CDM/JI Project Study and Global Warming Prevention Clean Development Mechanism Project Study: Summary

Project study for cogeneration using biomass in industrial estate located in eastern coast Thailand: Hokkaido Electric Power Co., Inc.

(1) Basic Elements concerning Project Implementation

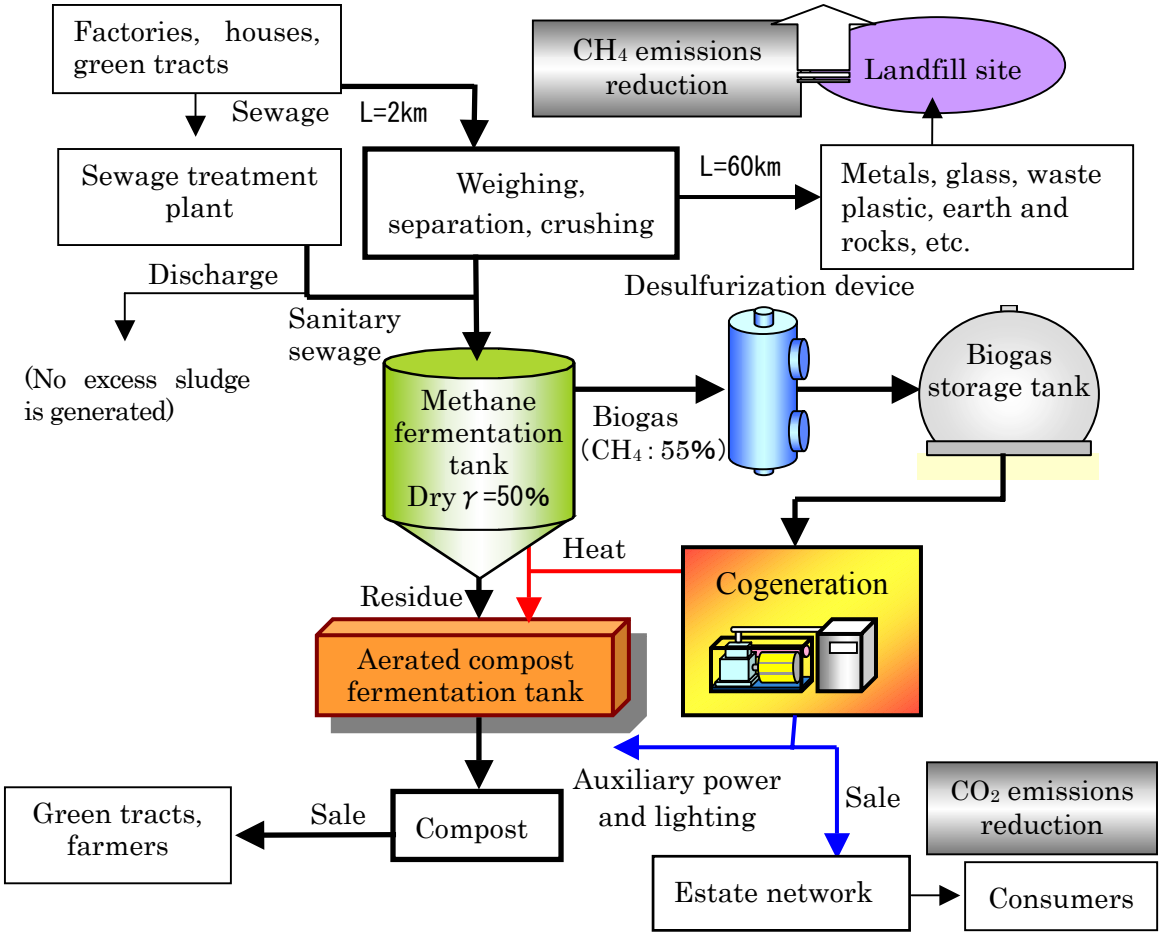
■ Outline of the proposed project and background to plan compilation

○ Objective

It is intended to implement a Feasibility Study with a view to preparing a project design document (PDD) for cogeneration using biomass in industrial estates located in the eastern coast of Thailand, as a project that will contribute to reduction of greenhouse gas emissions, in order to accumulate techniques for acquiring carbon credits in the quest to actualize CDM projects as adopted in the Kyoto Protocol.

○ Outline

Biomass (food wastes, waste paper, etc) is currently emitted from industrial estates in areas along the eastern coast of Thailand. The project aims to separate and collect this



biomass at the Amata Nakorn Industrial Estates in Chon Buri Province, with a view to using it as raw materials for conducting methane fermentation in order to treat waste and produce biogas, and to use the collected biogas as fuel for generating power and recovering thermal energy.
As a result, the project will reduce emissions of landfill gas (mainly comprising methane gas) arising from the landfill disposal of organic waste products, and it will also lead to reduction of CO2 emissions through utilizing alternative energy.

