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

CONTENTS

Annexes

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Title: Wastewater treatment and energy recovery at starch processing plant in Ninh Binh province, Viet Nam
Version: 1
Date: 13th February 2009.

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

Purpose of the project activity:
The purpose of the project activity is to recover biogas by installing an anaerobic covered lagoon (Digester) to the current anaerobic open lagoon system to treat wastewater from the Tapioca starch processing plant owned by ELMACO Tapioca Starch Co., Ltd. (ELMACO), Viet Nam. The collected biogas will be used to generate heat energy and substitute fossil fuels.

Explanation of GHG emission reductions:
The project activity will reduce emissions of GHG from two sources: avoidance of methane emissions from the current lagoons (where anaerobic digestion of the starch processing plant effluent takes place), and displacement of fossil fuels with less carbon-emission energy.

Proposed project activity:
The plant has capacity of producing 160 tons per day of Tapioca starch and now produces approximately 5,500 tons of Tapioca starch per year. Hereafter the production amount is assumed to increase to 20,000 tones of Tapioca starch per year. Therefore its production process will emit approximately 360,000 m3 per year of wastewater. This assumption is used for the calculation of Emission Reduction in this PDD. Currently the wastewater treatment system of the plant consists of succession of open lagoons, where anaerobic digestion of the wastewater takes place generating methane to the atmosphere. In addition, coals are used as fuel for the existing furnace in the plant to dry out the starch products and consequently emit carbon dioxide.

The project proposes to install Digester for wastewater treatment to the existing lagoons, thereby reducing emissions of methane to the atmosphere. The recovered methane will then be used to generate energy for the fuel of the thermal energy generation facilities, which consumes coals in furnace at the plant. At the same time, the project will substitute coals with energy from capture and combustion of the resulting biogas. Therefore, the project will reduce GHG emissions by an estimated 11,870 tCO2e per year.

Contribution of the project to sustainable development of Viet Nam (host company):

(i) Social dimension of sustainable development
The installation of the closed methane recovery system will eliminate the foul odor currently emanating from the existing lagoons. The project will therefore significantly improve the current situation for local environment.

The project will contribute positively to the Viet Nam Government’s sustainable development criteria of improving the nation’s water quality. Recovery of waster quality was identified as one of the environmental issues at “National Strategy for Environmental Protection until 2010 with vision to 2020” on December 2003. In the Viet Nam Agenda21, the Viet Nam Government continues with its efforts to promote and improve aquatic conservation and efficient use of water resources. Under the Eighth Economic Social Development (the five-year plan from 2006 to 2010), Environment is newly added as one of three main issues. In the plan, 50% of plants shall meet environment standards.

(ii) Economic dimension of sustainable development
The project will create indirect employment during construction and commissioning.

The project will install a new wastewater treatment system using Digester, which is not generally used in the starch plants in Vietnam. It is expected that this system based on a proven technology could be disseminated widely throughout the country.

The project also directly results in the efficient utilization of resources by "transforming" a biogas (methane) into a useful energy fuel, thereby displacing fossil fuel energy from the coals (though substituting of coals).

(iii) Environment dimension of sustainable development
Recovering the methane that is currently emitted by the anaerobic treatment system of the existing lagoons, and generating heating energy from the collected the biogas instead of fossil fuels, the project can contribute towards the reduction of the emissions of GHG.

The combination of Digester with existing lagoons will ensure that the COD levels of the wastewater at the end of the system meets Viet Nam's environmental regulations (less than 80mg/L by Viet Nam environmental standard (TCVN 5945-2005)). That will achieve a higher level of the water quality in local areas.

In conclusion, it can be said that the proposed project has no negative impact whatsoever. It will reduce emissions of GHG, and support the Vietnamese policy to promote aquatic conservation and efficient use of water resources. The project will directly create skilled employments. Generally speaking, the project will bring significant benefits to the sector concerned, i.e. ELMACO, by bringing improved technological information/consultation and demonstrating the feasibility and advantages of methane recovery from Tapioca starch effluent through the CDM.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participants (Yes/No)
Socialist Republic of Viet Nam (host)	ELMACO Tapioca Starch Co., Ltd. (private entity)	No
Japan	KAJIMA Corporation (private entity)	No
(*)In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

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

A.4.1.1. Host Party(ies):

Socialist Republic of Viet Nam

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

Ninh Bihn Province

A.4.1.3. City/Town/Community etc:

Son Lai Village, Nho Quan District

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

The physical location of the project activity site is shown in Figure 1. The project will be hosted by the ELMACO Tapioca Starch Co., Ltd. in Ninh Binh Province, Viet Nam located at latitude 20° 33′ N and longitude 105° 75′ E.

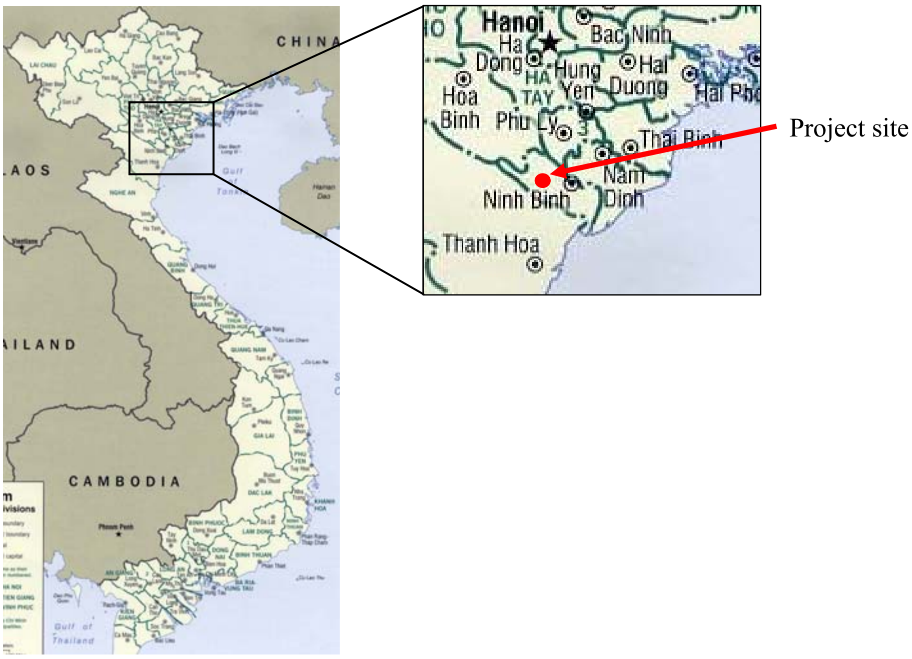

Figure 1: Location of the Project activity

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

Wastewater treatment in Digester
This project activity utilises a simple, effective and reliable technology to capture lagoon-produced biogas; installing new anaerobic covered lagoon (Digester) in the series of existing anaerobic open lagoons. The cover is made of a synthetic high-density polyethylene (HDPE) liner, which resists bad weather and providse a system to evacuate accumulated rainwater. The cover will also prevent the release of biogas to the atmosphere.

