Fiscal 2008 CDM/JI Feasibility Study
Summary

Study Title:

Wastewater treatment and energy recovery at starch processing plant in Viet Nam

Corporate Name:

KAJIMA Corporation

1. Outline of the Project

(1) Host Company, Area

Ninh Binh province and Quang Nam Province, Socialist Republic of Viet Nam

(2) Purpose of the Project

The purpose of the project activity is to recover biogas (methane gas) discharged from wastewater of Tapioca Starch processing plant in Ninh Binh province and Quang Nam province, Viet Nam. The biogas will be used to generate heat energy and to substitute fossil fuels. Table 1 shows the project profile for two plants.

Table 1: Project Profile

	Project 1	Project 2
Project activity site	Ninh Binh province	Quang Nam province
Installed facility	Anaerobic Covered Lagoon	Anaerobic Covered Lagoon
GHG emission reduction	11,870 tCO_2e/yr	16,449 tCO_2e/yr
Operation Start	January 2011	January 2011

2. Outline of the Study

(1) Study Subject

・Estimation of Biogas Yield

Primary source of income in the proposed project would be the profit on sales of recovered biogas and certified emission reduction (CER), therefore, accurate estimation of the biogas yield is essential to analyze its profitability. Since some data necessary for biogas yield estimation were not available or not reliable at the start of the project, this study aimed to collect more accurate and unbiased data.

・Appropriate Facilities Design

The wastewater treatment and biogas recovery system to be introduced in the project has a simple mechanism but requires proper and careful design to maximize the efficiency. On the other hand, the plant owners desire cost reduction through the project. Therefore it is needed to design the facilities to meet both of technical and budgetary requirements.

(2) Framework of the Study Implementation

（Japan）

- Electric power company : Collection of basic information

(Viet Nam)

- Consultation company : Collection of the plant data
- Engineering company : Facilities design
- Analysis laboratory : Wastewater analysis

(3) Study Content

1) Site Survey

Five site surveys were conducted during the study period to collect necessary data and information, and to discuss the project development scheme.

2) Identification of Baseline Scenario

Applicability of the proposed project to the approved small-scale methodologies AMS-III.H. and AMS-I.C. was determined. Based on the data collected, the baseline scenario and project boundary were identified and its additionality were examined.

3) Development of Monitoring Plan

Appropriate monitoring plan was developed based on the applied methodologies.

4) Identification of Duration of Project Activity and Crediting Period

Duration of implementation and crediting period of the project were set to be 7 years, taking into consideration the baseline scenario and profitability.

5) Estimation of GHG emission reductions

GHG emission reductions were estimated based on the data and information measured during the site survey and IPCC default value etc.

6) Environmental Impact Assessment

National policy on environment and EIA system in Viet Nam were studied, and the possible environmental impact of this project activities and its countermeasure were determined.

7) Assessment on Other Indirect Impacts

Possible socio-economic impacts of the project activities which contribute to the sustainable development of the host parties were studied.

8) Stakeholders' Comments

Hearings with the stakeholders of the proposed project were conducted. In general, study team received favorable opinions towards the implementation of the project.

9) Financial Analysis

Project cost and revenue were estimated and its profitability was analyzed using internal rate of return (IRR) as an indicator.

10) Preparation of the PDD

PDD were completed based on the result of the above-mentioned investigation.

11) Study on Realization of Co-benefit in host company and its Evaluation System

After careful assessment of the expected environmental pollution in the starch plant and its evaluation index, a comprehensive and quantitative evaluation system was established.

Results of the study subject are as follows;

・Estimation of Biogas Yield

Study team collected the existing data on the target plants, and conducted analysis on wastewater from the plant. Samples for the wastewater analysis were taken four times for Project 1 during the operation period of the plant, and ten times for Project 2. All the samples were analyzed at the governmental laboratory. Based on the obtained data, study team made more accurate estimation on biogas yield more accurately.

・Appropriate Facilities Design

As an appropriate technology to be applied to the target plant, two types of methane digesters were carefuly compared, namely UASB (Upflow Anaerobic Sludge Blanket) type and Covered Lagoon type digester. After due comparison and discussion with plant owners, the latter one was sellected to be introduced in the two projects. Facilities design was carried out by subcontractor, an experienced engineering company, under the technical guidance of KAJIMA's. Project cost was calculated using unit price of equipments and labours locally available.