○ Background and Local Needs

The Thai economy temporarily stagnated following the currency and economic crisis of 1997; however, it recovered from 1999 onwards. In recent times, Thailand has displayed a GDP growth rate of almost 7%, while the consumer price index has been stable at around 1~2% from 2000 onwards. This growth is being supported by more than 50 industrial estates/parks scattered around the country. In particular, due to proximity to the capital Bangkok and good port conditions nearby, industrial estates/parks in the provinces of Chon Buri and Rayon southeast of Bangkok are home to numerous Japanese and multinational processing companies that ship products for export or to the domestic market. Moreover, the country's second international airport is currently under construction southeast of Bangkok (scheduled for opening in 2005), and it is anticipated that industrial estates/parks in these two provinces will gain an even greater advantage when this is completed.
Industrial waste in industrial estates/parks in these two provinces is collected and separated on the estates/parks. Organic and plastic industrial wastes are disposed in private sector landfill disposal sites operated by Jenko Co. and other private landfill operators. Landfill sites are the managed type, however, landfill gases are emitted without control into the atmosphere
Meanwhile, urban waste treatment is an important issue for the government, which is aiming to shift from landfilling to incineration. However, in the face of location opposition movements by local residents and so on, it is unclear whether this policy shift will proceed smoothly in reality. In these circumstances, utilization of energy from biomass is gaining attention both in terms of implementing waste management policy and promoting small power producers (SPP).

○ Contribution to sustainable development

- Effect in terms of reducing waste treatment costs in factories on the industrial estates
- Laying of the foundations for a recycling-oriented society through promotion of

separate treatment of commercial industrial waste

- Improvement in understanding of the recycling society in surrounding rural villages
- Employment creation and effect in terms of developing an environmental industry out of waste treatment
- Ripple effect onto environmental conservation activities being implemented by the industrial estates overall
- Effect in terms of limiting illegal incineration resulting from the shortage of landfill disposal sites, and in terms of limiting illegal disposal into the ocean
- Foreign currency saving through substitution of fossil fuels

○ Transfer of technology

- Project technology concerning utilization of methane fermentation from biomass
- Solid waste separation techniques
- Power generation and heat utilization technology using biomass
- Dispersed power generation and network connection technology using small and medium gas engines

■ Outline of the Host Country

Thailand occupies the northern half of the Malay Peninsula and is situated almost in the center of the Indochina Peninsula. It shares borders with four countries: Myanmar in the north and west, Laos in the northeast, Cambodia in the southeast, and Malaysia in the south.

Thailand has a national land area of 513,115 km^2 (1.4 times the area of Japan) and is divided into 76 prefectures. It has the fourth largest population (63,530,000 as of September 2002) in the ASEAN region behind Indonesia, Vietnam and the Philippines, and the capital Bangkok has a population of 5,730,000 (2001).

■ Criteria for accepting CDM/JI, DNA installation conditions, etc. and policy and situation regarding CDM/JI in the host country

Thailand signed the Kyoto Protocol on February 2, 1999 and ratified it on August 28, 2002. Moreover, it established the DNA in the Ministry of Resources and Environment (MONRE) in February 2004.

Following administrative reorganization in October 2004, the following center was established as the agency responsible for DNA. Staffed by five members of staff including the center manager, this center acts as the receiving window for PDD in Thailand.

・New department in charge:

Climate Change Cooperation Centre

Office of Natural Resources and Environmental Policy and Planning (ONEP)

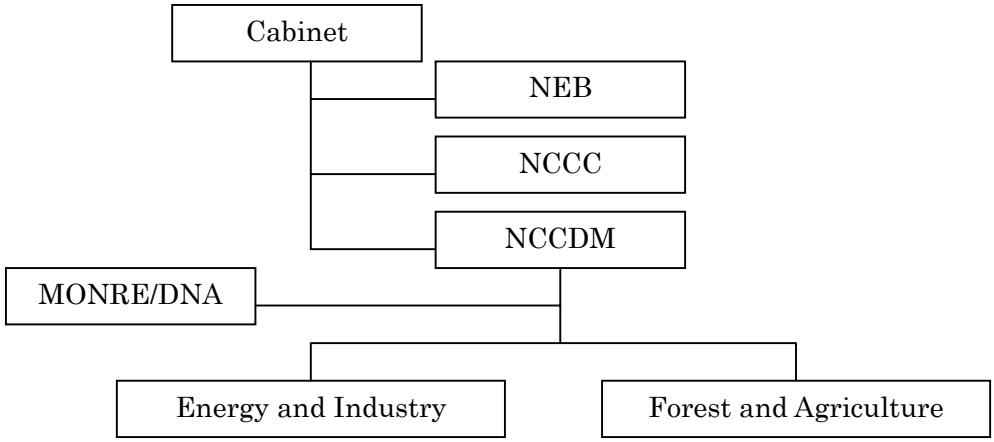
Ministry of Natural Resource and Environment (MONRE)

・(Reference) Former department in charge:

Office of International Cooperation on Natural Resource and Environment

Ministry of Natural Resource and Environment (MONRE)

In the conventional government approval setup, as is shown in the diagram, two working groups are formed under the MONRE (the DNA). The working groups are in charge of forest projects and energy projects respectively, and PDD submitted to the MONRE are examined and reviewed by either one of the working groups. After that, the MONRE passes on projects to the National Committee on CDM (NCCDM), the National Committee on Climate Change (NCCC), and the National Environmental Board (NEB) for review, before projects undergo final judgment by the Cabinet. It is forecast that this system will basically be retained under the new departmental setup.