Wastewater from the plant will flow into the Digester, where the biogas will be recovered. This Digester will ensure 80-90% reduction of the COD levels. The treated wastewater will then enter a series of existing nine (9) open lagoons for anaerobic digestion, as a means to further reduce the COD levels below Viet Nam environmental regulatory levels (80mg/L of COD), before being released into the nearby river.

Thermal energy generation from biogas
The biogas produced from Digester is sent to a dehumidifier unit in order to remove moisture before being fed into the biogas furnace. The biogas is burnt in the furnace for supplying heat energy to the starch production process. The thermal energy produced will be used for the on-site facilities, including the dryer for processing Tapioca starch until finely-ground in a food processer. By doing so, this project will substitute coals that have been used in the existing coals furnace.

Surplus biogas will be flared using a high efficiency flare system. Biogas will be accurately metered using a thermal mass flow meter that has sensing elements; a flow meter, a pressure sensor and a temperature sensor that automatically corrects for changes in gas temperature.

With reference to the “Appendix B-Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activities”, the project activity falls under the following types and categories;

- Scope 13, type III, AMS-III.H. “Methane recovery in wastewater treatment” version 10
- Scope 1, type I, AMS-I.C. “Thermal energy for the user with or without electricity” version 13

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

Table 1: Estimated Emission Reductions over the chosen crediting period (7-year renewable)

Years	**Annual estimation of emission reductions in tonnes of CO2e**
Year 1: 2011	11,870
Year 2: 2012	11,870
Year 3: 2013	11,870
Year 4: 2014	11,870
Year 5: 2015	11,870
Year 6: 2016	11,870
Year 7: 2017	11,870
Total estimated reductions (tonnes CO2e)	83,090
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period of (tonnes CO2e)	11,870

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

No public funding is being provided for this project.

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

As in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, 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: and
- Registered within the previous two years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

According to the above definition, this project activity is not debundled.

SECTION B. Application of a baseline and monitoring methodology

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

The project applies two approved baseline and monitoring methodologies;

- AMS-III.H Methane recovery in waste water treatment
  (Version 10, Scope 13, published at EB42)

- AMS-I.C. Thermal energy for the user with or without electricity
  (Version 13, Scope 1, published at EB38)

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

The project meets all the applicability conditions of the methodologies, as described below.

Applicability conditions for AMS-III.H.

Options for technology/ measure for AMS- III.H.	Justification Applicability of the project category
1. This methodology comprises measures that recover biogas from biogenic organic matter in wastewaters by means of one, or a combination, of the following options:	-
(i) Substitution of existing aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion;	Not applicable; The baseline wastewater treatment scenario comprises anaerobic lagoons.

(ii) Introduction of anaerobic sludge treatment system with biogas 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 biogas recovery and combustion to an existing sludge treatment system;	Not applicable; There is no existing sludge treatment system.
(iv) Introduction of biogas 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 biogas 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 biogas recovery and combustion, with or without sludge treatment, to an existing anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	Applicable; The project will install Digester to recover the methane that is currently emitted to the atmosphere through anaerobic digestion in open lagoons of the Tapioca starch plant.
2. The recovered biogas 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 biogas 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 biogas is used for thermal energy generation directly.
3. If the recovered biogas is used for project activities covered under paragraph 2 (a), that component of the project activity can use a corresponding methodology 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 biogas is utilised for production of hydrogen (project activities covered under paragraph 2 (d)), that component of project activity shall use corresponding category AMS-III.O.	Not applicable; No hydrogen production will be applied in the project activity.
5. In case of project activities covered under paragraph 2 (b) if bottles with upgraded biogas are sold outside the project boundary the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If however the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO2 emissions avoided by the displacement of the fuels is eligible under a corresponding type I methodology, e.g. AMS-I.C.	Not applicable; No biogas bottling will be applied in the project activity.
6. In case of project activities covered under paragraph 2 (c i) emission reductions from the displacement of the use of natural gas is eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	Not applicable; No biogas upgrading will be applied in the project activity.
7. In case of project activities covered under paragraph 2 (c ii) emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding type I methodology, e.g. AMS-I.C.	Not applicable; No biogas upgrading will be applied in the project activity.
8. In case of project activities covered under paragraph 2 (b) and (c), this 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, in the absence of national regulations, 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. New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the requirements in the General Guidance for SSC methodologies concerning these topics. In addition the requirements for demonstration of the remaining lifetime of the equipment replaced as described in the general guidance shall be followed.	Not applicable; The project facilities involve no change of equipments resulting in a capacity addition of the wastewater or sludge treatment system.
10. For project activities covered under paragraph 2 (b) and (c) additional guidance provided in annex 1 shall be followed for the calculations in addition to the procedures in the relevant sections below.	Not applicable; The recovered biogas is used for thermal energy generation directly.

11. The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater and described in the PDD.	Applicable; The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater and described in the PDD.
12. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60k tCO2 equivalent annually from all type III components of the project activity.	Applicable; The annual emission reductions are estimated 11,870 tCO2e per year, which are lower than 60k tCO2e per year over the crediting period.

Applicability condition for AMS-I.C.

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: The project will generate thermal energy that displaces fossil fuels from recovered methane.
2. Where thermal generation capacity is specified by the manufacturer, it shall be less than 45 MW.	Applicable; The maximum capacity to be installed under the project over the crediting period is 3MW, which is below 45MW, and will remain so during the crediting period.
3. For co-fired 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_{th}.
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.

B.3. Description of the project boundary:

- For the methane recovering part of the project, with reference to AMS-III.H., the project boundary is the physical, geographical site where the wastewater treatment takes place. The project boundary therefore comprises of the methane recovery facility, as opposed to the current anaerobic open lagoons (boundary of the baseline). It includes (1) Digester (an anaerobic covered lagoon), (2) anaerobic open lagoons, (3) nearby land that accommodates the gas handling, metering system(s) and combustion equipment.