3. Project Implementation

(1) Project Boundary and Baseline Senario

1） Applied Methodology

Both Project 1 and Project 2 apply the approved small-scales methodologies "AMS-III.H.: Methane Recovery in Wastewater Treatment (version 10)" and "AMS-I.C.: Thermal energy for the user with or without electricity (version 13)".

Methodology AMS-III.H. comprises the measures that recover methane from biogenic organic matter in wastewater and is applicable to the proposed project activity which introduce a new digester (anaerobic covered lagoon) with biogas (methane) recovery into the existing plant to avoid methane emissions from existing anaerobic open lagoon.

Methodology AMS-I.C. comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Thus it is applicable to the project activities which utilize recovered biogas as thermal energy for boilers that displaces fossil fuels.

2） Project Boundary

Project boundary was defined in line with the applied methodology AMS-III.H. and AMS-I.C.

For AMS-III.H., project boundary is the physical and geographical site where the wastewater treatment takes place and all facilities affected by the project activity including sites. For AMS-I.C., project boundary is the physical, geographical site of the renewable energy generation. The project boundary is as shown in Figure 1.

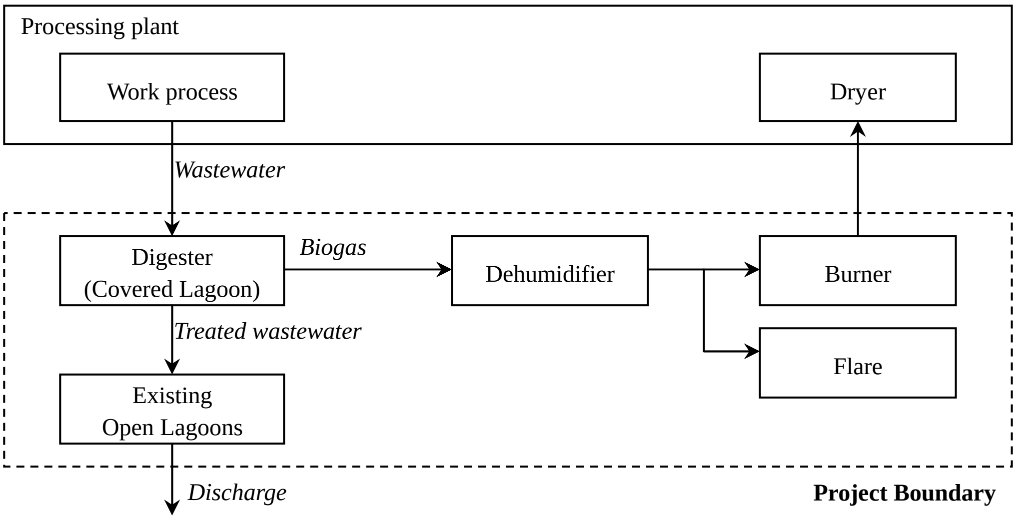

Figure 1: Project Boundary

3）Baseline Scenario

【AMS-III.H.】

Wastewater is now treated at the anaerobic open lagoons without biogas recovery system in the target plants. Therefore, the baseline scenario for the project activity is continuation of the current practice in which the existing anaerobic open lagoon system releases methane into the atmosphere.

【AMS-I.C.】

The baseline scenario is continuation of use of coal to generate heat energy and consequent CO2 emissions from the starch drying process.

4）Calculation of GHG Emission Reductions

Since no leakage defined in the AMS III.H and AMS I.C is applicable for both of the projects, Emission Reductions (ER) is calculated by subtracting Project Emissions (PE) from Baseline Emissions (BE). Calculation formula of BE and PE in line with the applied methodology are as shown below.

【AMS-III.H.】

・Baseline Emissions : $BE_{1,y}$ ($tCO_2e/_{year}$)

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

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

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

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

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

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

・Project Emissions : $PE_{1,y}$ ($tCO_2e/_{year}$)

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

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

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

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

$PE_{ww, discharge, y}$: Emissions from degradable organic carbon in treated wastewater discharged in to sea/river/lake in year y

$PE_{s,final, y}$: Emission from anaerobic decay of the final sludge produced by the project activity treatment system in year y

$PE_{fugitive, y}$: Fugitive emissions from biogas release in capture systems in year y

$PE_{biomass, y}$: Emissions from biogas stored under anaerobic conditions

$PE_{flaring, y}$: Emissions due to incomplete flaring in year y

【AMS-I.C.】

・Baseline Emissions : $BE_{2,y}$ (tCO_2e/y)

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

$BE_{2,y}$(tCO_2e/y) : Baseline emissions from steam/heat displaced by the project activity during the year y

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

EF_{CO2}(tCO_2e/TJ) : CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant

$\eta_{th, existing}$ (-) : Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

・Project Emissions : $PE_{2,y}$ (tCO_2e/y)

Both projects utilize biomass-derived methane as thermal energy that displaces fossil fuel. Therefore, Project Emissions ($PE_{2,y}$) are estimated to be zero.