Moreover, conditions for the acceptance of CDM projects are as follows, although specific criteria are not given:

・CDM must fully conform with the conditions required;

・Sustainable development of Thailand must be fully adhered to;

・Real and genuine technology transfer must be presented;

・Only quality proven CDM projects would be implemented in Thailand.

(Source: September 2002, The 13th Asia Pacific Seminar on Climate Change)

Out of 15 CDM projects that have been approved by the Government of Japan as of January 12, 2005, two (2) have been in Thailand, making it the second highest recipient of projects behind Chile. The following projects have been approved by the Government of Japan for implementation in Thailand.

Approval Date	Project Name	Applicant
June 29, 2004	ATB rice chaff power generation in Pichit Prefecture, Thailand	Chubu Electric Power Co., Inc.
May 22, 2003	Waste rubber power generation in Yara, Thailand	Electric Power Development Co., Ltd.

14 projects including the above two have been submitted to the DNA for approval, however, so far no projects have received government approval.

Comments from the ONEP, the new department in charge, in November 2003 are as follows.

- Currently, understanding towards CDM is high among regional governments and engineers; however, understanding among government officials including the Prime Minister is low, and many officials mistakenly believe that promoting such projects will be detrimental to the interests of Thailand. As a result, little progress is being made in preparing the government approval setup and approval criteria, etc.
- In the current situation, approval by the Prime Minister is required in order to obtain government approval. So far 14 project applications have been received, however, decisions are pending in all cases.
- In future, since it will be important to carry out capacity building within the government and related ministries regarding climate change countermeasures including CDM proposals, it is planned to implement this at an early stage.
- The government approval setup and approval criteria, etc. will be examined following implementation of capacity building, however, the specific timing of this remains undecided.

Accordingly, it is considered unlikely that the approval setup and approval criteria will be established in the near future, although the manager of the department in charge did express the desire to get things ready as soon as possible.

Since the Thai economy is displaying solid growth and is attracting a lot of investment from abroad, government circles have not always been enthusiastic towards calls for overseas investment involving the CDM. However, this does not mean that the Thai government has a negative attitude towards CDM; rather, it has steadily advanced the necessary steps of ratifying the Kyoto Protocol and registering a DNA. Now that the Kyoto Protocol has come into force and countries are starting to promote CDM projects with greater intensity, it is thought that the Government of Thailand will also establish the domestic setup with greater determination in the future. Moreover, Thailand has ample potential to respond to such a challenge. Remembering that energy saving and global warming prevention measures have only just begun in Thailand and that Thailand is one of the lower risk Annex I countries, it is considered to be endowed with high potential for promoting CDM activities.

■ Study Implementation Setup (in Japan, in Thailand, other)

Hokkaido Electric Power Co., Inc.: General supervision and management of the Study

Outline of the Cooperation Setup (Contractors) and Responsible Work in Japan

Shimizu Corporation

- Fact-finding survey of industrial estates and waste management
- Survey of environmental criteria and legislation
- Planning of plant building and compost shed

Hokuden General Engineering Design and Consulting Ltd.

- Survey of electric power conditions in Thailand
- Survey of electric power-related institutions

Kurita Water Industries Ltd.

- Biomass sample fact-finding survey
- Design and planning of the methane fermentation system

Cooperation Setup in Thailand

Amata Development Corporation

- Counterpart

Amata Plant Service Co./Amata Power/Amata Spring

- Various data collection

United Analyst and Engineering Consultant Co., Ltd. (contractor in Thailand)

- Component analysis of organic waste

Main Survey Implementation and Information Collection Sites (Thailand)

MONRE | DEDE | Ministry of Rayon City | Kasesaat University

Public Landfill Site (Chon Buri) | EGAT | PEA

(2) Project Compilation

■ Specific Contents of the Project

The basic system of the project is composed of a methane fermentation system and a composting system. Raw materials are urban waste, industrial waste and sanitary sewage, while the end products are electric power and compost. Out of the raw materials carried into the system, foreign objects other than organic waste materials will be removed from the system.

Methane fermentation, which is a means of utilizing organic waste products, is a technology for turning the organic content of organic waste products to methane in a methane fermentation tank, and then recovering and utilizing the resulting methane gas. This recovered biogas is used as fuel to produce electricity and heat in a power generating system.

