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

CONTENTS

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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.

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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 Viet Ma starch processing plant in Tay Ninh, Vietnam

Version 1.0, 16 June 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. Therefore the amount of CO_2 emissions derived from combustion of coal as fossil fuels.

Description of the project activity
- VIET MA CO., LTD. is capable of producing 120 tons per day of Tapioca starch.
  VIET MA CO., LTD. currently produces approximately 33,000 tons of Tapioca starch per year, and its production process emits approximately 2,300 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 VIET MA 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 thermal energy generation facilities, which is composed of boiler and furnace 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 39,814 tCO_2/year is expected to reduce by avoiding methane gas emissions from the existing open lagoons, by substituting coal with 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, 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

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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)
Socialist Republic of Vietnam (host)	VIET MA CO., LTD	No
Japan	TOSHIBA CORPORATION	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):
>>
Socialist Republic of Vietnam

A.4.1.2.   Region/State/Province etc.:
>>
Tay Ninh Province

A.4.1.3.   City/Town/Community etc:
>>
Tan Chau District, Tan Hiep Village

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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 VIET MA CO., LTD in Tay Ninh Province (Figure A-1)

Precise coordinates of the project site are latitude 11° 35' N, longitude 106 10' E.
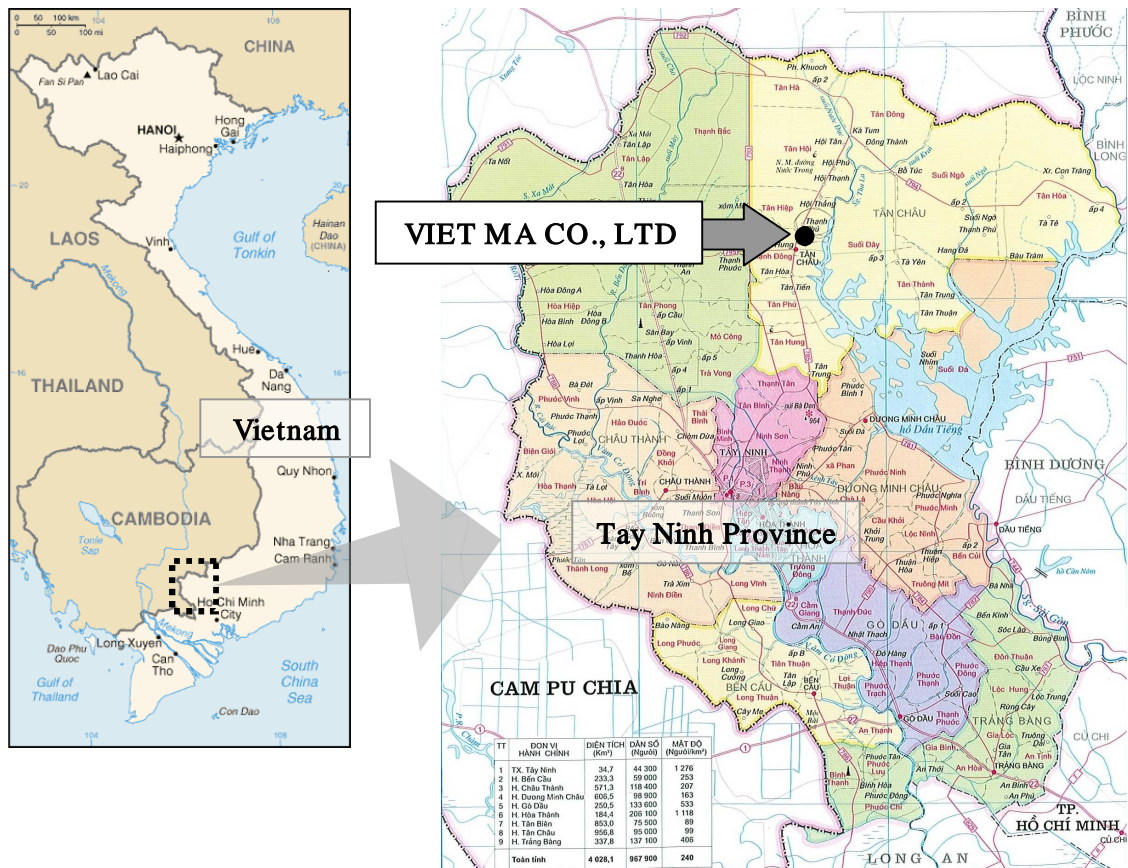
Figure A-1: Location of the Project activity

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 two 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)")

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

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simplified modalities and procedures for small-scale CDM project activities, because:

♦ The project activity introduces a sequential stage of wastewater treatment with 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 starch processing.

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

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-2)
- 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 treated in the desulfurizing facilities will be fed to the boiler as one of the energy generation facilities for producing steam. Produced steam will be consumed as a heat source for heating the digester.
- The remaining biogases will be used as a fuel of the furnace as one of 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 Fuel Oil, except when the biogas is short for continuous operation of the furnace.
- In principle, biogases that will be generated and recovered in the methane fermentation facilities will almost be used in the boiler and furnace. When these energy generation facilities are not running and excessive biogases are generated, these gases will be burnt in the flaring system.
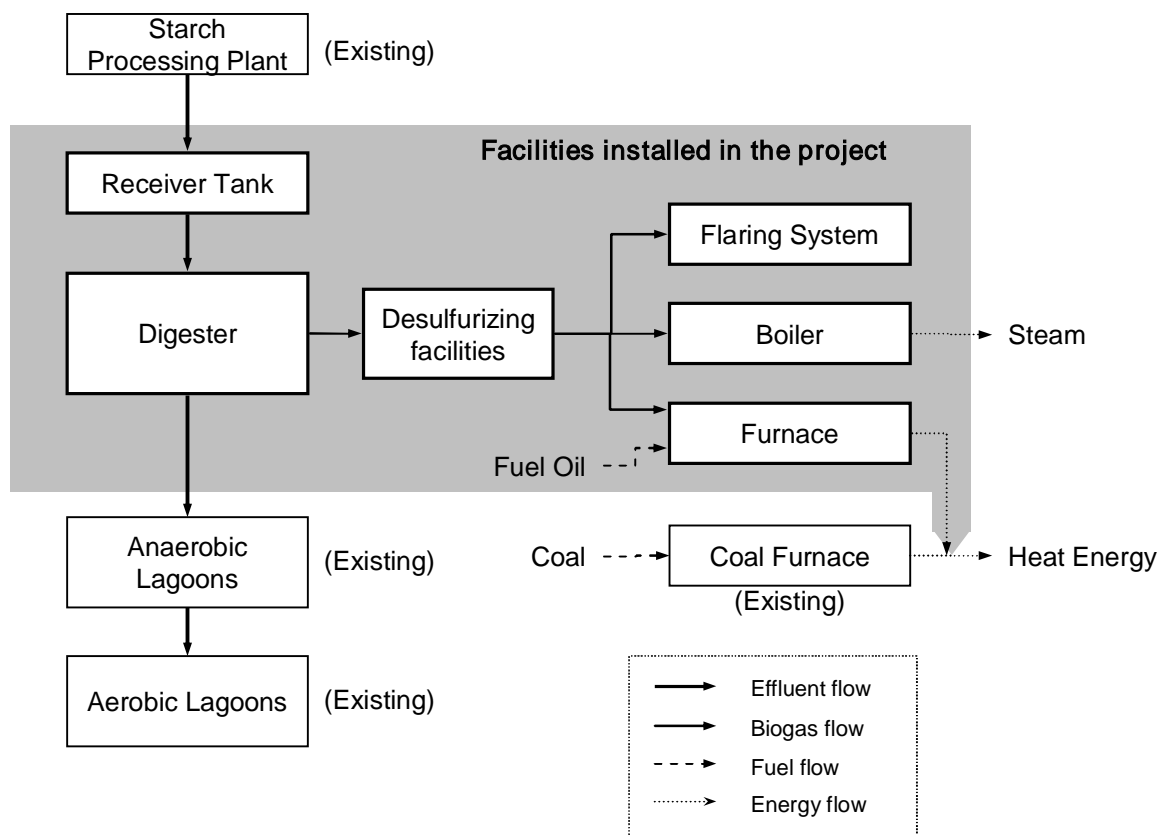
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Figure A-2: Process diagram of the Project wastewater treatment system

- 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 2160 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	40,000 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

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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 Vietnam, 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 563tCH_4/yr of captured methane in the project activity.
- The furnace will be used to generate heat energy for starch 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 1169tCH_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 flaring system will burn 428tCH_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 39,814tCO_2 every year, and the total acquired CERs during the crediting period of 10 years will be 398,140tCO_2.