(2) Monitoring Plan

A Monitoring Plan was established in line with the applied methodology AMS-III.H. and AMS-I.C. Parameters to be monitored are as described in Figure 2.

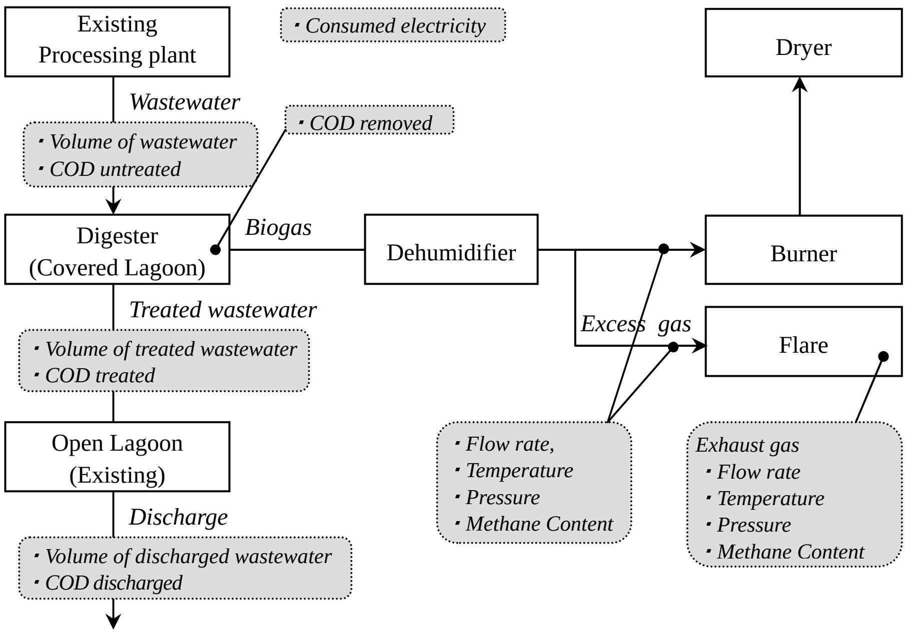

Figure 2: Monitoring Plan

(3) Emission Reductions of GHG

Table 2 shows the result of estimated GHG emission reductions in each project.

Table 2: Estimated GHG Emission Reductions

・Project 1 (Ninh Binh)

	AMS-III.H.	AMS-I.C.	Total
Baseline Emissions	10,640	4,393	15,033
Project Emissions	3,163	0	3,163
Leakage	0	0	0
Total	7,477	4,393	<u>11,870</u>

(tCO2e/yr)

・Project 2 (Quang Nam)

	AMS-III.H.	AMS-I.C.	Total
Baseline Emissions	15,411	5,613	21,024
Project Emissions	4,575	0	4,575
Leakage	0	0	0
Total	10,836	5,613	<u>16,449</u>

(tCO2e/yr)

(4) Duration of the Project Activity / Crediting Period

Table 3 shows the project implementation schedule. After feasibility study, both project plans to take necessary procedure to be registered by the CDM Executive Board in 2009, including validation, national approval and United Nations registration. Upon registered, detailed design and construction of the new facilities will be implemented and the new facilities will start its operation in January 2011.

Duration of the project activity and crediting period are set to be seven years (maximum 21 years with two extensions) taking into considering the economic profitability.

Table 3: Implementation Schedule

	2008		2009				2010				2011	
Feasibility Study												
Validation												
National approval												
UN Registration												
Detailed Design /Construction												
Operation												

(5) Environmental Impact and the Other Indirect Impact

In Viet Nam, the Appendix I of "Law on Environmental Protection (Decree No. 80/2006/ND-CP)" enacted in August 2006 stipulates 102 project activities which require Environmental Impact Assessment (EIA) report. As for the starch production activities, plant with the annual production capacity over 1,000 ton is required an EIA report. Both plants in Project 1 and 2 fall under this category, thus both require EIA reports.