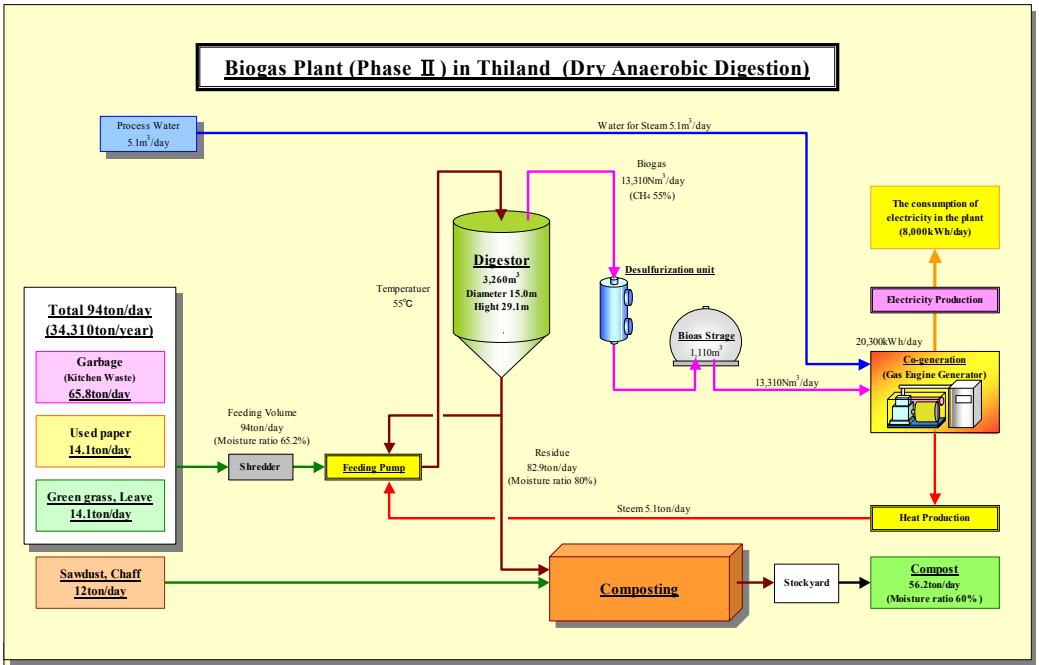
Methane fermentation systems can generally be divided into dry systems and wet systems. In this project, it has been decided to adopt the dry methane fermentation system.

The wet methane fermentation system is suited to kitchen waste in liquid form or waste containing high water content; however, when accepting organic waste products with low water content, it is necessary to add large quantities of water, the fermentation process becomes cumbersome, and it is necessary to treat effluent when dealing with the fermentation residue.

On the other hand, in the case of dry methane fermentation, it is possible to accept a wide variety of raw materials ranging from waste paper, which is conventionally incinerated as urban waste, to liquid waste and raw waste mainly comprising solids such as pruned twigs, and only a small amount of water is required compared to the case of wet methane fermentation. As a result, the water content of residue after fermentation is low at less than 85%, meaning that composting can be carried out without conducting dewatering; moreover, since there is no generation of effluent from dewatering, there is no need for wastewater treatment.

Moreover, in compiling the waste utilization plan, two cases were examined assuming, ① the current generated amount of waste (Case I: 39 t/day), and ② the projected amount of waste based on the estimated scale of the industrial estates in 2010 when project profitability can be expected (Case II: 94 t/day).