- For the thermal energy part of the project, with reference to AMS-I.C., the projects boundary encompasses the physical, geographical site of the renewable generation source. The project boundary therefore comprises of the thermal energy generation system using the biogas.

The diagram below provides an illustrative description of the project boundary.

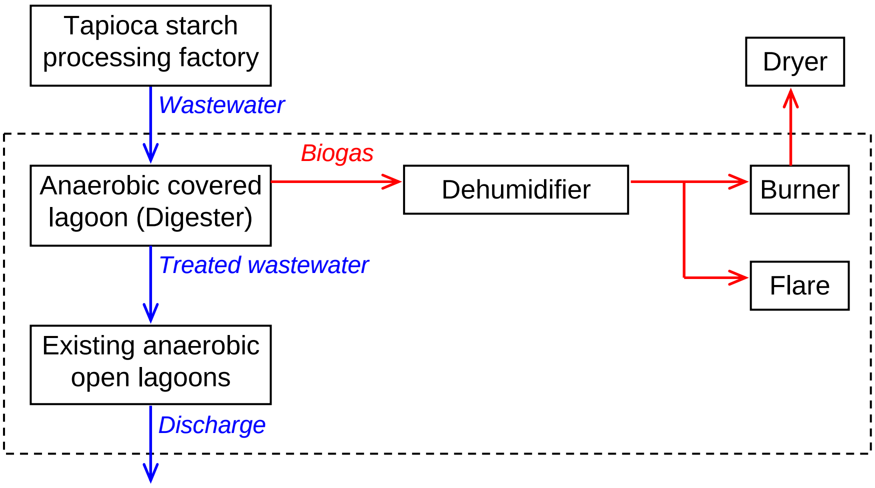

Figure 2: Project Boundary

B.4. Description of baseline and its development:

The baseline for the project activity has been developed by using two categories listed in the simplified modalities and procedure for small-scale CDM project activity:

1. Type III – Other project activities, Category III.H. – Methane recovery in wastewater treatment, Version 10 (AMS-III.H.)

   The existing wastewater treatment system consists of eight (8) anaerobic open lagoons. The effluent of starch processing plant flows into the first anaerobic open lagoon. Average depth of the lagoons is around 4m, thus the lagoons are kept in anaerobic condition. The lagoons store wastewater for a long time, and organic substances contained in the wastewater decompose, generating large amounts of methane gas that is emitted into the atmosphere. The treated wastewater outflows to local rivers from the eighth lagoon.

The existing lagoons 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.
The baseline emission is calculated to be 10,640tCO2e/year for this project.

2. Type I – Renewable energy projects, Category I.C. – Thermal energy for the user with or without electricity Version 13 (AMS-I.C.)

The baseline scenario is continuation of using coal to generate heat energy and emit CO2 consequently for starch drying process. In this project, the captured biogas will be utilised as thermal energy in the process. This renewable energy will replace the coal and result in CO2 emission reduction.
The baseline emission is calculated to be 4,393tCO2/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:

Identification of alternatives to the project activity consistent with current laws and regulations

Alternative scenario: Anthropogenic GHG, including methane, are released into the atmosphere via decomposition of Tapioca Starch plant effluent. Currently, this biogas is not collected. This scenario is credible and realistic.

Proposed CDM activity: The proposed project activity intends to improve current wastewater management practices. These changes will result in the mitigation of anthropogenic GHG emissions, specifically the recovery of methane, by controlling the decomposition processes of waste water in the lagoons and collecting and utilising the biogas efficiently.

The proposed project activity is in accordance with the current applicable laws and regulations. The project participants have solicited information regarding this issue during conversations with local and state government officials and through legal representation and have determined that there is no regulatory impetus for producers to upgrade current wastewater treatment systems with anaerobic open lagoons.

Attachment A to Appendix B of the simplified modalities and procedures for CDM small-scale project activities requires project participants to provide an explanation to show that the project activity would not have occurred in the absence of the CDM due to the one of following barriers: (a) investment barrier, (b) technological barrier, (c) barrier due to prevailing practice, and (d) other barriers. The tool for demonstration and assessment of additionality (version 05.2) is used.

(a) Investment analysis

Investment barriers

The existing lagoon system is an effective low-tech solution that can be easily applied to meet the Viet Nam Standards relating to the treatment and discharge of wastewater in the Tapioca Starch plant. There is also an abundance of local labour with experience in the lagoon's technology in Viet Nam.

Since the continuation of the current practice (anaerobic treatment of Tapioca starch plant effluent through existing lagoons) does not pose any financial or economical problem to the project host and it requires no further investment, there is no financial incentive for the owner to invest into the capture of biogas project with absence of CER's revenue. In addition, there is no requirement under the existing Viet Nam Laws for the Tapioca Starch plant to compulsory undertakes the methane recovery project.

The proposed CDM activity requires an investment of approximately 1 million USD for the methane recovery system. The methane recovery system will be built, owned and operated by the project participants. The project participants will benefit from the profit on sale of CERs and will reduce the cost of fossil fuels.

The financial details of the proposed project are summarized as below.

Item	Amount (USD)
1. Investment and Capital Cost Engineering Procurement Construction	**1,010,000**
2. Annual Operation and Maintenance Cost Labour Administration Repair Fuel Power cost	**80,000**
3. Annual Income Revenue from replacing coals with biogas	**105,882**
CER price (/ tCO_2e)	**13**

IRR analysis:

The Internal Rate of Return (IRR) had been chosen as calculation and comparison of financial indicators. The project IRR is calculated based on key assumptions as follows:

1. The CER trading price was set at 13 USD / tCO_2e and evaluation was made by taking fluctuations of the trading price into consideration.
2. The benchmark of IRR can be derived as 7.125% from Viet Nam government bonds. The IRR to be cleared in business is 7.125% (10-year Viet Nam government bonds, coupons (yield)).

The results of the project IRR calculations are shown in the following table.

	Without CER	With CER			Benchmark
		CER trading price			
		11 USD	13 USD	15 USD	
Project IRR (%)	negative	-5.6	-1.2	2.8	7.125

* IRR is a value in Year 7 of the project.

As shown in the above table, the project IRR without the revenues from the CERs sales is negative, and thus is deemed as not financially feasible. Taking into consideration the revenues from the selling of

CERs, the project IRR is 2.8% when CER price is set at 15 USD / tCO2e and thus making it financially feasible. The project IRR depends on the CER price and higher CER price produces higher project IRR. Therefore, the project cannot be carried out in the Business as Usual (BAU) situation.