Years	Annual estimation of emission reductions in tonnes of tCO_2e
2009 (Apr. 1-)	29,861
2010	39,814
2011	39,814
2012	39,814
2013	39,814
2014	39,814
2015	39,814
2016	39,814
2017	39,814
2018	39,814
2019 (- Mar. 31)	9,953
Total estimated reductions (tCO_2e)	398,140
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tCO_2e)	39,814

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A.4.4. Public funding of the <u>small-scale project activity</u>:

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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 <u>small-scale project activity</u> is not a <u>debundled</u> 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.

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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)

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 34,989tCO$_2$/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 and the furnace will be 4.1MW$_{thermal}$ and thus below the limit 45MW$_{thermal}$ for type I.C. 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.

Options for technology/ measure for AMS- III.H.	Justification Applicability of the project category
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.	Not applicable; The project involves introduction of a sequential stage of wastewater treatment to an existing anaerobic wastewater treatment system.
(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).	**Applicable;** The project involves 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	**Applicable;** The recovered methane is used for thermal energy generation directly.
(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.	Not applicable; The recovered methane is used for thermal energy generation directly.
3. If the recovered methane is used for project activities covered under paragraph 2 (a), that component of the project activity can use a corresponding category under type I.	**Applicable** Type I.C. : The recovered methane is used for heat generation by the project, therefore Type I.C. 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	Not applicable; No biogas bottling will be applied in the project activity.

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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.	
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 (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" is applicable for the calculations of the emission reductions achieved by the project activity.

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

Options for technology/ measure for AMS- I.C.	Justification Applicability of the project category
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 will not exceed 45MW.

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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 will 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 from the existing units.	Not Applicable; There is no existing renewable energy facility.

The total installed capacity of the boiler and the furnace included in the project activity is 4.1MW$_{thermal}$ this is below the threshold of 45MW$_{thermal}$. 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
Total	**4.1**

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

B.3.   Description of the project boundary:

>>
- 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.

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.

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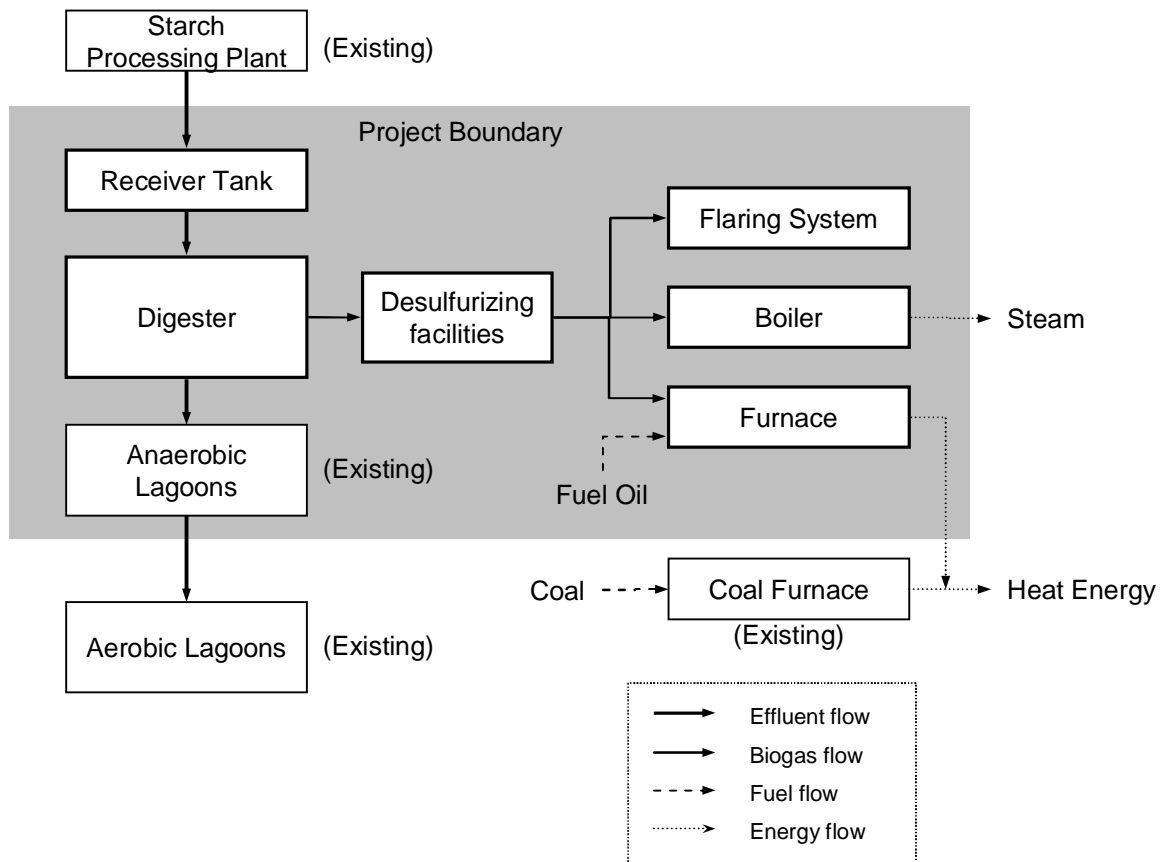
Figure B-1: Project Boundary

B.4. Description of <u>baseline and its development</u>:

>>

The project reduces greenhouse gas emissions in two ways:
(1) by methane capture and combustion in a wastewater treatment system : Component 1
(2) by replacement of fossil fuel used for heat generation at starch processing with captured methane (thermal energy for the user) : Component 2

The baseline for the two components is identified as follows.

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

The existing wastewater treatment system consists of anaerobic and aerobic open lagoons. The effluent of starch processing plant first flows into the anaerobic lagoons. Depth of the anaerobic lagoons are around 3.5m, thus these lagoons are kept in anaerobic condition. The anaerobic 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. Afterwards the treated wastewater flows into the aerobic lagoons.

Existing open lagoon based wastewater treatment system can be operated easily, and needs low running cost and no additional investment. Thus, the baseline scenario is continuation of the present open lagoon based treatment and release of methane into the atmosphere.

In accordance with the methodology AMS- III.H., the above stated conditions fit well with paragraph 23 scenario (vi) of AMS-III.H./Version 09.
Applicable situation is shown in the following table.

The baseline scenario of AMS- III.H./Version 09	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 has no methane recovery and combustion.
(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.	Not applicable; The project introduces a sequential anaerobic wastewater treatment system with methane recovery.
(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.	**Applicable**

The baseline emission of Component 1 is calculated to be 41,393tCO_2/year for this project.

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

The captured biogas in Component 1 will be used to produce thermal energy for starch processing. Without the implementation of installing project facilities, it is impossible to use renewable energy for production of thermal energy.

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 a fuel in the starch processing because of its low fuel cost. Therefore large amount of carbon dioxide is emitted into the atmosphere with exhaust gas from starch processing by coal combustion.

The baseline emission of Component 2 is calculated to be 4,825tCO$_2$/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 the following barriers:

Investment barriers
An investment analysis of the project activity was conducted with IRR (Internal Rate of Return) as a financial indicator. The investments, costs and revenues to be used in calculations of IRR for the project implementation are shown in the following table.