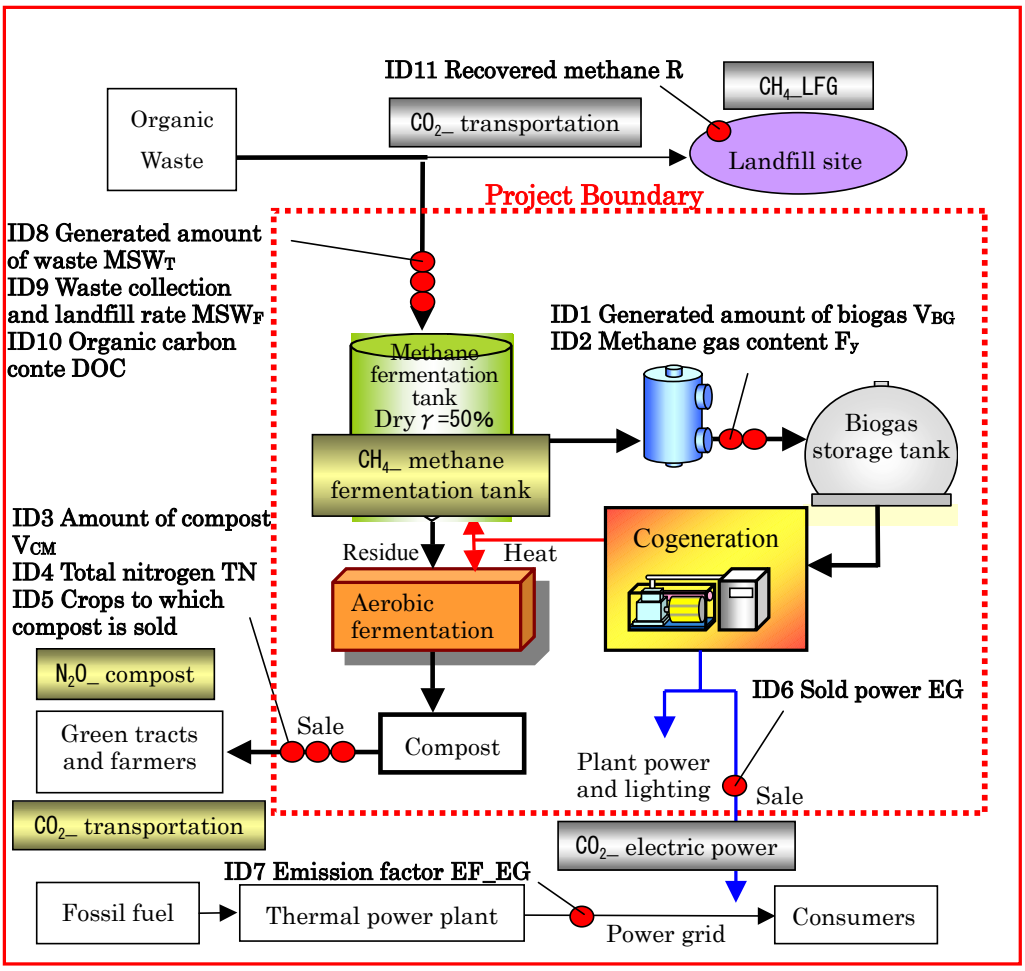
INDUSTRIAL ESTATE, ETC.	DISTANCE (km)	Phase I GENERATED WASTE (ton/day)		Phase II GENERATED WASTE (ton/day)		ORGANIC WASTE COMPOSITION: (%)			
		Total	Used amount (organic)	Total	Used amount (organic)	Paper	Grass	Food	Wood
Amata Nakorn	0	35.0	18.5	70.0	37.0	45	36	10	9
Welgrow	20	19.2	10.0	19.2	10.0				
Sai Group	25	15.0	7.8	15.0	7.8				
Pington	40	5.0	2.6	5.0	2.6				
Subtotal	—	74.2	38.9	109.2	57.4	100			
General waste	20	180	0	272	37	15	7.5	70	7.5
Total	—	254	**39**	381	**94**	100			



■ Project Boundary, Baseline Setting, Demonstration of Additionality

○ Project Boundary

Since it is impossible to acquire data or conduct measurements on the landfill disposal site, the disposal site is outside of the project boundary. Moreover, since the farmers who will use the compost and the grid to which power will be connected are beyond the control of the project participants, they are also outside of the project boundary. Accordingly, the site perimeter of the plant shall be the boundary.



○ Baseline Setting/Demonstration of Additionality

① Step 1: Draw up a list of possible baseline scenario alternatives.

- Scenario 1: Maintenance of business as usual.
- Scenario 2: Incineration. This scenario assumes that waste generated from the industrial estates is incinerated in an incinerator.
- Scenario 3: Composting. This scenario assumes that waste generated from the industrial estates is separated, and the organic contents are used to manufacture compost.

- Scenario 4: Wet methane fermentation. This scenario assumes that the organic contents of waste generated from the industrial estates are separated, and wet methane fermentation is carried out to collect methane gas and use it in cogeneration. Moreover, from the fermentation residue, compost is manufactured.
- Scenario 5: The project. This scenario assumes that the organic contents of waste generated from the industrial estates are separated, and dry methane fermentation is carried out to collect methane gas and use it in cogeneration. Moreover, from the fermentation residue, compost is manufactured.

② Step 2: Determine the baseline scenario upon conducting barrier analysis on each possible scenario.

The following table shows the results of barrier analysis in each scenario. This shows that Scenario 1 (business as usual) is desirable as the baseline.

Scenario		Barrier Analysis
1	Business as usual	No barriers exist. → Due to the restriction of landfill sites in Bangkok, new treatment methods are being examined; however, in regional areas, since there are no such constraints, conditions will remain the same in future.
2	Incineration	Amata Nakorn industrial estates had incineration facilities in the past, but scrapped them due to poor profits. Moreover, vociferous public opposition to incineration in Thailand has led to the abandonment of numerous incineration projects in recent years, and there is little chance of incineration being adopted in future.
3	Composting	Since there is no custom of waste separation in Thailand, it is difficult to manufacture high quality compost, and dissemination cannot be anticipated.
4	Wet methane fermentation	On industrial estates, since paper and other solids make up a large proportion of the organic wastes that will be used as fuel, large amounts of water will be required and it will be necessary to finely crush the waste. Since adding large amounts of water is uneconomical, while fine-crushing leads to machine breakdowns and is difficult in technical terms, dissemination cannot be anticipated.
5	Dry methane fermentation	Dry methane fermentation is suited to the treatment of solid waste; however, this is still only in the pilot stage even in Japan, while Thailand has no experience whatsoever. Considering the Thai climate and risks arising from the makeup of solid waste and different construction environment from Japan, there is little chance of the project being disseminated as a routine technology during the project period.