Conclusion

According to the above, it is clearly demonstrated that:

1. The only plausible and realistic scenario is the continuation of the current situation, which requires no further investment;
2. On the contrary, the proposed project faces significant financial barriers such as negative IRR;
3. The proposed project activity is not a prevailing practice.

Based on the above analysis, it can be concluded that the proposed project activity would not have occurred without the incentive from CDM and the additional income from the issuance of CERs. The proposed activity goes beyond the applicable legislation and prevailing practices in the Tapioca Starch plant in Viet Nam. As such, the proposed project activity is additional and not a baseline scenario.

B. 6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the baseline methodologies listed in section B.4., formulas to calculate the emission reductions, baseline emissions, project emissions and leakage are expressed as follows:

Emission reductions

The emission reduction for the project activity is calculated by using the formula:

$$\begin{aligned} \mathbf{ER_y} &= \mathbf{ER_{1,y} + ER_{2,y}} \\ &= \mathbf{(BE_{1,y} - PE_{1,y} - Leakage_{1,y}) + (BE_{2,y} - PE_{2,y} - Leakage_{2,y})} \end{aligned}$$

Where:

ER_y = Emission reductions in year y
$ER_{1,y}$ = Emission reductions in year y in accordance with AMS-III.H.
$ER_{2,y}$ = Emission reductions in year y in accordance with AMS-I.C.
BE_y = Baseline emissions in year y
PE_y = Project activity emissions in year y

AMS-III.H.

Baseline Emissions

According to AMS-III.H., the baseline scenario for this project is the case 6 (vi):

(vi) Introduction of sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).

Therefore the baseline emissions are calculated by using the following formulas:

$$BE_{1,y} = BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$$

Where:

$BE_{1,y}$:Baseline emissions in year y (tCO2e)

$BE_{power,y}$: Baseline emissions from electricity or fuel consumption in year y (tCO2e)

$BE_{ww,treatment,y}$: Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO2e)

$BE_{s,treatment,y}$: Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO2e)

$BE_{ww,discharge,y}$: Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO2e)

$BE_{s,final,y}$: Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO2e).

Since this project does not involve sludge treatment, and the amount of electricity consumption in the baseline wastewater treatment system is zero, the above equation can be simplified as follows;

$$BE_{1,y} = BE_{ww,treatment,y} + BE_{ww,discharge,y}$$

(A) Formula used to calculate $BE_{ww,treatment,y}$

$$BE_{ww,\ treatment,\ y} = \Sigma\ Q_{ww,\ i,\ y} * COD_{removed,\ i,\ y} * MCF_{ww,\ treatment,\ BL,\ i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

Where:

$Q_{ww,\ i,\ y}$: Volume of wastewater treated by baseline wastewater treatment system i in year y(m3)

$COD_{removed,\ i,\ y}$: Chemical oxygen demand removed by baseline treatment system i in year y (tonnes/m3), measured as the difference between inflow COD and the outflow COD in system i

$MCF_{ww,\ treatment,\ BL,\ i}$: Methane correction factor for baseline wastewater treatment systems I (Anaerobic deep lagoon (deep more than 2 meters) : 0.8)

$B_{o,ww}$: Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kgCH4/kgCOD)

UF_{BL} : Model correction factor to account for model uncertainties (0.94)

GWP_{CH4} : Global Warming Potential for methane (value of 21)

(B) Formula used to calculate $BE_{ww,discharge,y}$

$$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{0,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge}$$

Where:

$Q_{ww,y}$: Volume of treated wastewater discharged in year y (m3/y)

UF_{BL} : Model correction factor to account for model uncertainties (0.94)

$COD_{ww,discharge,BL,y}$: Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in the year y (tonnes/m3). If the baseline scenario is the discharge of untreated wastewater, the COD of untreated wastewater shall be used.

$MCF_{ww,BL,discharge}$: Methane correction factor based on discharge pathway in the baseline situation (e.g. into sea, river or lake) of the wastewater (fraction)

GWP_{CH4} : Global Warming Potential for methane (value of 21)

Project Activity Emissions

$$PE_{1,y} = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$$

Where:

$PE_{1,y}$: Project activity emissions of AMS-III.H. in year y (tCO2e)

$PE_{power,y}$: Emissions from electricity or fuel consumption in year y

$PE_{ww,treatment,y}$: Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO2e)

$PE_{s,treatment,y}$: Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO2e)

$PE_{ww,discharge,y}$: Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater in year y (tCO2e)

$PE_{s,final,y}$: Methane emissions from anaerobic decay of the final sludge produced by the project activity treatment systems in the year y (tCO2e)

$PE_{fugitive,y}$: Methane fugitive emissions from biogas release in capture systems in year y (tCO2e)

$PE_{flaring,y}$: Methane emissions due to incomplete flaring in year y (tCO2e)

$PE_{biomass,y}$: Methane emissions from biomass stored under anaerobic conditions (tCO2e)

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. In addition, there will be no biomass stored under anaerobic conditions under the proposed project. Hence, the above equation can be simplified as follows;

$$PE_{1,y} = PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,discharge,y} + PE_{fugitive,y} + PE_{flaring,y}$$

(A) $PE_{power,y}$:CO2 emissions on account of power used by the project 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 recovered methane at Digester. In the normal operation, methane recovered 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	: Amount of electricity in the year y that is consumed at the project site for the project activity (MWh)
CEF_{grid}	: CO2 emissions factor for electricity consumed at the project site during the project activity (tCO2e/MWh), estimated under the simplified methodology AMS-I.D.