Parameter	Value
Capital cost inclusive of: Engineering, procurement & construction	2.30 million USD
Operation & maintenance cost inclusive of: Labour, administration, repair, fuel and power cost	63,685 USD/year
Revenue from sales of biogas for coal alternative	184,643 USD/year
CER price	0, 5, 10, 15 US$/tCO$_2$

Based on the foregoing data, IRR with and without CER was calculated. In the calculations, the CER trading price was set at 5 USD/tCER to 15 USD/tCER, and evaluation was made taking fluctuations of the trading price into consideration.
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 Vietnam government bonds, coupons (yield)).
The results of IRR calculations are shown in the following table. (The details of the IRR calculations are shown in Appendix 1.)

With/without CER	Without	With CER trading price			Benchmark
		5USD	10USD	15USD	
IRR (%)	-10	3	14	24	6.875

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

As shown in the above table, IRR of the project depends on the CER price and a higher CER price produces higher IRR. The project without CER trading has the lower than the benchmark. In this case, the project cannot be considered as financially attractive. Only in use of CER trading, the project can be considered as financially attractive. Therefore, the project cannot carry out in the Business as Usual (BAU) situation.

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Thus, the additionally of the CDM project can be demonstrated.

The starting date of the project activity was 08/12/2007 that was the date to making "Emission Reduction Purchase Agreement" between Vietma Co., Ltd and Toshiba Corporation which is corresponding to the "Date of real action of the project begins".
Toshiba intends to purchase CERs generated by the project, and Vietma intends to apply Toshiba's payment for the installation of the project facilities in the above agreement.

Vietma and Toshiba had carried out the feasibility study for the project implementation since 2005 as the CDM project. According to the result of the feasibility study, both of parties have confirmed that the project could be performed, only when CDM was applied.
Therefore, the incentive from the CDM was seriously considered in the decision to proceed with the project activity since the beginning of the feasibility study report preparation work, and the above contract can be provided as the documentary evidence for the additionality of the project.

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. (Component 1)
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. (Component 2)

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

The ex-ante emission reductions for the methane recovery are calculated as per AMS-III.H. according to the scenario (vi) that applies to the project activity.
The project introduces an anaerobic digester with methane recovery as a sequential step for the wastewater that is presently treated in anaerobic lagoons without methane recovery. Recovered methane is destroyed by the boiler, the furnace and the flare that are introduced in the project activity.

The ex-post calculation of emission reductions are based on the amount of methane recovered and fuelled or flared by the project activity during a year. The amount of methane used in the boiler and the furnace to produce thermal energy and flared in the enclosed type flare is monitored to determine the emission reductions. (See B.7.1)

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

The emission reductions resulting from the generation of heat are estimated by use of approved small scale CDM baseline methodology AMS-I.C./Version 09. The ex-ante emission reductions are estimated from the coal consumption in the existing coal furnace. In the project activity, the furnace using captured biogas will be installed as substituting the existing coal furnace. Capacity of the furnace installed in the project activity will be as same as the existing coal furnace and captured biogas will be enough to operate the installed

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furnace. Therefore, all coal consumption will be displaced by captured methane in the normal operation.

The furnace applied in the project activity will be co-fired system which use both captured methane and Fuel Oil. The furnace will mainly use captured methane, and will use Fuel Oil only in the case of methane shortage.

Thus the ex-post calculation of emission reductions are based on the amount of heat output of the furnace except Fuel Oil based heat output. (See B.7.1)

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:	Annex 3 BASELINE INFORMATION
Value applied:	724,240
Justification of the choice of data or description of measurement methods and procedures actually applied :	The feasibility study for the project gives the expected production of tapioca starch and wastewater flow rate per starch production. This is based on the expected tapioca starch production 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:	Annex 3 BASELINE INFORMATION
Value applied:	0.0162
Justification of the choice of data or description of measurement methods and procedures actually applied :	The feasibility study for the project gives the COD value of wastewater and removal efficiency of organic carbon at existing anaerobic lagoons. This is based on the COD of wastewater multiplied by the removal efficiency of organic carbon at the existing anaerobic lagoons.
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
Justification of the choice of data or description of	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

measurement methods and procedures actually applied :	used as a conservative assumption for B_0.
Any comment:	-

Data / Parameter:	$MCF_{ww,treatment,i}$
Data unit:	Fraction
Description:	Methane correction factor for the anaerobic wastewater treatment system "i"
Source of data used:	Table III.H.1. IPCC default values for Methane Correction Factor (MCF) of AMS III.H./Version 09
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF higher value of Anaerobic deep lagoon (depth more than 2 meters)" in table III.H.1 is used.
Any comment:	-

Data / Parameter:	GWP_CH_4
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential for methane
Source of data used:	IPCC default value
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value of 21 is used.
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:	Calculations based on the feasibility study
Value applied:	635
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is based on the installed capacity of the project facilities and average electricity consumption.
Any comment:	Actual electricity consumption of the project facilities will be monitored to calculate ex-post project emissions.

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Data / Parameter:	CEF_{grid}
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:	Annex 3 BASELINE INFORMATION
Value applied:	0.496
Justification of the choice of data or description of measurement methods and procedures actually applied :	The carbon emission factor is 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.
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:	Vietnam environmental standard (TCVN 5945 -2005)
Value applied:	0.00005
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on the Vietnam environmental standard (TCVN 5945 -2005). 50mg/L of discharging limit in type A category is used as a conservative assumption.
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 domestic wastewater
Value applied:	0.2
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF higher value in table III.H.1 for sea, river and lake discharge i.e. 0.2 is used.
Any comment:	-

Data / Parameter:	$COD_{y,removed,j}$
Data unit:	tonnes/m^3
Description:	Chemical oxygen demand removed by the treatment system "j" of the project activity equipped with methane recovery in the year "y"

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Source of data used:	Calculations based on the feasibility study
Value applied:	0.0142
Justification of the choice of data or description of measurement methods and procedures actually applied :	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:	$MCF_{ww,j}$
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 wastewater treatment system "j" equipped with methane recovery and combustion/flare/utilization equipment
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF higher value of "Anaerobic reactor" in table III.H.1 is used.
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 :	There is no other appropriate value to represent this parameter, so the default value of the AMS III.H. is used.
Any comment:	-

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	Default value of the AMS III.H. is used

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choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	CC_y
Data unit:	tonnes/y
Description:	Amount of coal consumed in existing coal furnace in year y in tonnes
Source of data used:	Feasibility study
Value applied:	1975.2
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is based on the coal consumption per starch production provided by the plant owner multiplied by the estimated starch production volume.
Any comment:	-

Data / Parameter:	NCV_{coal}
Data unit:	TJ/Gg
Description:	Net Calorific Value of coal
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2
Value applied:	25.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value of "Other Bituminous Coal" in Table 1.2 of 2006 IPCC Guidelines is used.
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:	94.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value of "Other Bituminous Coal" in Table 1.4 of 2006 IPCC Guidelines is used.
Any comment:	-

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Data / Parameter:	$\eta_{th,existing}$
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 :	In accordance with No. 13 (c) of methodology AMS-I.C./Version 13, maximum efficiency of 100% is used as a conservative assumption for η_{th}. This data is required to calculate ex-post estimation of emission reductions.
Any comment:	-

Data / Parameter:	$\eta_{th,furnace}$
Data unit:	Fraction
Description:	The efficiency of the plant using renewable energy technology in the project activity.
Source of data used:	Manufacturer's specifications
Value applied:	0.865
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is based on the specifications of manufacturer. This data is required to calculate ex-post estimation of emission reductions.
Any comment:	-

Data / Parameter:	NCV_{CH4}
Data unit:	TJ/Gg
Description:	Net Calorific Value of coal
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2
Value applied:	50.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value of "Other Biogas" in Table 1.2 of 2006 IPCC Guidelines is used. This data is required to calculate ex-post estimation of emission reductions.
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