(6) Stakeholders' Comments

Interviews with stakeholders (organizations) were conducted to gain their comments for the project activities. All stakeholders expressed favorable views towards the implementation of the proposed projects because it would eliminate GHG emissions as CDM projects as well as contribute to the sustainable development of the country socially, economically and environmentally.

(7) Implementation Framework

Both projects will be implemented by a special purpose company (SPC) which will be co-invested by both of the Japanese private companies (including KAJIMA Corporation) and parent companies of the target starch plants in Viet Nam. SPC will generate revenue by selling the recovered biogas to the plants, and by selling CER obtained through CDM projects to Japanese parties. Actual operations of the projects (operation and maintenance of facilities, monitoring etc.) will be entrusted to the plants (Figure 3).

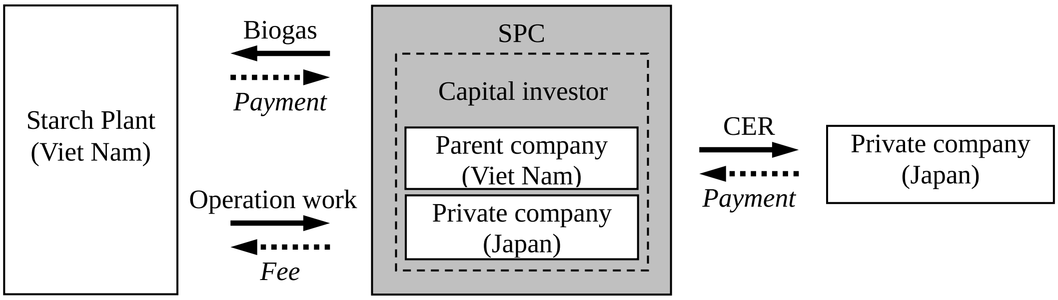

Figure 3: Implementation Framework

(8) Financial Plan

・Project Cost

Table 4 shows the project cost calculated based on the facilities design described above.

Table 4: Project Cost

	Project 1	Project 2
Initial cost (USD)	1,010,000	1,200,000
Operation and Maintenance cost (USD/yr)	80,000	93,000

・Project Revenue

The project will generate revenue from the sales of the biogas and CER. The biogas recovered in the project will replace the coals now being used in the burner. Although the unit sales price of the biogas should be discussed with plants owner, this study estimated the project revenue on the assumption that the recovered biogas would be sold at the same unit price as currently-applied unit price of coal (project1:1,000VND/kg-coal, project2:1,150VND/kg-coal). The CER sales price was assumed to be 13 USD/tCO2e based on the transaction prices in Japan and abroad.

(9) Financial Analysis

Table 5 shows the conditions for financial analysis.

Table 5: Analytical Conditions

Items	Requirements
Duration	Seven years (extendible)
Operation condition (production)	Stable during the project
Dept loan	No loan
Inflation rate	9.2 % (Average rate in 2005, 2006, 2007, in Viet Nam)
Corporation tax	28 % (Average tax rate in Viet Nam)
Residue value	No
Depreciable rate	5 years equal proportion (20%)
Exchange rate	17,000 VND/USD
Bench mark	7.125 % : Viet Nam government bonds (10-years governmental bonds issued at August 2005)

Based on the above condition, profitability was evaluated using internal rate of return (IRR) as an indicator (Table 6). Without CDM projects (no income from CER sales), both projects are expected to be negative in IRR. With CDM projects, only project 2 surpasses the milestone figure.

Table 6: Financial Analysis Results

	Project 1	Project 2
Without CDM	Negative	Negative
CDM project	Negative	7.2

IRR [%]

(10) Demonstration of Additionality

Small scale CDM methodologies require project participants to demonstrate that the project activity would not have occurred in the absence of the CDM due to one of the following barriers:

(a) Investment barrier : Financially more viable alternatives would be implemented which generate bigger GHG emissions than the proposed activity;

(b) Technological barrier : Less technologically advanced alternatives with smaller performance uncertainty would be adopted and result in bigger GHG emissions;

(c) Barrier due to prevailing practice : Prevailing practice or existing regulation or policy would have led to implementation of a technology with higher GHG emissions;

(d) Other barriers : Alternatives with higher GHG emissions would be implemented due to certain factors such as institutional barriers and lack of information, human resources, organizational capacity and technological capacity.