③ Step 3: Prevailing practice analysis

Since Scenario 5, i.e. the project, uses technology that has never been tried in Thailand, there are no similar projects.

④ Step 4: Registration effect

As was described in Step 2, Scenario 5, i.e. the project, it is impossible for the project to be the baseline scenario. However, since the project participants will utilize the dry fermentation technology with the aim of acquiring CERs in spite of the risks of climate, solid waste composition and health environment, etc., the project is additional. Moreover, even if the project is implemented, since waste disposal incurs disposal costs, the project will not lead to an increase in the amount of waste discharged on the industrial estates, etc.

■ GHG Reductions (CO2 Absorption) and Leakage Resulting from Project Implementation

○ Target greenhouse gases

		Inside the Boundary	Outside the Boundary
Baseline	Targeted		① CH_4 emissions from the landfill disposal site
	Targeted, but small enough to ignore		② CO_2 emissions arising from transport of waste to the landfill disposal site
	Not targeted		③ CO_2 emissions from the landfill disposal site
Project Line	Targeted		④ CO_2 emissions reduction arising from sale of power ⑤ N_2O emissions resulting from use of organic compost
	Targeted, but small enough to ignore	⑥ CH_4 emissions from the injection pump	⑦ CO_2 emissions arising from construction works ⑧ CO_2 emissions arising from transportation of the manufactured compost ⑨ CO_2 emissions arising from transportation of waste to the project site
	Not targeted	⑩CO_2 emissions from lighting and ventilation utilities, etc. arising from operation of the cogeneration system. ⑪ CO_2 emissions arising from cogeneration ⑫ CO_2 emissions arising from compost manufacture	

※ ▭ : Shaded areas indicate leakage.

○ Reduction of CH4 emissions from the landfill site

In the project, to be on the safe side, the amount of methane gas obtained from the methane fermentation system will be measured and compared with the generated amount of methane gas calculated using the IPCC default method, and the smaller of the two will be adopted as the baseline. This technique was also adopted in the Baseline methodology for biomethanation of municipal solid waste in India, using compliance with MSW rules (AM0012), which was approved by the 13th CDM Board Meeting.

$CH_4 = \min [CH_4^{Util}{}_y, CH_4^{IPCC}{}_y]$

Where, $CH_4^{Util}{}_y$: Measured amount of methane gas obtained from the methane fermentation tank

$CH_4^{IPCC}{}_y$: Generated amount of methane calculated according to the IPCC default method

$CH_4^{Util}{}_y = Q^{LFG} \times F_y$

Where, Q^{LFG} : Produced amount of biogas (t/y) (measured value)

F_y : Methane gas content (%) (measured value)

$CH_4^{IPCC}{}_y = MSW_T \times MSW_F \times MCF \times DOC \times DOC_F \times F_y \times Conv - R$

○ Reduction of CO2 emissions arising from sale of electric power

In the project, since the total amount of energy is no more than 45 MW, small-scale CDM methodology will be used for the GHG reduction arising from connection to the grid. In small-scale CDM, using the weighted average emission factor of the present generating mix with the simple baseline applicable to the type ID is given as one technique. This technique will also be used in the project in order to calculate the reduction in GHG.

Emissions ($t\text{-}CO_2/y$) = Electric power for sale (kWh/y) × emission factor ($t\text{-}CO_2/kWh$)

○ N_2O emissions arising from use of organic compost

In the project, compost will be manufactured and sold to farmers who would not normally use compost. However, since the farmers will use this, N_2O emissions will result from this new use of compost.

The method for calculating GHG arising from use of compost will be based on the Methodology Guideline for Calculating GHG Emissions from Operators (trial draft ver .1.5, Ministry of Environment, Global Environment Department, July 2003).

Emissions (kg-N_2O) = Nitrogen fertilization (t) by crop × emission factor (kg-N_2O/t)

○ GHG reductions arising from the project

Based on the above methodology, GHG reductions in the project are as follows.

Item	Phase I	Phase II
Reduction in landfill GHG arising from reduction of organic waste (t-CO_2/y)	27,300	79,800
Reduction of GHG arising from sale of electric power (t-CO_2/y)	1,100	2,000
Increase in GHG arising from use of compost (t-CO_2/y)	(−) 100	(−) 400
Total	28,300	81,400

■ Monitoring Plan

Monitoring items in the project activity are as shown in the following table. Moreover, the monitoring points are as indicated in the diagram shown in an earlier section (Project boundaries).