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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:

The ex-ante baseline emissions of Component 1 are calculated by using the formulae given in paragraph 24 (d) of AMS III. H/Version 09 shown as follows.

$$BE_{y,1} = Q_{y,ww} * \sum_i (COD_{y,removed,i} * B_{o,ww} * MCF_{ww,treatment,i} * GWP\_CH_4)$$

Where:

$BE_{y,1}$	Baseline emissions of Component 1 in the year "y" (tCO$_2$ e)
$Q_{y,ww}$	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" to which the sequential anaerobic treatment step is being introduced (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
$MCF_{ww, treatment,i}$	Methane correction factor for the anaerobic wastewater treatment system "i" to which the sequential anaerobic treatment step is being introduced (MCF lower values in table III.H.1).
GWP_CH_4	Global Warming Potential for methane (value of 21 is used)

Hence, with using the values given in Section B.6.2, the ex-ante baseline emissions of Component 1 are calculated as follows.

$$BE_{y,1} = 724240 \text{ (m}^3/\text{yr)} * 0.0162 \text{ (tones/m}^3) * 0.21 \text{ (kgCH}_4/\text{kgCOD)} * 0.8 * 21$$
$$= 41393 \text{ (tCO}_2\text{e/y)}$$

Ex-ante estimation of the project activity emissions:

$$PE_{y,1} = PE_{y, power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,upgrading} + PE_{y,leakage,pipeline}$$

Where:

$PE_{y,1}$	Project activity emissions of Component 1 in the year "y" (tCO$_2$e)
$PE_{y,power}$	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".
$PE_{y,fugitive}$	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".
$PE_{y,upgrading}$	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"

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(i) CO_2 emissions on account of power used by the project activity facilities;

Electricity consumed at the project facilities will be supplied from grid in this project activity. Fuel oil will be used only in the case of shortage of methane generation at digester. In the normal operation, methane generated by digester will be enough to consume at furnace, therefore Fuel Oil consumption is not considered in ex-ante calculation of project emissions. Fuel Oil consumption will be monitored for calculating ex-post project emissions.

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

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.

Hence:

$$PE_{y,\,power} = 635\ (MWh/y) * 0.496\ (tCO_2e/MWh)$$
$$= 315\ (tCO_2e/y)$$

(ii) Project activity emissions from degradable organic carbon in treated wastewater;

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

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)

$MCF_{ww,final}$ Methane 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)

Hence:

$$PE_{y,ww,treated} = 724240\ (m^3/y) * 21\ (tCO_2/tCH_4) * 0.21\ (kgCH_4/kgCOD) * 0.00005\ (tones/m^3) * 0.2$$
$$= 32\ (tCO_2e/y)$$

(iii) Project activity emissions from anaerobic decay of the final sludge produced;

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.

$PE_{y,s,final} = 0$ (tCO$_2$e/y)

(iv) Project activity emissions from methane release in capture and utilization/combustion/ flare systems;

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

Where:

$PE_{y,fugitive,ww}$ Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic wastewater treatment in the year "y" (tCO$_2$e)

$PE_{y,fugitive,s}$ Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic sludge treatment in the year "y" (tCO$_2$e)

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

Where:

$MEP_{y,ww,treatment}$ Methane emission potential of wastewater treatment plant in the year "y" (tonnes)

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

$MCF_{ww,j}$ 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).

Hence:

$MEP_{y,ww,treatment}$ = 724240 (m^3/y) * 0.21 (kgCH$_4$/kgCOD) * 0.0142 (t/m^3) * 1.0
= 2160 (tCH$_4$/y)

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

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)

Hence:

$PE_{y,fugitive,ww}$ = (1- 0.9) * 2160 (tCH$_4$/y) * 21 (tCO$_2$/tCH$_4$)
= 4536 (tCO$_2$e/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.
Hence:

$PE_{y,fugitive,s} = 0$ (tCO$_2$e/y)

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Hence:
$$PE_{y,fugitive} = 4536 \ (tCO_2e/y) + 0 \ (tCO_2e/y)$$
$$= 4536 \ (tCO_2e/y)$$

(v) Project activity emissions from dissolved methane in treated wastewater.

Project emissions of this source are considered according to the choice of the case (vi) "Introduction of sequential stage of wastewater treatment with methane recovery and combustion" of paragraph 1 of AMS-III.H./Version 09.

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

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.

Hence:
$$PE_{y,dissolved} = Q_{y,ww} * [CH_4]_{y,ww,treated} * GWP\_CH_4$$
$$= 724240 \ (m^3/y) * 0.0001 \ (tCH_4/m^3) * 21 \ (tCO_2/tCH_4)$$
$$= 1521 \ (tCO_2e/y)$$

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

In this project, no biogas upgrading system will be applied.
Hence:
$$PE_{y,upgrading} = 0 \ (tCO_2e/y)$$

(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.
Hence:
$$PE_{y,leakage, \ pipeline} = 0 \ (tCO_2e/y)$$

(viii) Amount of project activity emissions

Hence:
$$PE_{y,1} = PE_{y, \ power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,upgrading} + PE_{y,leakage, \ pipeline}$$
$$= 315 \ (tCO_2e/y) + 32 \ (tCO_2e/y) + 0 \ (tCO_2e/y) + 4536 \ (tCO_2e/y) + 1521 \ (tCO_2e/y)$$
$$+ 0 \ (tCO_2e/y) + 0 \ (tCO_2e/y)$$
$$= 6404 \ (tCO_2e/y)$$

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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.
Hence:
Leakage $_{y,1}$ = 0 (tCO$_2$e/y)

Ex-ante estimation of the emission reductions:

$ER_{y,1} = BE_{y,1} - PE_{y,1} - Leakage_{y,1}$
$= 41393 \text{ (tCO}_2\text{e/y)} - 6404 \text{ (tCO}_2\text{e/y)} - 0 \text{ (tCO}_2\text{e/y)}$
$= 34989 \text{ (tCO}_2\text{e/y)}$

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

Ex-ante estimation of the Baseline emissions:

The baseline for the GHG emissions from fossil fuel combustion in the existing coal furnace is determined by the fuel consumption in the absence of the project activity. In the project activity, the consumed coal in the existing coal furnace will be displaced to the captured methane fueled in the furnace.

$BE_{y,2} = HG_y * EF_{CO2}$

Where;
$BE_{y,2}$	the baseline emissions from steam/heat displaced by the project activity during the year y in tCO$_2$e.
HG_y	the net quantity of steam/heat supplied by the project activity during the year y in TJ.
EF_{CO2}	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.

$HG_y = CC_y * NCV_{coal}$

Where;
CC_y	Amount of coal which would have been consumed in existing coal furnace in year y in tonnes.
NCV_{coal}	Net Calorific Value of coal in TJ/Gg (= GJ/t)

Hence:
$HG_y = 1975.2 \text{ (t/y)} * 25.8 \text{ (GJ/t)}$
$= 50960 \text{ (GJ/y)} = 51.0 \text{ (TJ/y)}$

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Hence:

$BE_{y,2} = 51.0 \text{ (TJ)} * 94.6 \text{ (tCO}_2/\text{TJ)}$
$= 4825 \text{ (tCO}_2\text{e/y)}$

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.
Hence:

$Leakage_{y,2} = 0 \text{ (tCO}_2\text{e/y)}$

Ex-ante estimation of the emission reductions:

$ER_{y,2} = BE_{y,2} - Leakage_{y,2}$
$= 4825 \text{ (tCO}_2\text{e/y)} - 0 \text{ (tCO}_2\text{e/y)}$
$= 4825 \text{ (tCO}_2\text{e/y)}$

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 two components, **Component 1:** AMS-III.H. and **Component 2:** AMS-I.C.

Two separate tables for each Components of the approved project category are applied as show in Table B.6-1 and B.6-2.