(a) Investment barrier was analyzed for these projects. The financial analysis described in the previous section showed that the proposed project activities would be deemed as unprofitable and would not be implemented without income from CER credit. That is, the projects face investment barrier, thus can be concluded to be additional.

(11) Business Potential and Concerns

The study revealed that both of the proposed projects were less profitable. Project 1 (Ninh Binh province) would be less feasible even if some business conditions were improved. It is expected that Project 2 (Quang Nam province) can be feasible only with CDM project. However, the company has much interest in developing this project from environmental point of view. Therefore it is planned to facilitate the detailed design of facilities and start-up of SPC, as well as to promote the CDM procedures (such as the validation, national approval and registration at the United Nations) for early implementation of project 2.

Concerns for the project implementation are; 1) fluctuation of the received cassava amount (Tapioca production amount) and 2) post Kyoto Protocol system.

1) The amount of received cassava is the important factor to secure the profitability of the project which directly impacts the amount of wastewater and the recovered biogas. Therefore, the study team will encourage the plant to make necessary measures to secure the stable procurement of cassava, such as increase in the number of contracted cassava farmers, etc.
2) The previously-mentioned results on financial analysis on Project 2 which showed rather high feasibility was obtained on the condition that the CER sales would be secured even after the first commitment period. Therefore, it is needed to keep a careful observation on the discussion on the post Kyoto Protocol scheme, and make a final decision on the project implementation.

4. Realization of Co-benefit in Host Party

(1) Evaluation on Pollution Control in Host Party

To evaluate the contribution of the proposed activity to pollution control in the Host Party, the study team established an assessment system with three major factors, i.e., Odor, Water Pollution Control and Air Pollution Control. Each factor is evaluated on a five-point scale. Bigger number represents higher efficiency. (Table 7).

Table 7: Example of Assessment Index for Pollution Control

a : Odor

	Condition	Applicable technology
1	Strong odor is clearly recognized near the plant (odor intensity 4 or 5)	
2	Odor is clearly recognized within the plant (odor intensity 4 or 5)	
3	Odor is recognized in the part of plant (odor intensity 2 or3)	Open lagoon
4	Weak odour is perceived (odor intensity 1 or 2)	Covered lagoon
5	No odor or very weak (odor intensity 0 or 1)	Closed Digester

b : Water Pollution Control

	Condition	Applicable technology
1	Comply with the Governmental Standard (Type B) in more than 20% of listed items	
2	Comply with the Governmental Standard (Type B) in less than 20% of listed items	Open lagoon
3	Comply with the Governmental Standard (Type B) in all the listed items	Covered lagoon
4	Comply with the Governmental Standard (Type B) in all the items and with the Governmental Standard (Type A) in less than 20% of items	Closed Digester
5	Comply with the Governmental Standard (Type A) in all the listed items	

c : Air Pollution Control

	Condition	Applicable technology
1	Comply with the Governmental Standard in more than 20% of listed items	
2	Comply with the Governmental Standard in less than 20% of listed items	Coals consumption
3	Comply with the Governmental Standard in all the listed items	Biofuel consumption
4	(Not applicable)	
5	(Not applicable)	

(2) Proposal for Co-benefit Assessment Index

A comprehensive evaluation matrix was established based on the comprehensive assessment system for building environmental efficiency (CASBEE). Total score is calculated by summing up the grade point of each factor which is obtained by multiplying the original grade points by the corresponding weighting coefficient, and converting it to 100-point scale. The total score is rated on 1-5 scale, i.e., S rank, A rank, B^+ rank, B^- rank, C rank, as shown in the table below. Table 8 shows the result of Pollution Control Assessment for the open lagoon (existing), covered lagoon and closed digester as the wastewater treatment technologies the projects would apply.

Table 8: Impact of estimation for antipollution measure

Items	weighting factor	reason	facility applicable		
			open lagoon	covered lagoon	closed digester
a. Odour	0.3	limited impact	3	4	5
b. Water qualit	0.5	high impact	2	3	4
c. Atmosphere	0.2	limited impact	2	3	3
Pollution evaluation index:P			2.3	3.3	4.1
Antipollution effect:25*(P-1) (100-point scale)			32.5	57.5	77.5
Total Judge		Rank evaluation	B^-	B^+	A
		Comment	It is required to improve the efficiency of wastewater treatment	Water quality and odor are relatively improved than those in open lagoon	Wastewater is treated quickly and efficiently, and with less leakage of odor from digester.

Relation between Rank estimation and point :

C	B−	B+	A	S

0 50 100