(B) $PE_{ww, treatment, y}$:Project activity emissions from treatment system;

$$PE_{ww, treatment, y} = \Sigma Q_{ww, i, y} * COD_{removed,k, y} * MCF_{ww, treatment, PJ,k} * B_{o,ww} * UF_{PJ} * GWP_{CH4}$$

$Q_{ww, i, y}$	: Volume of wastewater treated by treatment system k in year y (m3/y)
$MCF_{ww, treatment, PJ,k}$	: Methane correction factor for project wastewater treatment system k
$COD_{removed,k, y}$	: Chemical oxygen demand removed by project wastewater treatment system k in year y (tonnes/m3), measured as the difference between inflow COD and the outflow COD in system k
$B_{o,ww}$	: Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kgCH4/kgCOD)
UF_{PJ}	: Model correction factor to account for model uncertainties (1.06)
GWP_{CH4}	: Global Warming Potential for methane (value of 21)

(C) $PE_{ww, discharge, y}$:Project activity emissions from degradable organic carbon in treated wastewater;

$$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$$

Where:

$Q_{ww,y}$	: Volume of treated wastewater discharged in year y (m3/y)
$B_{o,ww}$	: Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kgCH4/kgCOD)
UF_{PJ}	: Model correction factor to account for model uncertainties
$COD_{ww,discharge,PJ,y}$	: Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in the year y (tonnes/m3).
$MCF_{ww,PJ,discharge}$	: Methane correction factor based on discharge pathway in the project situation (e.g. into sea, river or lake) of the wastewater (fraction)
GWP_{CH4}	: Global Warming Potential for methane (value of 21)

(D) $PE_{fugitive, y}$:Project activity emissions from methane release in capture system;

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

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 the above equation can be simplified as follows;

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

$$PE_{fugitive, ww, y} = (1 - CFE_{ww}) * MEP_{ww, treatment,y} * GWP_{CH4}$$

Where:

$PE_{fugitive, ww, y}$	: Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in year y (tCO2e)
CFE_{ww}	: Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9)
$MEP_{ww, treatment,y}$	: Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (tonnes)
GWP_{CH4}	: Global Warming Potential for methane (value of 21)

$$\mathbf{MEP_{ww, treatment,y} = Q_{ww\ y} * B_{o,ww} * UF_{PJ} * \Sigma\, COD_{removed, PJ, j, y} * MCF_{ww, treatment, PJ, j\ y}}$$

Where:

$Q_{ww,y}$	: Volume of treated wastewater discharged in year y (m3/y)
$B_{o,ww}$	: Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kgCH4/kgCOD)
UF_{PJ}	: Model correction factor to account for model uncertainties
$COD_{removed, PJ, j, y}$	: The chemical oxygen demand removed by the treatment system j equipped with biogas recovery in the year y (tonnes/m3)
$MCF_{ww, treatment, PJ, j, y}$	: Methane correction factor for the project wastewater treatment system j equipped with biogas recovery equipment

(E) $PE_{flaring, y}$:Project activity emissions from incomplete flaring in year y;

The emission amount from incomplete flaring is calculated using "Tool to determine project emissions from flaring gases containing methane" as follows:

$$\mathbf{PE_{flaring, y} = \Sigma\, TM_{RG, h} * (1 - \eta_{flare, h}) * GWP_{CH4} / 1000}$$

Where:

$TM_{RG, h}$	: Mass flow rate of methane in the residual gas in the hour h (kg/h)
$\eta_{flare, h}$	: Flare efficiency in hour h (-)
GWP_{CH4}	: Global warming Potential of methane (value of 21) (tCO2e/kgCH4)

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

Where:

$FV_{RG, h}$	: Volumetric flow rate of the residual gas in dry basis at normal condition in hour h (m3/h)
$fv_{CH4, RG, h}$	: Volumetric fraction of methane in the residual gas on dry basis in hour h (-)
$\rho_{CH4, n}$	: Density of methane at normal conditions (0.716) (kg/m3)

This term is neglected because the biogas recovered by the project is mainly used in the furnace. The flaring disposal of the biogas shall be monitored during the crediting period.

AMS-I.C.

<u>Baseline Emissions:</u>

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 recovered methane fueled in the furnace.

$$BE_{2,y} = HG_y * EF_{CO2} / \eta_{th}$$

Where:

$BE_{2,y}$: the baseline emissions from steam/heat displaced by the project activity during the year y (tCO2e)

HG_y : the net quantity of steam/heat supplied by the project activity during the year y (TJ)

EF_{CO2} : the CO2 emission factor per unit of energy of the fuel that would have been used in the baseline plant (tCO2/TJ)

η_{th} : the efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

$$HG_y = Q_{tcoal,y} * NCV_{coal}$$

Where:

$Q_{tcoal,y}$: Amount of coal which would have been consumed in existing coal furnace in year y (t-coal/y)

NCV_{coal} : Net Calorific Value of coal (TJ/t-coal)

Leakage

According to AMS-III.H., "if the used technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered".

For AMS-I.C., "if the energy generating equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered".

In the proposed project, all equipments to be installed are new and no equipments are being transferred from or to another activity. Therefore, leakage of the project is considered to be zero; Leakage = 0 tCO2/y

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

Data / Parameter:	$Q_{ww,y}$
Data unit:	m3/y
Description:	Volume of waste water treated in year y
Source of data used:	Calculated based on facility's historical records
Value applied:	360,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Determined by multiplying the Tapioca starch production by the conversion factor for Tapioca starch to starch plant effluent.
Any comment:	-

Data / Parameter:	**$COD_{removed, y}$**
Data unit:	tonnes/m3
Description:	Chemical Oxygen demand removed by wastewater treatment system in year y
Source of data used:	Chemical oxygen demand removed from the wastewater entering the anaerobic treatment system in year y
Value applied:	0.00877 (baseline)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data shall be multiplied inflow COD by the removal efficiency that is calculated by the difference between COD values of inflow and outflow.
Any comment:	-

Data / Parameter:	**$MCF_{ww, treatment}$**
Data unit:	Fraction
Description:	Methane correction factor (MCF) for existing wastewater treatment system to which the sequential anaerobic treatment step is being introduced.
Source of data used:	Table III.H.1. Intergovernmental Panel on Climate Change, *Climate Change 1995: The science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)(IPCC) default values for Methane Correction Factor (MCF) of AMS III.H., Version 10
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	From the plant's measurement data, depth of anaerobic lagoons is 4meters which falls into the type of anaerobic deep lagoon (depth more than 2meters) as per AMS-III.H., Table III.H.1.
Any comment:	-

Data / Parameter:	**$B_{0,ww}$**
Data unit:	kgCH4/kgCOD
Description:	Methane producing capacity of the wastewater
Source of data used:	IPCC lower value for domestic wastewater
Value applied:	0.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default IPCC value for B_0, the maximum amount of CH4 that can be produced from given quantity of wastewater, is 0.25 (kgCH4/kgCOD). Taking into account the uncertainty of this estimate, a value of 0.21 (kgCH4/kgCOD) issued as a conservative assumption for B_0.
Any comment:	-

Data / Parameter:	**UF_{BL}**
Data unit:	Fraction
Description:	Model correction factor to account for model uncertainties

