/year	According to the data provided by plant owner
	Average of 2006-2007	20,484 t/year	According to the data provided by plant owner
Annual power consumption	Average of 2006-2007	3,810,416 kWh/year	According to the data provided by plant owner
Power consumption per production	-	185.0 kWh/t-starch	Calculation
Average coal consumption per production	Average of Jan.-Mar., 2008	0.034 t-coal/t-starch	Calculation according to the data provided by plant owner

Table Annex 3.2 Measurement results of wastewater flow volume (Dec. 21, 2007 - Feb.21, 2008)

Item	Value	Remarks
Amount of starch production volume from Dec. 21,2007 to Mar.13, 2008	6084.3 t	According to the data provided by plant owner
Amount of wastewater flow volume from Dec. 21,2007 to Mar.13, 2008	130100 m^3	Data of measurement
Wastewater flow rate per production	21.4 m^3/t-starch	Calculation

Table Annex 3.3 Analysis results of water content (Dec., 2007 - Feb., 2008)

Sampling date	COD	Remarks
Dec. 11, 2007	36,700 mg/L	
Jan. 14, 2008	9,088 mg/L	
Feb. 20, 2008	11,795 mg/L	
Mar. 1, 2008	9,644 mg/L	
Average	16,807 mg/L	

Annex 4

MONITORING INFORMATION

1. Organization

Monitoring formation is shown in Figure Annex 4.1

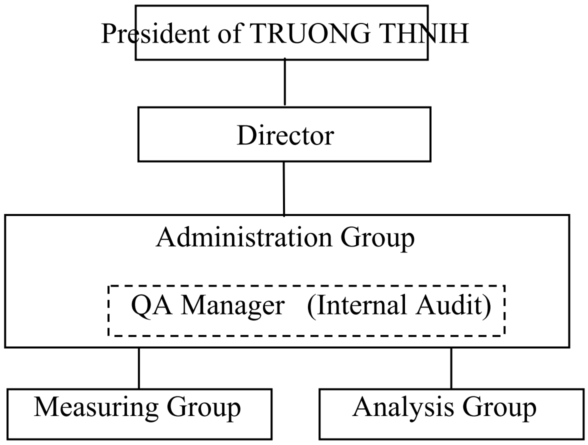

Figure Annex 4.1 Monitoring formation

- President of TRUONG THNIH is the top of this organization.
- Director has responsibilities to carry out the monitoring plan and advice to the stuff of administration group.
- Administration Group shall carry out the management work for measuring group and analysis group.
- QA manager belongs to administration group and makes an internal audit periodically.
- Measuring Group and Analysis Group shall carry out the measuring, calculation, and analysis, These are based on the monitoring plan.

2. Monitoring period

- Monitoring period is from Jan. 2009 to Dec. 2022.

3. Data keeping

- Data shall be put into the computer as the electronic data, which is handled by the computer software. Backup data is stored in the recording device periodically.
- Data shall be arranged to the monthly report once a month.
- The monthly report shall be kept from Jan. 2009 to Dec. 2027 in the factory.

4. Device maintenance

- In order to keep the accuracy of measuring devices, maintenance shall be done periodically.

5. Accuracy keeping

- In order to keep the accuracy of water analysis, analysis is done based on the international standard by the specialty testing body.
- In order to keep the accuracy of measuring, calculation, and analysis in this organization, internal audit is done periodically.

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