Table B.6-3 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	4,803	31,045	0	26,242
2010	6,404	41,393	0	34,989
2011	6,404	41,393	0	34,989
2012	6,404	41,393	0	34,989
2013	6,404	41,393	0	34,989
2014	6,404	41,393	0	34,989
2015	6,404	41,393	0	34,989
2016	6,404	41,393	0	34,989
2017	6,404	41,393	0	34,989
2018	6,404	41,393	0	34,989

2019	1,601	10,348	0	8,747
Total (tCO$_2$e)	64,040	413,930	0	349,890

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$_2$e)	Estimation of baseline emissions by coal combustion (Tonnes of CO$_2$e)	Estimation of Leakage (Tonnes of CO$_2$e)	Estimation of emission reductions for thermal Energy (Tonnes of CO$_2$e)
2009	0	3,619	0	3,619
2010	0	4,825	0	4,825
2011	0	4,825	0	4,825
2012	0	4,825	0	4,825
2013	0	4,825	0	4,825
2014	0	4,825	0	4,825
2015	0	4,825	0	4,825
2016	0	4,825	0	4,825
2017	0	4,825	0	4,825
2018	0	4,825	0	4,825
2019	0	1,206	0	1,206
Total (tCO$_2$e)	0	48,250	0	48,250

Table B.6-3 Summary of estimation of overall emission reductions

Year	Estimation of project activity emissions (Tonnes of CO$_2$e)	Estimation of baseline emissions (Tonnes of CO$_2$e)	Estimation of Leakage (Tonnes of CO$_2$e)	Estimation of overall emission reductions (Tonnes of CO$_2$e)
2009	4,803	34,664	0	29,861
2010	6,404	46,218	0	39,814
2011	6,404	46,218	0	39,814
2012	6,404	46,218	0	39,814
2013	6,404	46,218	0	39,814
2014	6,404	46,218	0	39,814
2015	6,404	46,218	0	39,814
2016	6,404	46,218	0	39,814
2017	6,404	46,218	0	39,814
2018	6,404	46,218	0	39,814
2019	1,601	11,554	0	9,953
Total (tCO$_2$e)	64,040	462,180	0	398,140

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

B.7.1   Data and parameters monitored:

Data / Parameter:	EC_y (ID_1)
Data unit:	GWh/yr
Description:	Annual electricity consumption at the project site for the project activity
Source of data to be used:	Measurements by project participants by using a watt-hour meter (kWh)
Value of data	Value of data would be used to calculate project emissions
Description of measurement methods and procedures to be applied:	The electricity consumption of project facilities installed in project activity is measured continuously. The frequency for this measurement is at least weekly and depends on accumulated values of electricity consumption. A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Data / Parameter:	$W_{CH4,y}$ (ID_2)
Data unit:	m^3_{CH4}/m^3_{biogas}
Description:	Fraction of methane in the biogas
Source of data to be used:	Measurements by project participants with using a periodical gas analyzer
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	The methane fraction will be measured and registered periodically using an electronic gas analyzer. This measurement will be performed with a frequency to satisfy statistical 95% confidence level and at least quarterly. A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Data / Parameter:	$BG_{flare,y}$ (ID_3)
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas flowed into the flaring system in year y
Source of data to be used:	Measurements by project participants by using flow meter
Value of data	Value of data would be used to calculate baseline emissions
Description of	The volumetric flow rate measured by flow meter will be automatically corrected

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measurement methods and procedures to be applied:	to standard conditions by measuring equipment. The corrected data is automatically recorded and stored as accumulated values of volumetric flow in the monitoring system's interface, SCADA (Supervisory Control and Data Acquisition). A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Data / Parameter:	$BG_{boiler,y}$ (ID_4)
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas flowed into the boiler in year y
Source of data to be used:	Measurements by project participants by using flow meter
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	The volumetric flow rate measured by flow meter will be automatically corrected to standard conditions by measuring equipment. The corrected data is automatically recorded and stored as accumulated values of volumetric flow in the monitoring system's interface, SCADA (Supervisory Control and Data Acquisition). A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Data / Parameter:	$BG_{furnace,y}$ (ID_5)
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas flowed into the furnace in year y
Source of data to be used:	Measurements by project participants by using flow meter
Value of data	Value of data would be used to calculate baseline emissions
Description of measurement methods and procedures to be applied:	The volumetric flow rate measured by flow meter will be automatically corrected to standard conditions by measuring equipment. The corrected data is automatically recorded and stored as accumulated values of volumetric flow in the monitoring system's interface, SCADA (Supervisory Control and Data Acquisition). A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

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Data / Parameter:	T_{flare} (ID_6)
Data unit:	deg C
Description:	Flame temperature of burner of flare
Source of data to be used:	Measurements by project participants by using thermocouple
Value of data	>500
Description of measurement methods and procedures to be applied:	The temperature is measured continuously with a thermocouple sensor to demonstrate that the flare is operated in optimal condition. A high level of accuracy of the measurements will be achieved due to the use of high precision equipment. The monitored data is automatically recorded and stored in the monitoring system's interface, SCADA (Supervisory Control and Data Acquisition). Data should be kept two years after last issuance of CERs.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Ex-post calculations of emission reductions:

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

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

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.

- **Component 1:** 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 boiler and the furnace have a combustion efficiency of 100%, the only project emissions occur at the flare. The project emissions are determined as paragraph 38 in Monitoring of AMS-III.H./Version 09. The

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project uses an enclosed flare, and continuous check of compliance with manufacturers specification of the flare device (temperature, biogas flow rate) will be done. Therefore the default value will be used in the ex-post calculation of emission reductions.

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 and the flare:

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

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

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

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

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

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

$W_{CH4,y}$ =   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;

$$MD_{flare,y} = BG_{flare,y} * W_{CH4,y} * D_{CH4} * \quad _{flare}$$

Where:

$BG_{flare,y}$ =   The quantity of biogas fed into flare in year "y" by boiler in Nm^3

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$_{flare}$ = Flare efficiency (enclosed flare, 90%)

90% of default value is adopted as flare efficiency. The flare system applied in the project has automatic control system and is stopped automatically by detecting abnormal flame temperature. Thus, the flare can not operate when any of the parameters is out of the range of specifications.

• **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 No. 10 of simplified baseline methodology AMS I.C.

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

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.

$_{th,existing}$ = 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 net quantity of steam/heat supplied by the project activity means the heat output of the furnace. The heat output of the furnace can be calculated according to:

$$HG_y = MD_{furnace,y} * NCV_{CH4} *\ _{th,furnace}$$

Where;

NCV_{CH4} = Net Calorific Value of methane in TJ/ (50.4TJ/Gg, default value of "Other Biogas" in Table 1.2 of 2006 IPCC Guidelines is used.)

$_{th,furnace}$ = The efficiency of the furnace supplied as a manufacturer's specifications (heat efficiency of 86.5% is used.)