Source of data used:	FCCC/SBSTA/2003/10/Add.2, page25.
Value applied:	0.94
Justification of the choice of data or description of measurement methods and procedures actually applied :	The conservative factor for the base year in the case that "the estimated uncertainty range is greater than 10 and less than or equal to 30" is used.
Any comment:	-

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO2e/kgCH4
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:	**$COD_{ww, discharge, y}$**
Data unit:	tonnes/m3
Description:	Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in year y
Source of data used:	Viet Nam environmental standard (TCVN 5945 -2005)
Value applied:	0.00008 (project)
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). In the project activity, 80mg/L of discharging limit in type B category is used as a conservative assumption.
Any comment:	-

Data / Parameter:	**$MCF_{ww, discharge}$**
Data unit:	Fraction
Description:	Methane correction factor based on discharge pathway in the baseline and project situation (e.g. into sea, river or lake) of the wastewater
Source of data used:	Table III.H.1. IPCC default values for Methane Correction Factor (MCF) of AMS III.H./Version 10
Value applied:	0.1
Justification of the choice of data or description of measurement methods	MCF value of "Discharge of wastewater to sea, river or lake" in table III.H.1 is used.

and procedures actually applied :	
Any comment:	-

Data / Parameter:	**PC_y**
Data unit:	MWh/y
Description:	The amount of electricity in year y that is consumed at the project site for the project activity
Source of data used:	Calculations based on the facilities design
Value applied:	198
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is based on the capacity of the installed facilities in the project.
Any comment:	Actual electricity consumption of the project facilities will be monitored to calculate *ex-post* project emissions.

Data / Parameter:	**CEF_{grid}**
Data unit:	tCO2e/MWh
Description:	CO2 emissions factor (CEF) for electricity consumed at the project site during the project activity
Source of data used:	Data come from Electricity Viet Nam
Value applied:	0.584
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:	**$COD_{removed, y}$**
Data unit:	tonnes/m3
Description:	Chemical Oxygen demand removed by wastewater treatment system in year y
Source of data used:	Chemical oxygen demand removed from the wastewater entering the anaerobic treatment system in year y
Value applied:	0.00141 (project)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data shall be multiplied inflow COD by the removal efficiency that is calculated by the difference between COD values of inflow and outflow.
Any comment:	-

Data / Parameter:	**UF_{PJ}**
Data unit:	Fraction
Description:	Model correction factor to account for model uncertainties
Source of data used:	FCCC/SBSTA/2003/10/Add.2, page 25.
Value applied:	1.06
Justification of the choice of data or description of measurement methods and procedures actually applied :	The conservative factor for a year of the commitment period in the case that "the estimated uncertainty range is greater than 10 and less than or equal to 30" is used.
Any comment:	-

Data / Parameter:	**$COD_{removed, y}$**
Data unit:	tonnes/m3
Description:	Chemical Oxygen demand removed by wastewater treatment system in year y
Source of data used:	Chemical oxygen demand removed from the wastewater entering the Digester in year y
Value applied:	0.00844 (project)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data shall be multiplied inflow COD by the removal efficiency that is calculated by the difference between COD values of inflow and outflow. The project value is based on the average value of the result of water content analysis 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:	**CFE_{ww}**
Data unit:	fraction
Description:	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data used:	Default value of AMS III.H., version 10
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value of 0.9 is used.
Any comment:	-

Data / Parameter:	**EF_{CO2}**
Data unit:	tCO2e/TJ
Description:	The CO2 emission factor per unit of energy of the fuel that would have been used in the baseline plant.
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2
Value applied:	94.6
Justification of the	Default value of "Other Bituminous Coal" in Table 1.4 of 2006 IPCC

choice of data or description of measurement methods and procedures actually applied :	Guidelines is used.
Any comment:	-

Data / Parameter:	$\mathbf{Q_{tcoal,\ y}}$
Data unit:	t-coal
Description:	Amount of coal consumed in existing coal furnace in year y
Source of data used:	Coal consumption in 2007
Value applied:	1,800
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is based on the plant owner which is the coal consumption per starch production multiplied by the estimated starch production.
Any comment:	-

Data / Parameter:	$\mathbf{NCV_{coal}}$
Data unit:	TJ/t-coal
Description:	Net Calorific Value of coal
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2
Value applied:	0.0258
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:	η_{th}
Data unit:	Fraction
Description:	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.
Source of data used:	IPCC default value and AMS I.C.
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	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}.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

The following calculation is based on the each year of operation of the project.

AMS-III.H. Methane recovery in wastewater treatment

Baseline Emissions:

$BE_{1,y} = BE_{ww,treatment,y} + BE_{ww,discharge,y}$

$BE_{ww,\ treatment,\ y} = \Sigma\ Q_{ww,\ i,\ y} * COD_{removed,\ i,\ y} * MCF_{ww,\ treatment,\ BL,\ i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$

$BE_{ww,\ treatment,\ y}$ = 360,000(m3/y)*0.00877(tonnes/m3)* 0.8* 0.21(kgCH4/kgCOD) * 0.94 *21
= 10,466 (tCO2e/y)

$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{0,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge}$

$BE_{ww,\ discharge,\ y}$ = 360,000(m3/y) * 21 * 0.21(kgCH4/kgCOD) *0.94*0.00116(tonnes/m3)*0.1
= 173.6(tCO2e/y)

Baseline emissions, BE_y is:

$BE_{1,y}$ = 10,466(tCO2e/y) + 173.6 (tCO2e/y)
= 10,640 (tCO2e/y)

Project Emissions:

$PE_{1,y} = PE_{power,\ y} + PE_{ww,\ treatment,\ y} + PE_{ww,\ discharge,\ y} + PE_{fugitive,\ y} + PE_{flaring,\ y}$

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

$PE_{power,\ y}$ = 198 (MWh/y) * 0.584 (tCO2e/MWh)
= 116 (tCO2e/y)

$PE_{ww,\ treatment,\ y} = \Sigma\ Q_{ww,\ i,\ y} * COD_{removed,k,\ y} * MCF_{ww,\ treatment,\ PJ,k} * B_{o,ww} * UF_{PJ} * GWP_{CH4}$

$PE_{ww,\ treatment,\ y}$ = 360,000(m3/y) *0.00141(tonnes/m3)*0.8* 0.21(kgCH4/kgCOD) *1.06 *21
= 1,898 (tCO2e/y)

$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$

$PE_{ww,\ discharge,y}$ = 360,000(m3/y) *21* 0.21(kgCH4/kgCOD) * 1.06 * 0.00008(tones/m3)* 0.1
= 13 (tCO2e/y)

$PE_{fugitive,\ y} = PE_{fugitive,\ ww,\ y}$

$PE_{fugitive,\ ww,\ y} = (1 - CFE_{ww}) * MEP_{ww,\ treatment,y} * GWP_{CH4}$

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

$PE_{fugitive,y}$ = (1-0.9)*360,000(m3/y) * 0.21(kgCH4/kgCOD)* 1.06 * 0.00844(tones/m3)* 0.8 *21
= 1,136 (tCO2e/y)

$PE_{flaring, y}$ = 0 (tCO2e/y)

This term is neglected because the biogas recovered in the project is mainly fuelled in the furnace.