ID NO	DATA VARIABLE	DATA SOURCE	DATA UNIT	Measured (m), calculated (c) or estimated (e)	RECORDING FREQUENCY
1	Generated amount of biogas	Gas flowmeter	Nm^3/day	m	Every day
2	Methane gas content	Methane gas analyser	%	m	Every day
3	Amount of compost	Scale	t/day	m	Every day
4	Total nitrogen TN	TN analyser	mg/kg	m	Every month
5	Crops to which compost is sold	—	—	m	4 times/year
6	Sold power	Voltmeter	kWh/y	m	Every month※
7	Emission factor	EGAT	kg-CO_2/kwh	m	Every year
8	Generated amount of waste	Truck scale	t/day	m	Every day
9	Rate of organic waste	Scale	%	m	Every day
10	Organic carbon content	TOC/DOC meter	%	m, c	Every month
11	Recovered methane	Measured value	%	e	Every month

※ Continuously measure, and record every week or month.

■ Environmental Impacts/Other Indirect Impacts (including risk survey findings in case of forestation)

○ Environmental impacts

The main environmental impacts resulting from project implementation will be improvements in air pollution and greenhouse gases. Moreover, through manufacturing and reusing biogas and compost, the useful life of the landfill disposal site, which is becoming more and more constricted, will be extended. Concerning water pollution too, reduction in the amount of organic waste on the landfill disposal site will contribute to mitigation of the pollution load.

In terms of negative impacts, operation of the gas engine will lead to noise and vibration. However, because the engines to be installed are relatively small, and these will be housed in an enclosure and so on, it will be relatively easy to take countermeasures. Moreover, since the plant construction site is located within an industrial estate, noise and vibration shouldn't present any problems, providing that levels are within control values.

○ Other indirect impacts

Other indirect impacts are given as follows.

IMPACT	CONTENTS
Extension of disposal site service life	The project can resolve the issue of constricted landfill site space.
Employment	People currently employed in transportation of organic waste will be laid off, however, new employment will be created in separation work and compost transportation.
Dissemination of separate collection	Higher awareness of waste screening and collection will contribute to the recycling-oriented society.
Introduction of foreign currency	Implementation of such an environmental improvement project under foreign capital will contribute to the sustainable development of Thailand and have a major social impact.

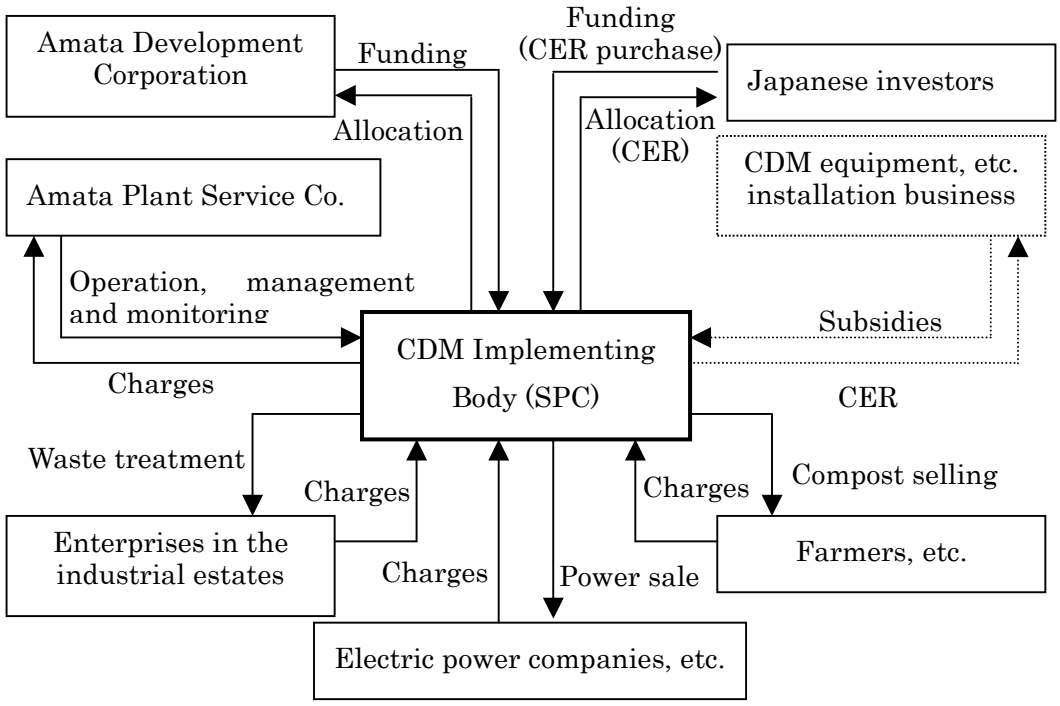
■ Comments of Stakeholders

IMPACT	CONTENTS
Owners and management of the industrial estates	- Contributing to improvement of the pressing problem of global warming is very important. - Since waste disposal costs are high, reduction is desirable. - Countermeasures to prevent odor are needed.
Ministry of Energy, MONRE	- Introduction of a renewable energy project is to be welcomed. - It is necessary to carry out explanations for local residents living outside of the industrial estates.
Local government	- It is desirable to extend the useful life of the landfill disposal site for urban waste; therefore, the project is to be welcomed. - It is hoped the project will result in less damage in terms of

	odor and crows, etc. - Education of separate collection is needed, and the project is a significant undertaking.
Local residents	- Reduction of odor and vibration from trucks, etc. is to be welcomed.
Waste landfill disposal site	- Since less waste will be received, income will be reduced; therefore, not everything about the project is welcome. However, the disposal site needs to examine ways for extending the useful life and, if it is able to receive waste products (hazardous objects, etc.) with a higher transaction value, it will not matter if the amount of waste from industrial estates decreases. - If the amount of organic waste entering the disposal site is reduced, landfill gas emitted from the site will also decrease, and this will be desirable in terms of fire prevention and odor prevention.