B.7.2 Description of the monitoring plan:

>>

Monitoring parameters:

The monitoring parameters are shown in Figure B-2. The Numbers in the diagram indicate ID Numbers.
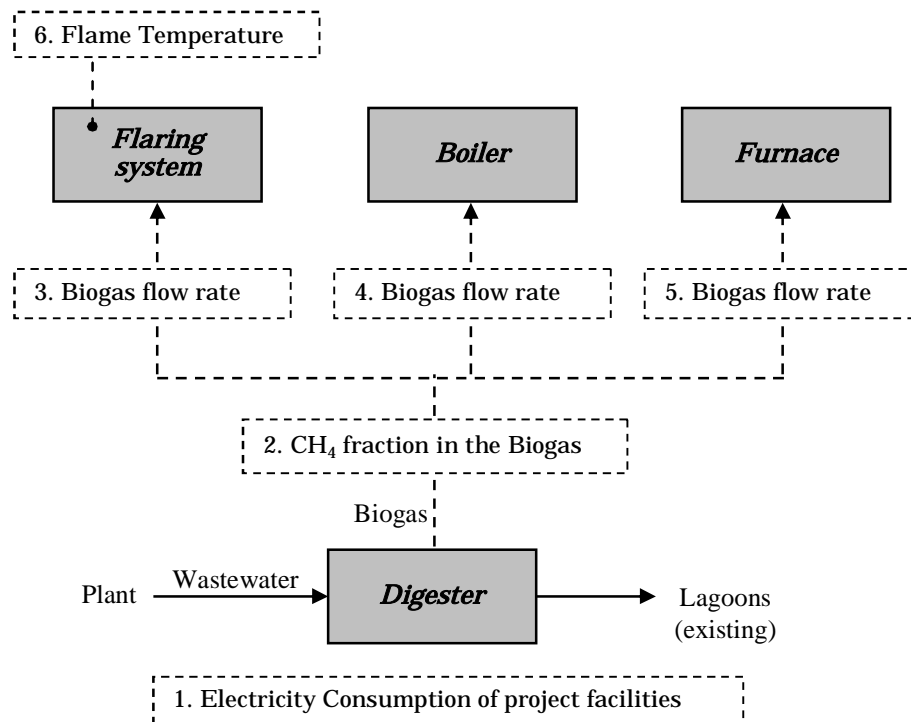
Figure B-2: Monitoring parameters

The monitored data is sent automatically from measurement devices to the PLC (Programmable Logic Controller) and stored in a data management system SCADA (Supervisory Control and Data Acquisition) directly connected to the PLC. SCADA is the main interface of the monitoring system, although the data stored will be also kept in an external hard drive for back up. This system will be able to represent the collected data graphically. At least every month a copy of this information will be stored in an external hard drive as backup.

Organization of monitoring:

Organization of CDM implementation will be composed by staff of Viet Ma Co., Ltd and external entities which will be operation adviser and CDM consultant.

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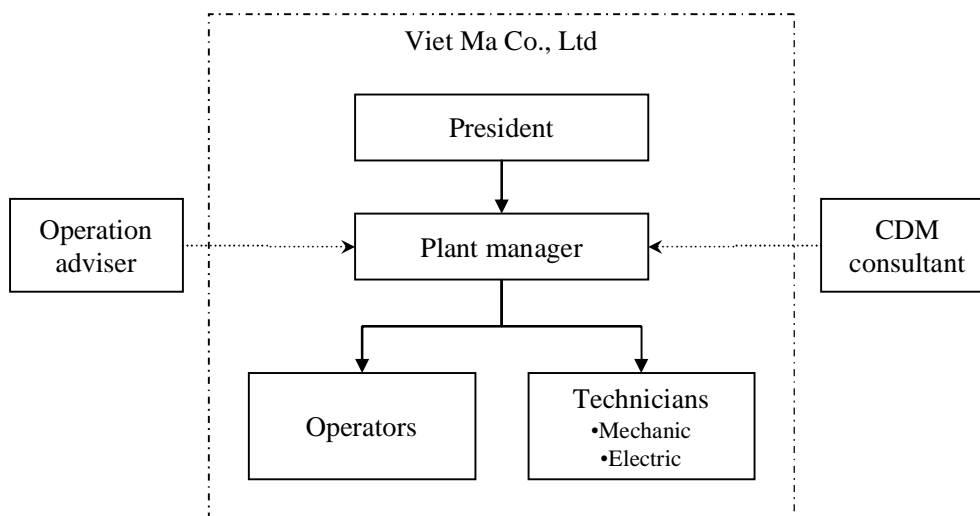
Figure B-3: Organization of the project

The monitoring tasks will be distributed as follows.

Description of tasks	President	Plant manager	Operators	Technicians	Operation adviser	CDM consultant
Plant operation						
Calibration and maintenance of monitoring equipments						
Gathering the raw data Checking the stored data in SCADA						
Data backup						
Checking the completeness and errors of the data						
Integrating the data for calculation Comparing the data with planning						
Calculation of emission reductions						
Preparation of monitoring report for verification						

Training of Personnel:

The personnel of Viet Ma Co., Ltd will receive training of plant operation, trouble shooting, maintenance and monitoring procedure of the project facilities by the technology provider in the start up period. The operators will operate the project facilities with receiving advices from the external operation adviser.

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All new workers will be given a briefing of safety and operation manual before going the site. Then they will undergo on job training with plant manager and former operators and plant manager will give a certificate of plant operation after completion of training period.

Monitoring procedure will be undertaken by plant manager with receiving advices and check of CDM consultant.

Corrective and preventive actions for unusual operation:

In the monitoring of the emissions reduction, the uncertainties of monitoring procedure should be reduced. Therefore, unusual operation of the project activity that may effect the monitoring will be identified and analyzed, and issued as an unusual operation report. Preventive and corrective actions will be implemented simultaneously.

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: 16 June 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

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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:
>>
08/12/2007

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:
>>
01/04/2009 or the date of project registered, whichever is later

C.2.2.2. Length:
>>
10 years

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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 installed with considering ventilation for good dispersion of flue gas. The bottom of the digester will be reinforced for prevention of groundwater pollution. The characteristics of inlet and outlet wastewater from the project facilities will be watched.

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 reduce 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 existing 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, reduction of GHGs emission 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 project participants have conducted the Environmental Impact Assessment Report of CDM project. 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 June 2008. People's Committee of Tay Ninh formed a

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Committee for review EIA Report. It takes 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 is given by Chairman of Tay Ninh people's committee on beginning of July 2008.

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

\>>
Not applicable

SECTION E.   <u>Stakeholders</u>' comments

\>>

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

\>>
To collect stakeholders' comments, following activities have been carried out:
- On June 02nd 2008, Viet Ma Co., Ltd. has submitted Official Letter to the People's Committee of Tan Hiep Village to present activities of CDM project, including potential environmental impacts if project developed and request comments and/feedbacks from Village authority and community who are neighbours of project site and may be affected by project's impacts.
- Review on explanation of Viet Ma Co., Ltd., on June 04th, 2008, People's Committee of Tan Hiep Village has issued Official Letter to upper authority and the project's participants with agreement for project development in the local.
- Besides, to get public comments and satisfy question of neighbours who maybe affect by project activities, on June 06th, 2008, Viet Ma Co., Ltd. (the owner of project) and Techcom Development JS Co., have mutually cooperated in holding a public meeting with authority and community of Tan Hiep Village. Comments or claims of related parties are recorded in Minute of Meeting with their confirmation in evidence.

E.2.   Summary of the comments received:

\>>
Extraction from Minute of Meeting on June 06th, 2008 for CDM project of "Wastewater treatment with Anaerobic Digester at Viet Ma starch processing plant in Tay Ninh, Vietnam" has taken place during 14:15 am to 16:00 am with following details:

1. Mr. Tạ Văn Minh, on behalf of Viet Ma Co., Ltd. has given opening speech.

2. Mr. Nguyễn Huy Vũ & Mr. Nguyễn Kim Huệ, on behalf of Consultants, has presented about activities of CDM project which will be developed in Viet Ma starch processing plant, summarize

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its impacts and contribution to carbon emission reduction through anaerobic digester for wastewater treatment and biogas utilization:

- Project based on anaerobic digester for wastewater treatment and biogas to energy by using modern technology and facilities from Toshiba.
- Project can contribute to reduce pollution of COD in wastewater, reduce smell by using closed digester and degrading organic substances in wastewater and consequently reduce contamination for soil and groundwater.
- Project can reduce carbon emission by biogas collection and combustion activities to give energy and transform CH_4 into CO_2.