Project activity emissions, $PE_{1,y}$ is:

$PE_{1,y}$ = 116(tCO2e/y) +1,898(tCO2e/y)+ 13 (tCO2e/y)+1,136 (tCO2e/y)+0(tCO2e/y)
= 3,163 (tCO2e/y)

Emission Reduction:

$ER_{1,y}$ = $BE_{1,y}$ - $PE_{1,y}$ - $Leakage_{1,y}$
= 10,640 (tCO2e/y) - 3,163 (tCO2e/y) - 0 (tCO2e/y)
= 7,477 (tCO2e/y)

AMS-I.C. Thermal energy for the user with or without electricity

Baseline Emissions:

$BE_{2,y} = HG_y * EF_{CO2} / \eta_{th}$

$HG_y = Q_{tcoal, y} * NCV_{coal}$

$BE_{2,y} = Q_{tcoal, y} * NCV_{coal} * EF_{CO2} / \eta_{th}$
= 1,800(t-coal/y) * 0.0258 (TJ/t-coal) *94.6 (tCO2e/TJ) / 1.0
= 4,393 (tCO2e/y)

Emission Reduction:

$ER_{2,y}$ = $BE_{2,y}$ - $PE_{2,y}$ - $Leakage_{2,y}$
= 4,393 (tCO2e/y) - 0 (tCO2e/y) - 0 (tCO2e/y)
= 4,393 (tCO2e/y)

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

Table 4 shows the aggregate emission reductions of the project activity (AMS-III.H. and AMS-I.C.) for 7 years crediting period.

Table 2 AMS-III.H. Methane Recovery in Waste Water Treatment

Year	Estimation of Baseline Emissions (tCO2e)	Estimation of Project Activity Emissions (tCO2e)	Estimation of Leakage (tCO2e)	Estimation of Emission Reductions in Component 1 (tCO2e)
Year 1: 2011	10,640	3,163	0	7,477
Year 2: 2012	10,640	3,163	0	7,477
Year 3: 2013	10,640	3,163	0	7,477
Year 4: 2014	10,640	3,163	0	7,477
Year 5: 2015	10,640	3,163	0	7,477
Year 6: 2016	10,640	3,163	0	7,477
Year 7: 2017	10,640	3,163	0	7,477
Total (tCO2e)	74,480	22,141	0	52,339

Table 3 AMS-I.C. Thermal energy for the user with or without electricity

Year	Estimation of Baseline Emissions (tCO2e)	Estimation of Project Activity Emissions (tCO2e)	Estimation of Leakage (tCO2e)	Estimation of Emission Reductions in Component 2 (tCO2e)
Year 1: 2011	4,393	0	0	4,393
Year 2: 2012	4,393	0	0	4,393
Year 3: 2013	4,393	0	0	4,393
Year 4: 2014	4,393	0	0	4,393
Year 5: 2015	4,393	0	0	4,393
Year 6: 2016	4,393	0	0	4,393
Year 7: 2017	4,393	0	0	4,393
Total (tCO2e)	30,751	0	0	30,751

Table 4 Summary of estimation of overall emission reductions

Year	Estimation of Baseline Emissions (tCO2e)	Estimation of Project Activity Emissions (tCO2e)	Estimation of Leakage (tCO2e)	Estimation of Emission Reductions (tCO2e)
Year 1: 2011	15,033	3,163	0	11,870
Year 2: 2012	15,033	3,163	0	11,870
Year 3: 2013	15,033	3,163	0	11,870
Year 4: 2014	15,033	3,163	0	11,870
Year 5: 2015	15,033	3,163	0	11,870
Year 6: 2016	15,033	3,163	0	11,870
Year 7: 2017	15,033	3,163	0	11,870
Total (tCO2e)	**105,231**	**22,141**	**0**	**83,090**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$Q_{ww,y}$**
Data unit:	m3/y
Description:	Volume of wastewater treated in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	The data is measured continuously and the measurements are taken using flow meters electrically.
QA/QC procedures to be applied:	Flow meters will be calibrated according to manufacturer recommended standards.
Any comment:	Used for the project emission and baseline emissions calculation. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**$COD_{ww, untreated, y}$**
Data unit:	tonnes/m3
Description:	Chemical oxygen demand of the wastewater entering the treatment system
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Sampling shall be done on-site and analysis will be carried out.
QA/QC procedures to be applied:	The data are cross-checked with samples and analysed by an accredited laboratory periodically.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**$COD_{ww, treated, y}$**
Data unit:	tonnes/m3
Description:	Chemical oxygen demand of the treated wastewater in the treatment system
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Sampling shall be done on-site and analysis will be carried out.
QA/QC procedures to be applied:	The data are cross-checked with samples and analysed by an accredited laboratory periodically.
Any comment:	Data will be kept electronically in a systematic and transparent manner during

	the crediting period and two years after the end of the crediting period.