(3) Towards Project Actualization

■ Project implementation setup (Japan, Thailand, other)



■ Funding Plan for Project Implementation

The project shall basically be financed by Japanese corporations, with consideration also given to utilization of subsidization schemes by the Government of Japan. At the same time, consideration shall be given to utilizing finance from the Japan Bank of International Cooperation, etc.

■ Cost Effectiveness

○ Initial investment

Phase I: 1,008 million yen　　Phase II: 1,488 million yen

○ CO_2 reduction effect

	CASE I			CASE II		
Crediting period	7 years	10 years	20 years	7 years	10 years	20 years
Reduction	198,100	283,000	566,000	569,800	814,000	1628,000
Reduction cost	48.46	33.92	16.96	24.87	17.41	8.70

(※ 1$ = 105 yen)

○ IRR (%, after-tax)

	CASE I			CASE II		
Crediting period	7 years	10 years	20 years	7 years	10 years	20 years
No credit	7.14%			10.45%		
5$/t-$CO_2$	7.88	8.09	8.52	11.93	12.29	12.86
10$/t-$CO_2$	8.64	9.06	9.84	13.50	**14.21**	**15.16**

Whereas the project IRR (after-tax) in Phase I is less than 10%, in the Phase II case where CO2 credits are $10/t-CO2, an IRR of around 15% can be anticipated. Accordingly, even though this doesn't reach the 20% that is regarded as the guideline for making investment in Thailand, in the event where preferential tax measures can be obtained, there is a possibility the project can be implemented by the private sector, and there is a strong possibility of the project attracting investment or financing on the strength of its financial potential too.

■ Prospects and Issues facing Project Actualisation

○ Items that need to be coordinated with the Thailand side for CDM actualisation

As was mentioned above, because the Thai government has not finalized its CDM approval system or criteria nor established the conditions for CDM implementation (as of November 2004), it is forecast that some time will be required for the government to give approval. However, with the Kyoto Protocol coming into force and CDM projects starting to be implemented in each country, it is anticipated that the approval system in Thailand will fall into place relatively smoothly. Considering the effect of the project in terms of contribution to sustainable development and transfer of technology, there is no doubt that it will receive approval as a CDM undertaking providing that the approval system is established.

○ Thorough implementation of separation

Since most organic waste is currently disposed in the landfill site, it is necessary to overhaul the system of waste collection and separation.

In order to achieve this, it will be essential to promote dissemination and education activities on the grassroots level.

○ Securing of compost customers

Compost can be used for creating green tracts within Amata Nakorn Industrial Estates and fertilizing lawns on golf courses; however, since this will not provide enough demand to process the amount produced, it will be essential to promote dissemination and enlightenment activities.

In Japan, roughly 80% of compost consumers belong to agricultural cooperatives; however, in Thailand, only around 10% of consumers belong to agricultural cooperatives, whereas the remaining 90% are general wholesalers. Moreover, since Thai farmers conduct triple cropping, there is a chronic shortage of compost. When it comes to commercially actualising the project, it is planned to coordinate with wholesalers in securing new customers for compost.

○ Comments from stakeholders

MONRE has recommended it is necessary to secure comments not only from stakeholders on the industrial estates, but also from residents living around the estates before implementing the project, so this will need to be done.

Out of the issues described above, apart from the need for state approval by the Thai government, all the remaining issues can be addressed during the project actualisation stage. Moreover, concerning state approval, although international trends need to be considered, now that the Kyoto Protocol has come into force, it is hoped that the approval system in Thailand will be established at a relatively early stage.

This feasibility study has shown that the amount of waste discharged from the industrial estates is not as much as was first estimated and that the project is not necessarily attractive for investors in the current situation (Phase I). However, it is also shown that the project can be commercially viable if waste (raw materials for the project) can be collected with greater efficiency.

The Thai economy is displaying sound growth, and the numbers of companies setting up in industrial estates are increasing. Accordingly, since it is forecast that waste disposal will become more important in future, now may be a good time to put the project into effect.

From now on it is intended to utilize the human network formed during this study in order to implement provisional validation and other necessary steps for CDM implementation, while at the same time continuing to investigate the feasibility of securing sufficient waste (raw materials), so that it will be possible to quickly put the project into effect once approval is granted by the Government of Thailand.