3. Related parties have discussed and given comments for project, summarized in following table:

Question	Answer
Does it generate smell from project activities? Is smell strictly solved as one of targets of project?	Smell from existing lagoons consists of mainly acid smell depending on storing wastewater, which contains high concentration of organic substances, in the open lagoons. The digester installed in the project activity is closed pond and degrades the organic substances in the wastewater. Thus, acid smell will be reduced by the project activity.
How is treatment method applied for collected biogas?	Biogas generated from project will be collected and burnt for energy production. Surplus gas will be burnt at flare.
Can wastewater in anaerobic digestion ponds permeate into soil and influence in groundwater?	No, ponds used for anaerobic digestion process separated by HDPE lining. Therefore, wastewater permeation into soil and groundwater can be avoided.
How to reduce GHG effect from project establishment?	Project includes activity of methane collection and storage, one of GHGs, and using it as fuel in furnace and boiler, and surplus gas will be burnt at flare. Therefore it is not released directly into environment. Burning CH_4 to transform into CO_2 is also contribution to reducing 21 fold of GHG effect, relatively.
When does project start?	At the moment, project is still in constructional step. At least until April 2009, project is coming to operation stage.

4. Closing speech with presentation of Mr. Tạ Văn Minh.

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Overall, in the public meeting, all related parties have fully agreed to develop project as suggestion and plan of project participants, no rejection or opposition or further requirements.

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

\>\>
All comments have been recorded in Minute of Meeting and in Part E.2
Any claim or feedback of community and local authority will be included in PDD.

<u>Annex 1</u>

CONTACT INFORMATION ON PARTICIPANTS IN THE <u>PROJECT ACTIVITY</u>

Organization:	TOSHIBA CORPORATION
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FAX:	-
E-Mail:	-
URL:	http://www.toshiba.co.jp/index_j3.htm
Represented by:	-
Title:	-
Salutation:	Mr.
Last Name:	Tajiri
Middle Name:	-
First Name:	Sumio
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Mobile:	-
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Direct tel:	+81-3-3457-4305
Personal E-Mail:	sumio.tajiri@toshiba.co.jp

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City:	-
State/Region:	Tay Ninh Province
Postfix/ZIP:	-
Country:	People's Republic of Vietnam
Telephone:	+84-66-732191
FAX:	+84-66-732192
E-Mail:	-
URL:	-
Represented by:	-
Title:	President, CEO
Salutation:	Mr.
Last Name:	Vu
Middle Name:	Van
First Name:	Thieu
Department:	-

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Mobile:	-
Direct FAX:	-
Direct tel:	-
Personal E-Mail:	-

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

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Annex 3

BASELINE INFORMATION

The following tables "Table Annex 3.1 –6" summarises the data used in the ex-ante calculations of baseline emissions.

Determination of $Q_{y,ww}$:

Table Annex 3.1 Actual results of starch production (2006)

Year	Month	Production volume	Remarks
2006	Jan.	3,079 t	
	Feb.	2,576 t	
	Mar.	2,976 t	
	Apr.	3,112 t	
	May	3,068 t	
	June	3,072 t	
	July	2,478 t	
	Aug.	0 t	Operation stop for maintenance
	Sep.	3,100 t	
	Oct.	2,980 t	
	Nov.	3,324 t	
	Dec.	3,155 t	
	Annual amount	32,920 t/yr	

Viet Ma Co., Ltd started operation in January 2005, and regular operation has been kept since September 2005. Starch production volume of Viet Ma Co., Ltd after project implementation is estimated according to the actual production volume in 2006.

Table Annex 3.2 Measurement results of wastewater flow volume (June. 27, 2007 - Aug.18, 2007)

Item	Value
Term of measurement	June. 27, 2007 - Aug.18, 2007
Hours for measurement	1241.33 h
Accumulated flow volume of wastewater	80,112m^3
Amount of starch production volume during the measurement term	3,641 t
Wastewater flow per production	22.0 m^3/t

Actual wastewater flow rate of Viet Ma Co., Ltd was measured by an electro-magnetic flow meter from June. 27, 2007 to Aug.18, 2007 for estimating wastewater flow during project activity.
Wastewater flow during project activity can be estimated according to the wastewater flow rate per production multiplied by the estimated annual production volume.
Thus, annual wastewater flow rate ($Q_{y,ww}$) will be 724,240m^3/yr.

Determination of $COD_{y,removed,i}$:

Table Annex 3.3 Analysis results of water content (June, 2006 - Nov., 2006)

Sampling date	COD
June 30, 2006	24,828 mg/L
Sep. 11, 2006	12,632 mg/L
Nov. 6, 2006	10,230 mg/L
Nov. 9, 2006	19,038 mg/L
Average	16,682 mg/L

Table Annex 3.4 Information of existing wastewater treatment system

Facilities	Total area	Average depth	Removal rate of organic matter
Anaerobic lagoon	31,000 m^2	3.5 m	97 %
Aerobic lagoon	10,400 m^2	1.3 m	3 %

* According to the original EIA report of existing facilities of Viet Ma Co., Ltd

Chemical oxygen demand removed by the existing anaerobic lagoons in the baseline situation is calculated according to the average of analyzed COD multiplied by the removal rate of existing anaerobic lagoons.
$COD_{y,removed,i}$ = 0.0167 tonnes/m^3 * 0.97 = 0.0162 tonnes/m^3

Determination of CEF_{grid}:
All the electricity to be consumed at the site of this project will be supplied by AC power through the grid. CEF_{grid} 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 Annex 3.5** and **3.6**, respectively, show the operating margins and build margins.

Table Annex 3.5 The average emission coefficient of operating margin from 2004 to 2006

Type of plants	Applied technology	EG (MWh)	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 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/ /10,000	Calculation

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Table Annex 3.6 The average emission coefficient of build margin

Year of operation	Names of plants	Type of plants	Applied technology	EG (MWh)	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/ /10,000	Calculation
Note	Total EG is over 20% of total generation (MWh) in 2006 CFBS:Atmospheric Circulating Fluidised Bed Combustion							

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

$$CEF_{grid} = (0.650+0.342)/2 = 0.496 \text{ (kg-CO}_2\text{/kWh)}$$

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<u>Annex 4</u>

MONITORING INFORMATION

Please refer to section B.7.

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APPENDIX 1: ADDITIONAL INFORMATION

IRR Calculation without CER

CER trading price: **0** USD/tCO$_2$

Input data

Item		Value	Unit
Unit price of CER		0.0	USD
Fee for CER acquisition		2%	
Unit price of electricity	(in VND)	877	VND/kWh
	(in USD)	54	USD/MWh
Unit price of coal	(in VND)	1,523	VND/kg
	(in USD)	93	USD/t
Investment cost	EPC of project facilities	2,300,000	USD
	CDM procedure before implementation	0	USD
Exchange rate	VND / USD	16,290.5	VND/USD * June 9, 2008

Profit and loss statement

		0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Data for calculation	CER (tCO$_2$/yr)		0	0	0	0	0	0	0	0	0	0	0
	Coal alternative (t-coal/yr)		1,481	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	494
	Electricity consumption (MWh/yr)		476	635	635	635	635	635	635	635	635	635	159
Revenue	Sales of CER	0	0	0	0	0	0	0	0	0	0	0	0
	Sales of biogas for coal alternative	0	138,459	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	46,184
	TOTAL REVENUES	0	138,459	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	46,184
Operating expences	Maintenance	0	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500
	Electricity consumption	0	25,625	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	8,560
	O&M staff	0	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
	CDM procedure	0	0	0	0	0	0	0	0	0	0	0	0
	Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
	TOTAL EXPENCES	0	285,125	293,685	293,685	293,685	293,685	293,685	293,685	293,685	293,685	293,685	38,060
Operating profit		0	-146,667	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	8,124
Other profit and loss	Interest of loan	0	0	0	0	0	0	0	0	0	0	0	0
Ordinary profit (excluding tax)		0	-146,667	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	8,124
Accumulated ordinary profit (excluding tax)		0	-146,667	-255,709	-364,751	-473,794	-582,836	-691,879	-800,921	-909,963	-1,019,006	-1,128,048	-1,119,924