Data / Parameter:	**COD** $_{ww, removed, PJ, y}$
Data unit:	tonnes/m3
Description:	Chemical oxygen demand removed by the treatment system activity in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	The data shall be multiplied inflow COD by the removal efficiency (same with baseline calculation) that is calculated by the difference between COD values of inflow and outflow.
QA/QC procedures to be applied:	The data are cross-checked with samples and analysed by an accredited laboratory periodically.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**COD** $_{ww, discharge, PJ, y}$
Data unit:	tonnes/m3
Description:	Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the project situation in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	This is based on the Viet Nam environmental standard (TCVN5945-2005). 80mg/L of discharging limit in type B category is used as a conservative assumption.
QA/QC procedures to be applied:	The data are cross-checked with samples and analysed by an accredited laboratory periodically.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**PC_y**
Data unit:	MWh/y
Description:	The amount of electricity in year y that is consumed at the project site for the project activity
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	The data shall be measured continuously by electricity meter.
QA/QC procedures to be applied:	Electricity meters will be calibrated in accordance with the manufacturer's standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	Flow rate of biogas
Data unit:	m3/h
Description:	Flow rate of biogas fuelled/flared
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Flow rate of biogas will be measured with continuous flow meters.
QA/QC procedures to be applied:	The flow meter will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	Temperature of biogas
Data unit:	Degree Celsius
Description:	Temperature of the biogas fuelled/flared
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Temperature of the biogas will be measured with a continuous temperature sensor or with periodical measurement at a 95% confidence level. This parameter is required to determine the density of methane fuelled/flared.
QA/QC procedures to be applied:	The temperature sensor will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	Pressure of biogas
Data unit:	Bar
Description:	Pressure of the biogas fuelled/flared
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Pressure of the biogas will be measured with a continuous sensor or with periodical measurement at a 95% confidence level. This parameter is required to determine the density of methane fuelled/flared.
QA/QC procedures to be applied:	The pressure transducer will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	Fraction of methane
Data unit:	Fraction (volumetric basis)

Description:	Fraction of methane in the recovered biogas
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	The fraction of methane in the gas will be measured with a continuous analyser or with periodical measurement at a 95% confidence level.
QA/QC procedures to be applied:	The analyser will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**$BG_{furnace, y}$**
Data unit:	m3/y
Description:	Volumetric flow rate of biogas fuelled into the furnace in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Flow rate of biogas will be measured with continuous flow meters.
QA/QC procedures to be applied:	The flow meter will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**$BG_{flare, y}$**
Data unit:	m3/y
Description:	Volumetric flow rate of biogas flared into the flare in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	Flow rate of biogas will be measured with continuous flow meters.
QA/QC procedures to be applied:	The flow meter will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	**$FV_{RG,h}$**
Data unit:	m3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data to be	On-site measurement

used:	
Value of data	
Description of measurement methods and procedures to be applied:	Flow rate of residual gas will be measured with continuous flow meters.
QA/QC procedures to be applied:	The flow meter will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.

Data / Parameter:	$\mathbf{fv_{CH4,RG,h}}$
Data unit:	Fraction (volumetric basis)
Description:	Volumetric fraction of methane in the residual gas in the hour h
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods and procedures to be applied:	The fraction of methane in residual gas will be measured with continuous analyser or with periodical measurement at a 95% confidence level.
QA/QC procedures to be applied:	The analyser will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas.

Data / Parameter:	$\mathbf{w_{CH4,\ y}}$
Data unit:	Mass fraction
Description:	Methane content in the biogas in year y
Source of data to be used:	On-site measurement
Value of data	Refer to UNFCCC methodology AMS-H.III. version 10
Description of measurement methods and procedures to be applied:	The fraction of methane in the gas will be measured with continuous analyser or with periodical measurement at a 95% confidence level. Data will be kept electrically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	The analyser will be calibrated in accordance with the manufacturer standards or appropriate industry standards.
Any comment:	Value of data would be used to calculate *ex-post* emissions

Data / Parameter:	$\mathbf{D_{CH4,\ y}}$
Data unit:	tonnes/m3
Description:	Density of methane at the temperature and pressure of the biogas in year y
Source of data to be used:	On-site measurement
Value of data	
Description of measurement methods	Density of methane combusted is calculated by using temperature and pressure of the gas.

and procedures to be applied:	
QA/QC procedures to be applied:	The data is cross-checked with samples and analysed by an accredited laboratory periodically.
Any comment:	Value of data would be used to calculate *ex-post* emissions

B.7.2 Description of the monitoring plan:

In order to monitor the project emission reductions, the biogas plant staff will receive appropriate trainings on the monitoring equipment to be installed, the data to be monitored, and related monitoring and quality control procedures. All monitoring data will be converted to and stored in the electronic format and cross-checked with the original data. The data and calculation result will be managed by the SPC that will be established for project implementation. The various data and calculation results will be verified by a DOE yearly for the issuance of CER's. All data is maintained for a minimum of two years beyond the duration of the project.

	Items	Responsible Organization	Description
1	Monitoring Planning	SPC	Training will be done for the O/M team for the good understanding and practice of the monitoring plan and the actual monitoring methods
2	Monitoring	SPC or outsourced	All data will be stored by electronic files and partly by paper
3	Monitoring of Regulation	SPC or outsourced	Periodical reports will be made
4	Calibration of Monitoring Equipments	Authorized entity	Authorized entity issues the certification of calibration record. The record will be kept by the SPC

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 of the application: 13 February 2009 (13/02/2009)

Responsible Person/Entity:
Hideki FUJII
Kajima Corporation
5-11, Akasaka 6-Chome
Minoto-ku
Tokyo 107-3848
Japan
Telephone: +81-3-5544-0744
Fax: +81-3-5544-1736
E-mail: hfujii@kajima.com

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:

1st January 2011

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

7 years 0 month

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:

1st January 2011 or date of registration with CDM-EB whichever is later

C.2.1.2. Length of the first crediting period:

7 years 0 month

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

n/a

C.2.2.2. Length:

n/a

SECTION D. Environmental impacts

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

The Environmental Impact Assessment report of the project will be completed by the project participants in line with the new Environmental Protection Law of 2005.

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

Project Participants expect no significant negative environmental impact from the project activity.

SECTION E. Stakeholders' comments

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

This project is to establish the wastewater treatment facilities within the area of the existing starch plant. Therefore the local stakeholders in the project area include; Department of National Resources and Environment of Ninh Binh province, and Local communities in Son Lai Village, Nho Quan District.

The project participants have conducted some meetings. In these meetings, the general plans on project activities were presented including the applied methodologies, project scale, implementation structures, schedule, technology, etc., followed by the discussion about the feasibility of the study and feedback comments from the participants.

The meeting with local stakeholders has not been completed. It will be arranged and carried out before the project implementation.

E.2. Summary of the comments received:

All participants expressed their satisfaction towards the implementation of the proposed project because this project will contribute to improving treatment of wastewater in the local area, as well as reducing the GHG emissions by utilising captured biogas as existing coal-derived fuel.

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

At present project has not received any claims from local stakeholders to obstruct project implementation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	
Middle Name:	
First Name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is being provided for this project.

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

Please refer to the Section B.7