Unit USD

Cash flow statement

	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Net profit (before tax)	0	-146,667	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	-109,042	8,124
Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
Free cash flow (FCF)	-2,300,000	83,333	120,958	120,958	120,958	120,958	120,958	120,958	120,958	120,958	120,958	8,124
Accumulated FCF	-2,300,000	-2,216,667	-2,095,709	-1,974,751	-1,853,794	-1,732,836	-1,611,879	-1,490,921	-1,369,963	-1,249,006	-1,128,048	-1,119,924
IRR								-20%	-16%	-13%	-11%	-10%

(Unit USD

CDM – Executive Board

APPENDIX 1: ADDITIONAL INFORMATION

IRR Calculation with CER

CER trading price: **5** USD/tCO$_2$

Input data

Item		Value	Unit
Unit price of CER		5.0	USD
Fee for CER acquisition		2%	
Unit price of electricity	(in VND)	877	VND/kWh
	(in USD)	54	USD/MWh
Unit price of coal	(in VND)	1,523	VND/kg
	(in USD)	93	USD/t
Investment cost	EPC of project facilities	2,300,000	USD
	CDM procedure before implementation	45,000	USD
Exchange rate	VND / USD	16,290.5	VND/USD * June 9, 2008

Profit and loss statement

		0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Data for calculation	CER (tCO$_2$/yr)		29,861	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	9,953
	Coal alternative (t-coal/yr)		1,481	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	494
	Electricity consumption (MWh/yr)		476	635	635	635	635	635	635	635	635	635	159
Revenue	Sales of CER	0	146,319	195,089	195,089	195,089	195,089	195,089	195,089	195,089	195,089	195,089	48,770
	Sales of biogas for coal alternative	0	138,459	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	46,184
	TOTAL REVENUES	0	284,778	379,731	379,731	379,731	379,731	379,731	379,731	379,731	379,731	379,731	94,954
Operating expences	Maintenance	0	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500
	Electricity consumption	0	25,625	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	8,560
	O&M staff	0	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
	CDM procedure	0	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
	Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
	TOTAL EXPENCES	0	320,125	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	73,060
Operating profit		0	-35,348	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	21,894
Other profit and loss	Interest of loan	0	0	0	0	0	0	0	0	0	0	0	0
Ordinary profit (excluding tax)		0	-35,348	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	21,894
Accumulated ordinary profit (excluding tax)		0	-35,348	15,698	66,745	117,791	168,837	219,883	270,930	321,976	373,022	424,068	445,962

Unit USD

Cash flow statement

	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Net profit (before tax)	0	-35,348	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	51,046	21,894
Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
Free cash flow (FCF)	-2,345,000	194,652	281,046	281,046	281,046	281,046	281,046	281,046	281,046	281,046	281,046	21,894
Accumulated FCF	-2,345,000	-2,150,348	-1,869,302	-1,588,255	-1,307,209	-1,026,163	-745,117	-464,070	-183,024	98,022	379,068	400,962
IRR						-16%	-10%	-5%	-2%	1%	3%	3%

(Unit USD)

CDM – Executive Board

APPENDIX 1: ADDITIONAL INFORMATION

IRR Calculation with CER

CER trading price: **10** USD/tCO$_2$

Input data

Item		Value	Unit
Unit price of CER		10.0	USD
Fee for CER acquisition		2%	
Unit price of electricity	(in VND)	877	VND/kWh
	(in USD)	54	USD/MWh
Unit price of coal	(in VND)	1,523	VND/kg
	(in USD)	93	USD/t
Investment cost	EPC of project facilities	2,300,000	USD
	CDM procedure before implementation	45,000	USD
Exchange rate	VND / USD	16,290.5	VND/USD * June 9, 2008

Profit and loss statement

	Item	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Data for calculation	CER (tCO$_2$/yr)		29,861	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	9,953
	Coal alternative (t-coal/yr)		1,481	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	494
	Electricity consumption (MWh/yr)		476	635	635	635	635	635	635	635	635	635	159
Revenue	Sales of CER	0	292,638	390,177	390,177	390,177	390,177	390,177	390,177	390,177	390,177	390,177	97,539
	Sales of biogas for coal alternative	0	138,459	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	46,184
	TOTAL REVENUES	0	431,097	574,820	574,820	574,820	574,820	574,820	574,820	574,820	574,820	574,820	143,723
Operating expences	Maintenance	0	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500
	Electricity consumption	0	25,625	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	8,560
	O&M staff	0	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
	CDM procedure	0	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
	Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
	TOTAL EXPENCES	0	320,125	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	73,060
Operating profit		0	110,971	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	70,664
Other profit and loss	Interest of loan	0	0	0	0	0	0	0	0	0	0	0	0
Ordinary profit (excluding tax)		0	110,971	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	70,664
Accumulated ordinary profit (excluding tax)		0	110,971	357,106	603,241	849,376	1,095,510	1,341,645	1,587,780	1,833,915	2,080,050	2,326,185	2,396,848

Unit USD

Cash flow statement

Item	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Net profit (before tax)	0	110,971	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	246,135	70,664
Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
Free cash flow (FCF)	- 2,345,000	340,971	476,135	476,135	476,135	476,135	476,135	476,135	476,135	476,135	476,135	70,664
Accumulated FCF	- 2,345,000	- 2,004,029	- 1,527,894	- 1,051,759	- 575,624	- 99,490	376,645	852,780	1,328,915	1,805,050	2,281,185	2,351,848
IRR						- 1%	4%	8%	11%	13%	14%	14%

(Unit USD

CDM – Executive Board

APPENDIX 1: ADDITIONAL INFORMATION

IRR Calculation with CER

CER trading price: **15** USD/tCO$_2$

Input data

Item		Value	Unit
Unit price of CER		15.0	USD
Fee for CER acquisition		2%	
Unit price of electricity	(in VND)	877	VND/kWh
	(in USD)	54	USD/MWh
Unit price of coal	(in VND)	1,523	VND/kg
	(in USD)	93	USD/t
Investment cost	EPC of project facilities	2,300,000	USD
	CDM procedure before implementation	45,000	USD
Exchange rate	VND / USD	16,290.5	VND/USD * June 9, 2008

Profit and loss statement

		0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Data for calculation	CER (tCO$_2$/yr)		29,861	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	39,814	9,953
	Coal alternative (t-coal/yr)		1,481	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	1,975	494
	Electricity consumption (MWh/yr)		476	635	635	635	635	635	635	635	635	635	159
Revenue	Sales of CER	0	438,957	585,266	585,266	585,266	585,266	585,266	585,266	585,266	585,266	585,266	146,309
	Sales of biogas for coal alternative	0	138,459	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	184,643	46,184
	TOTAL REVENUES	0	577,415	769,909	769,909	769,909	769,909	769,909	769,909	769,909	769,909	769,909	192,493
Operating expences	Maintenance	0	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500
	Electricity consumption	0	25,625	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	34,185	8,560
	O&M staff	0	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
	CDM procedure	0	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
	Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
	TOTAL EXPENCES	0	320,125	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	328,685	73,060
Operating profit		0	257,290	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	119,433
Other profit and loss	Interest of loan	0	0	0	0	0	0	0	0	0	0	0	0
Ordinary profit (excluding tax)		0	257,290	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	119,433
Accumulated ordinary profit (excluding tax)		0	257,290	698,513	1,139,737	1,580,960	2,022,184	2,463,407	2,904,631	3,345,854	3,787,077	4,228,301	4,347,734

Unit USD

Cash flow statement

	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10
Item	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Net profit (before tax)	0	257,290	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	441,223	119,433
Depreciation	0	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	0
Free cash flow (FCF)	- 2,345,000	487,290	671,223	671,223	671,223	671,223	671,223	671,223	671,223	671,223	671,223	119,433
Accumulated FCF	- 2,345,000	- 1,857,710	- 1,186,487	- 515,263	155,960	827,184	1,498,407	2,169,631	2,840,854	3,512,077	4,183,301	4,302,734
IRR						11%	16%	19%	21%	23%	24%	24%

(Unit USD